UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC , CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS, T-MOBILE USA, INC., AT&T SERVICES, INC., NOKIA OF AMERICA, CORP., AND ERICSSON INC.
Petitioners

v.

KT CORPORATION (Patent Owner) and
PEGASUS WIRELESS INNOVATION LLC (Exclusive Licensee)

Case No. IPR2025-00290
Patent 10,721,118

DECLARATION OF CRAIG BISHOP

Petitioners' Exhibit 1023 (Part 1 of 2)
Google et al. v. KT Corporation et al.
IPR2025-00290

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I. INTRODUCTION

I, Craig Bishop, declare as follows:

1. I have been retained as an independent expert witness on behalf of GOOGLE LLC, CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS, T-MOBILE USA, INC., AT&T SERVICES, INC., NOKIA OF AMERICA, CORP., and ERICSSON INC., (to whom I will refer to as Petitioners) for this *inter partes* review proceeding (which I may refer to at times as an "IPR").

2. I am being compensated for my work in this matter at my accustomed hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the results of my study, the substance of my opinions, or the outcome of this matter.

3. In the preparation of this expert report I have reviewed the documents cited herein, each of which is a type of material that experts in my field would reasonably rely upon when forming their opinions, as well as all of the Appendices attached hereto.

4. In forming the opinions expressed within this expert report, I have considered:

- The appendices listed above; and

- My own academic background, knowledge, and professional experiences in the field of wireless communications.

5. Although I have attempted to organize the information presented in this report into helpful sections and/or divisions, my opinions are supported by the information in the report in its entirety.

II. QUALIFICATIONS

6. My complete qualifications and professional experience are described in my *curriculum vitae*, a copy of which is attached as **Appendix 1 and is filed concurrently herewith as Exhibit 1024.** The following is a summary of my relevant qualifications and professional experience.

7. I earned my Bachelor of Electronic Engineering degree with Honors from Polytechnic of Central London in 1989. In 2006, I earned my MSC in Computer Science with Distinction from the University of Kent.

8. After graduating with my first degree, I worked as an operations engineer at the British Broadcasting Corporation (BBC) for 4 years, then as a civil servant at the UK Radiocommunications Agency until 1996, during which time I became involved in telecommunications standardization in the European Telecommunication Standards Institute ("ETSI"), working in particular in Technical Committee Radio Equipment and Systems (TC RES2) concerned with the standardization of Private Mobile Radio (PMR). From 1994 through 1996, I acted

as Rapporteur for voice and data related PMR standards ETS 300 113, ETS 300 219 and ETS 300 390. I participated as the only TC RES2 delegate on behalf of the UK Radiocommunications Agency, generating proposals in support of UK administration and business requirements, downloading and reviewing other meeting input documents, and proposing changes as necessary to ensure input documents and the resulting specifications were in line with said requirements.

9. In 1996, I joined Samsung Electronic Research Institute as a Senior Standards Engineer where I worked for 16 years, eventually becoming Director of Standards and Industry Affairs in 2011. My work at Samsung mainly focused on the standardization of Global System for Mobile Communications (GSM)/ General Packet Radio Service (GPRS), Universal Mobile Telecommunications System (UMTS), the IP Multimedia subsystem (IMS), and Long-Term Evolution (LTE)/ Evolved Packet System (EPS) systems. Initially, I participated in ETSI Special Mobile Group (SMG) committees SMG1, SMG2, SMG4, SMG5, and SMG9, and relevant UMTS related sub-committees working on the air interface radio access network protocols, service, and terminal aspects of UMTS and GSM/GPRS until 1999. In particular, I was a participant in the ETSI SMG2 meetings leading up to selection of Wideband Code Division Multiple Access (WCDMA) as the radio access technology for the Frequency Division Duplex (FDD) mode of UMTS.

10. Beginning in 1998, I worked as a Principal Standards Engineer on the 3rd Generation Partnership Project (3GPP) on UMTS. I attended the inaugural 3GPP Technical Specification Group (TSG) meetings held in December 1998, and I began attending Working Group (WG) meetings in 1999. Specifically, I was a regular participant in Radio Access Network (RAN) WG1, Services & System Aspects (SA) WG1, Terminals (T) WG2, but I also attended TSG RAN and T plenary meetings and sometimes other Working Groups and covering similar technical aspects as in my previous work in ETSI. As an example, RAN WG2 was, and is, a Working Group responsible for the specification of layer 2 and layer 3 Radio Resource, protocols for the UE. As part of this work, I would prepare meeting contributions in support of Samsung's research and development activities. Also, by way of preparation for each meeting, I would download all contributions and review those of interest to Samsung, and where necessary, prepare additional input to the meeting based on said review.

11. Beginning in 2000, I acted as project manager and then as system engineering manager at Samsung, providing technical requirements for the team working on Samsung's UMTS modem development. This involved scrutiny of ongoing standardization work, particularly in RAN WG1, RAN WG2, and TSG Core Network (CN) WG1, from which I would download, and assess the impact of, contributions on Samsung's development projects, ensuring that Samsung's

development team was kept informed about the latest developments as layers 2 and 3 of the UMTS standard were stabilized.

12. During this period, in addition to authoring and presenting technical contributions for the 3GPP standard, and producing technical requirements for the radio modem, I acted as Rapporteur for 3GPP Technical Reports covering User Equipment ("UE") capability requirements (3GPP TR 21.904) from 1999–2000, and the Evolution of the 3GPP System (3GPP TR 21.902) in 2003 (the first Study Item to consider the 3GPP system beyond UMTS towards LTE/EPS).

13. In 2005, I became Head of Advanced Technologies, Standards, and Regulation (ATSR) at Samsung. In addition to my managerial duties which included responsibility for standards, research, and regulatory engineers—including three standards engineers who were regularly attending 3GPP RAN WG2 and Core Network and Terminals (CT) WG1 Working Groups—I personally continued to work on 3GPP standardization issues. From 2005 until 2008, I regularly attended and participated in SA WG2 meetings, mainly focusing on IP Multimedia Subsystem (IMS) including voice over IMS but also looking at wider Evolved Packet System (EPS) related issues. From 2008 until 2011, I regularly attended and participated in SA WG1 meetings. I also attended SA plenary meetings from 2008 until I left Samsung in 2013. As well as generating contributions in support of Samsung's research and development as preparation for each meeting, I would download and

review documents from other 3GPP members, identifying those of interest to Samsung and, where necessary, preparing additional contributions on behalf of Samsung. The work required a sound working knowledge of the broader 3GPP system to ensure effective management of the ATSR team, effective participation in meeting discussions, expert assessment of third-party standards contributions, and provision of implementation guidance to Samsung developers.

14. From 2005 until I stopped attending SA WG1 meetings in 2011, I authored and presented over 100 contributions to SA WG2 and SA WG1 meetings at 3GPP and appeared as an author/co-author on 18 patent applications related to User Equipment operation in the IMS and the 3GPP Core Network.

15. In 2011, I became Director of Standards and Industry Affairs at Samsung, and in November of that year I was elected to the Board of ETSI on which I served for a term of 3 years until November 2014. In this position I gained further perspective on the organisation, management, and activities of ETSI and its Technical Committees and Partnership Projects including 3GPP.

16. Since leaving Samsung in January 2013, I have formed my own consulting company which is a member of ETSI, and as part of various projects undertaken, I have continued to regularly access the ETSI and 3GPP document servers, and to keep abreast of ETSI and 3GPP document handling and publication practices.

17. Through my extensive work in ETSI and on 3GPP standardization issues over the years, I have become very familiar with ETSI and 3GPP practices for when and how the technical standards (including revisions thereto) and other standards-related contributions are made publicly available, including in the 1999–2012 timeframe when I was attending or monitoring various 3GPP Working Groups, including RAN WG1 and RAN WG2, and since 2013 in support of my work as an independent standardisation consultant.

18. For purposes of my analysis in this declaration, I have been informed that a person of ordinary skill in the art ("POSITA") would have had a bachelor's degree in electrical engineering, computer engineering, or a related discipline, knowledge of the relevant 3GPP standards as of this time, and at least 2 years of experience working in a field involving wireless communications. A person with a different degree but with additional relevant experience could still qualify if the additional experience compensates for the different educational background. A person with less than 2 years of experience working in a field involving wireless communications could still qualify if the person has additional education that compensates for their lesser experience.

III. PUBLIC AVAILABILITY OF 3GPP STANDARDS PROPOSALS AND OTHER DOCUMENTS

19. Based on my years of experience working in various capacities in 3GPP and on 3GPP standards issues, I am familiar with the regular business practices of

the 3rd Generation Partnership Project (3GPP) relating to technical documents including specifications, draft standards and proposals, and standards-related technical contributions, as well as the business practices through which 3GPP makes these documents public.

A. Prominence and Purpose of 3GPP

20. 3GPP was inaugurated in December 1998 to produce Technical Specifications and Technical Reports for the Universal Mobile Telecommunications System (UMTS), a 3G Mobile System based on evolved GSM core networks and a new radio access network known as UTRA (UMTS Terrestrial Radio Access). **Appendix 2** at 2, 3 ("[3GPP] Partnership Project Description"); **Appendix 3** at 1; **Appendix 4** at 5. At that time, various standards organisations agreed to cooperate to produce a "complete set of globally applicable Technical Specifications" that would then be transposed into standards by the relevant standardization bodies (also known as Organizational Partners). **Appendix 2** at 3, 5 ("[3GPP] Partnership Project Description"). 3GPP "attracted a very strong commitment from organisations and companies around the world, reflecting the truly global nature of the project." **Appendix 4** at 7.

21. 3GPP is a global initiative partnership made up of Organizational Partners, Market Representation Partners, and Individual Members. **Appendix 5** at 8, 9; **Appendix 2** at 10. Today, 3GPP unites seven telecommunications standard

development organisations ("Organizational Partners") from around the world: the Association of Radio Industries and Businesses (ARIB) and the Telecommunication Technology Committee (TTC) from Japan, the China Communications Standards Association (CCSA) from China, the Telecommunications Standards Development Society, India (TSDSI) from India, the Telecommunications Technology Association (TTA) from Korea, the European Telecommunications Standards Institute (ETSI), and the Alliance for Telecommunications Industry Solutions (ATIS) from the United States. These Organizational Partners are regional standards organisations that have the authority to define, publish, and set standards for their respective regions. **Appendix 2** at 12. 3GPP also includes "Market Representation Partners" that represent various industry perspectives and offer market advice. **Appendix 5** at 9 (3GPP Working Procedures, "Market Representation Partnership"); **Appendix 2** at 14; **Appendix 4** at 5. Additionally, 3GPP includes individual member companies ("Individual Members") that participate in 3GPP through their membership in a 3GPP Organizational Partner. **Appendix 5** at 9 (3GPP Working Procedures, "Individual Membership"); **Appendix 6** at 5 (textbook including a chart showing 3GPP structure at the time of publication); **Appendix 8** at 9, 10. As an example of how prominent 3GPP was (and remains) in the industry, there were 450 participating Individual Members in 2015. **Appendix 7** at 7 (3GPP

Project Coordination Group document showing 3GPP membership numbers to 2015). There were 835 individual members as of August 2024. **Appendix 9**.

22. As noted in paragraph 20, a primary goal of 3GPP is to provide an environment to produce Technical Specifications and Technical Reports that define and standardize technologies covering cellular telecommunications networks, including User Equipment or Mobile Device (UE) technologies, Radio Access Network (RAN) technologies, Core Network (CN) technologies, and service and system capabilities such as work on codecs, security, and quality of service. The specifications also provide hooks for interworking with non-3GPP networks including, but not limited to, Wi-Fi networks. **Appendix 2** at 32–40; **Appendix 3** at 2.

23. Given the prominence of 3GPP in the wireless communication industry, beginning in 1999 and continuing through today, interested POSITAs were tracking the developments of the latest 3GPP specifications and reports to ensure timely development of products and services by their companies that were consistent with the standards being developed. In other words, it is my opinion that a POSITA would have to be familiar with 3GPP and with the specification-related documents produced as part of the 3GPP process in order to properly perform his or her job. Without access to and knowledge of the 3GPP documentation, including, for example, the substantive contents of 3GPP technical specifications, an engineer

could not develop products that were interoperable with the worldwide 3G, 4G, and 5G standards. Because 3GPP documents were an important aspect of a POSITA's professional experience, textbooks and articles about cellular communications commonly directed readers to the 3GPP website for information regarding standards development. **Appendix 4** at 9 (directing readers to the 3GPP website at the conclusion of the chapter on the success of 3GPP in the standards development process). As a POSITA myself, I would regularly visit the 3GPP website for the latest developments in mobile communications standards setting and refer colleagues involved in the development of such devices to the 3GPP website as a valuable reference.

24. My personal experience at Samsung confirms 3GPP's prominence in the wireless industry. For example, engineers and managers at Samsung who were responsible for implementing 3GPP compliant modem software (and who were not attending 3GPP meetings or involved with development of the 3GPP standard in any direct way) would enquire as to which version of a given 3GPP specification they should be developing, or to the interpretation of specified requirements. Further, between 2000 and 2004, part of my role at Samsung involved advising software engineers implementing the 3GPP standard on the correct interpretation of the specifications and ensuring that they were made aware of any changes and proposals made during the 3GPP standards development process that would impact their work.

In short, the technical output of 3GPP was, and continues to be, well known at 3GPP member companies, even by engineers who were not directly involved with designing the 3GPP system or contributing to the 3GPP standard process.

B. 3GPP's Policy of Making Documents Public

25. 3GPP's policy was to make 3GPP documents available to the public, including to interested POSITAs. The free availability of 3GPP documents to any interested member of the public was widely recognized in the industry. As an example of the prominence of 3GPP and its place in the wireless standards industry, I note that textbooks directed readers to the 3GPP website for information about relevant standards. For example, **Appendix 6** at 6, 9 ("The latest specifications can be obtained from 3GPP [9]", "[9] http//:www.3GPP.org"); **Appendix 8** at 10 ("3GPP TSs and TRs are publicly available at the 3GPP web site at either of the following URIs: http://www.3gpp.org/specs/specs.htm [or] http://www.3gpp.org/ftp/Specs/archive/"). Because the purpose of 3GPP is the worldwide adoption of a common standard, no restrictions on distribution or discussion have ever been placed on 3GPP documents. **Appendix 10** at 9 ("No password is needed to access any information on the 3GPP Web site, all information is openly published").

C. 3GPP Structure and Standards Development Process

26. Within 3GPP, responsibility for producing specifications was delegated to the Technical Specification Groups (TSGs). **Appendix 5** at 10, 13 (3GPP Working Procedures, "TSG tasks"). At its inception, 3GPP was divided into four Technical Specification Groups (TSGs), each covering a particular category of technology. **Appendix 2** at 31 (3GPP Partnership Project Description); **Appendix 6** at 5, 6 (textbook listing four TSGs and noting the subsequent addition of a fifth TSG); **Appendix 4** at 6, 11, 12. Each TSG is further divided into a number of Working Groups (WGs). **Appendix 8** at 8, 9; **Appendix 4** at 6; *see also* **Appendix 5** at 13 (3GPP Working Procedures). Two of the TSGs from 1998 are still in existence in 2024: TSG Radio Access Networks (RAN) and TSG Service & Systems Aspects (SA). The activities of two other TSGs, TSG Core Networks (CN) and TSG Terminals (T), were amalgamated under Core Network and Terminals (CT) following the closure of TSG T in 2005, with responsibility for terminal test specifications being moved to a RAN working group (RAN WG5). The fifth TSG, GSM EDGE Radio Access Networks (GERAN), was responsible for evolution of the GSM radio technology from 2000 until that TSG closed in 2016 and its work was transferred to a RAN working group (RAN WG6) which was itself closed in July 2020.

27. The TSGs held quarterly plenary meetings where members' contributions, draft specifications/reports, and other documents that had been agreed upon by the Working Groups were presented for discussion and approval. **Appendix 5** at 23 (3GPP Working Procedures, "Deliverable types," stating that Technical Specifications and Technical Reports are "drawn up by the TSGs" and are approved by TSGs); **Appendix 8** at 9 ("3GPP Deliverables"). Once a Technical Specification was, or Change Requests creating a new version of a Technical Specification were, formally approved by TSG plenary, the latest version of said Technical Specification would be created by the Mobile Competence Centre (MCC) and uploaded to the file server. **Appendix 10** at 6, 7; **Appendix 11** at 1. In that way, the conclusion of 3GPP TSG plenary meetings serves as notice that new versions of specifications incorporating Change Requests approved by the TSG meeting will shortly be made available on the public 3GPP server.

28. As part of the standards development process, delegates could submit contributions on behalf of the Individual Members. Members had an incentive to stay updated on 3GPP developments because those members usually wanted to contribute to the standard and make suggestions as to what technology and/or features should (or should not) be included. Delegates also attended 3GPP meetings to keep their employers abreast of developments related to the standards that would ultimately apply to those members and the products those members (*e.g.*, companies)

produced. 3GPP members around the world, and the interested POSITAs employed by them, would have been motivated to stay up to date regarding 3GPP technology evolution to ensure their research and development programmes remained relevant to the systems being specified and that their products were compliant with the published 3GPP specifications. In light of this need to follow the standards development process, delegates often distributed 3GPP-related documents far beyond the attendees at 3GPP meetings. This was certainly my experience at Samsung.

D. 3GPP Documents

1. Technical Specifications and Reports

29. The Technical Specifications and Reports developed by 3GPP were, and still are, driven by the technical contributions of 3GPP members. As part of that development process, various types of documents were produced. The 3GPP process involved the consideration of temporary documents ("TDocs," also referred to as "contributions"), many of which constituted technical proposals for how the system should be implemented and some of which were adopted as the basis for parts of the Technical Specifications.

30. As I noted in paragraphs 20 and 22, a primary purpose of 3GPP is to prepare, approve, and maintain globally applicable Technical Specifications and Technical Reports. **Appendix 5** at 7 (3GPP Working Procedures, "Purpose"). A

"Technical Specification" as defined by 3GPP is "[a] 3GPP output document containing normative provisions approved by a Technical Specification Group." **Appendix 5** at 28. 3GPP would (and still does) periodically freeze a complete set of standards (referred to as a "Release"), and each set would include new specifications. **Appendix 10** at 6. 3GPP would also make publicly available draft specifications that would usually be included as part of the next Release once approved.

31. It was widely known that Technical Specifications (and Technical Reports) were publicly available on 3GPP's website. It was also well known that the latest version of a given specification that was under change control would be made available following each TSG Plenary meeting responsible for that specification, and that TSG Plenary meetings usually occur four times per year. **Appendix 10** at 6; **Appendix 11** at 1.

32. Latest and previous versions of Technical Specifications could be easily accessed from the 3GPP website. The specifications page provided direct links to the specifications area in the 3GPP website's file repository. **Appendix 11** at 1. In the 2015 to 2016 timeframe, the specifications page listed the specifications by the date of the approval of the latest versions reflecting the TSG plenary meeting date. *E.g.*, **Appendix 11** at 1.

33. Additionally, the 3GPP specifications followed a clear numbering scheme to help the public, including interested POSITAs, identify the subject matter

of each specification. **Appendix 12** at 1. As described on the 3GPP Numbering Scheme webpage, all 3G and GSM specifications had a specification number of 4 or 5 digits, where the first two digits defined the series. **Appendix 12** at 1. The Numbering Scheme webpage included a table showing the subject matter corresponding to each series. **Appendix 12** at 1. For example, the "36 series" focused on "LTE (Evolved UTRA) and LTE-Advanced radio technology" aspects (*i.e.*, 4G or LTE). **Appendix 12** at 1. An interested POSITA could narrow down the relevant specifications based on whether the specification applied to only evolved UTRA (*i.e.*, 4G or LTE), 3G, GSM, or to GSM, 3G and evolved UTRA (GSM-only specifications were transferred from ETSI to 3GPP in July 2000). **Appendix 12** at 1. For a specification in the 21–35 series, this could be determined based on the third digit of the specification number, where a "0" indicates that the specification applies to both systems. Specifications outside the 21–37 series in 2015 applied only to GSM systems. **Appendix 12** at 1.

34. The specifications were stored on the 3GPP website's file repository as zipped files, where the filenames followed the structure: SM[-P[-Q]]-V.zip. This format corresponded to the numbering scheme discussed in paragraph 33. **Appendix 12** at 2. "S" represented the series number; "M" represented the mantissa (the part after the series number); "P" represented an optional part number; "Q" represented

an optional sub-part number; and "V" represented the version number (without the separating dots). **Appendix 12** at 2.

35. The Working Groups would create incremental versions of the draft specifications (*e.g.*, V0.2.1, V1.0.0, V1.1.0, etc.). These versions were made available on the 3GPP website's file repository which is accessible from the 3GPP specifications page. The version numbering scheme for Technical Specifications and Technical Reports was standardized by 3GPP. The version number included three fields: the major version field, the technical version field, and the editorial version field. **Appendix 13** at 3. The major version field reflects the stage of the specification, with "0" representing an immature draft and a value of "3" or greater representing a specification that has been approved by the relevant TSG and thus placed under change control. **Appendix 13** at 3. The technical version field begins at zero and is incremented every time a technical change is made to the specification (either as part of the drafting process or as part of an approved change request). **Appendix 13** at 3. The editorial version field begins at zero and is incremented each time a non-technical change is made to the specification (*e.g.*, to fix a typographical or formatting issue). **Appendix 13** at 3.

36. I understand that the alleged invention in the '118 patent relates to cellular telecommunications networks, and more particularly to dual connectivity. Any POSITA interested in dual connectivity would have been monitoring 3GPP's

activities in this area and would probably have been already participating as a full or associate member or observer in the standard development process, or would have at least known that information regarding the proposed revisions to the technical specifications under discussion were available through 3GPP.

2. 3GPP TDocs

37. As mentioned in paragraph 29, the technical specifications and reports developed by 3GPP were and are driven by the technical contributions of 3GPP member companies. As part of that development process, various types of documents were produced and submitted. Relevant to this case, the 3GPP process involved the consideration of temporary documents or "TDocs," which are also referred to as proposals, contributions, or change requests. The agreement of proposals submitted as TDocs results in the production of technical specifications.

38. Prior to each Working Group meeting, members of the Working Group would prepare TDocs to identify, discuss, and/or propose a new feature or change(s) to an existing feature or to identify a technical issue for discussion. Interested POSITAs would have known that TDocs could be a helpful source of technical information regarding the 3GPP specifications.

39. Each TDoc was assigned a TDoc number, according to a standard format set by 3GPP.[1] As described in the 3GPP Working Procedures, the numbering system followed the format xminnzzzz. **Appendix 5** at 19. This general naming convention has been in use since at least 1999 with only minor variations. Within that format, "x" referred to the relevant TSG. **Appendix 5** at 20. For example, "R" was used for TSG RAN. **Appendix 5** at 20. Likewise, "m" referred to the relevant Working Group. **Appendix 5** at 20. A document for RAN WG2 would therefore begin with "R2." **Appendix 5** at 20. The "i" is normally a hyphen character but may take on other values depending on the meeting to which the Tdoc is sumbmitted. The two digits "nn" represented the year (*e.g.*, 17), and the digits "zzzz" represented the unique document number. **Appendix 5** at 20. This document number was used as the TDoc's filename. **Appendix 5** at 20.

40. Each TDoc would include in its header the meeting at which the contributor intended the TDoc to be discussed. Most TDocs were uploaded to the 3GPP website for public viewing prior to the relevant Working Group meeting listed on the TDoc, although some TDocs, including those created at meetings, were

[1] Documents other than technical contributions (such as meeting reports) were also assigned TDoc numbers for ease of reference.

uploaded during or after the meeting. **Appendix 10** at 10. The documents were uploaded to the public file repository in an area allocated to the particular Working Group, *e.g.*, **Appendix 14** at 2 (RAN WG2 homepage with link to WG2's "Meeting documents"). Immediately upon upload, any member of the public could download and access the TDocs and other documents offered for discussion. This process has been in place since I began attending Working Group meetings in 1999.

E. The 3GPP Website's Public File Repository

41. All TDocs, Technical Reports, and Technical Specifications were also freely available to interested members of the public through the public file repository accessible via the 3GPP website. Interested members of the public would have been well aware of 3GPP and of the 3GPP website. 3GPP documents were accessible to any member of the public through the 3GPP website without providing any login credentials or other exclusive access criteria. **Appendix 10** at 9.

42. It is my recollection that in the 2013 to 2016 timeframe, any interested member of the public could locate relevant documents of interest on the 3GPP website using reasonable diligence based on the website's indexing scheme, the specification numbering, and/or the TDoc's naming convention. The TDocs on the 3GPP website file server were (and remain) organized according to the relevant Working Groups within 3GPP (each of which focused on particular subject matter) and then further organized based on the meetings of those groups. The Technical

Specifications and Reports were (and remain) organized according to their subject matter as indicated by their series number and version. POSITAs would have known which Working Groups focused on particular subject matter.

43. An interested member of the public could locate documents of interest by first navigating a web browser to the 3GPP website (www.3gpp.org). In the 2013 to 2016 timeframe, to locate documents from the 3GPP home page, a user could have clicked "Specification Groups" **Appendix 15**. The corresponding webpages contained links to the 3GPP's public file repository (*e.g.*, through the "Meeting d" link of a Working Group page). **Appendix 14**. To locate specifications, a user could have clicked "Specifications" and followed links as described in section III.D.1 above. Instead of accessing the 3GPP file repository from the 3GPP website home page, a user could have also accessed the file repository through the web address www.3gpp.org/ftp or directly using ftp client software connected to ftp.3gpp.org. A POSITA was also able to search for relevant documents using keywords on the search facility on the 3GPP website from at least 2000, and from at least 2015 using the 3GPP search portal (https://portal.3gpp.org/#/), where an interested person could search for documents by title and source, among other things.

44. The top two levels of indexing within the file repository were based wholly on subject matter, as reflected by the division of subject matter among the various TSGs and Working Groups, or into various Specifications. Specifically, an

individual could select the relevant TSG (or specification series) covering the subject matter of interest. **Appendix 16**.

45. For example, if the individual were interested in the radio access aspects of 3GPP, they would click "tsg_ran." From there, the individual would click on the particular RAN Working Group covering the subject matter of interest. **Appendix 17**.

46. Then, if the individual were interested in the Radio Interface Radio layer 2 and Radio layer 3 RR, the individual would know to choose the folder for WG1. **Appendix 17**. Once a user is in the relevant Working Group folder (RAN WG2 in this example), an individual would see a list of all meetings held by RAN WG2 including ad hoc meetings. **Appendix 18**.

47. As shown in **Appendix 18**, a folder existed for each meeting. For example, "TSGR2_83bis" corresponded to TSG RAN WG2 meeting 83bis in October 2013. **Appendix 18** at 2.

48. A POSITA would know which meeting(s) would have covered particular subject matter based on the working groups area of responsibility (*e.g.*, for RAN WG2 - **Appendix 14)**, and from publicly available meeting agendas. Many POSITAs received notification of the meeting agenda directly via the 3GPP Working Group email reflector lists. **Appendix 19, Appendix 20**. Further, an

individual could ascertain what subject matter was addressed at each meeting by reviewing the report issued after each meeting. **Appendix 21.**

49. In my experience, whilst the servers used for 3GPP file repository and many of its directories have been updated since 1999, and directories may as a result have later dates associated with them (*e.g.*, reflecting the last time they were modified in some way or their contents were updated), the original upload date for files including specifications has always been preserved, providing a true and accurate indication of their earliest availability for download.

50. Once an individual navigated to the desired meeting folder, for example "TSGR2_83bis" the individual could then select the "Docs" folder to view the documents associated with that meeting. **Appendix 22.** The documents within this folder were listed by TDoc number, and interested members of the public would have known to review the meeting report for each meeting to confirm which topics were discussed at that meeting. *E.g.*, **Appendix 23**. The meeting report also contained a complete list of TDocs submitted to the meeting which could be sorted by title, agenda item and agenda item description among other things. **Appendix 23a** (Annex A of the meeting report). The TDoc list is also accessible from the "Docs" folder. E.g., **Appendix 22** at 38.

51. Many TDocs were uploaded to the public file server for public viewing prior to the relevant meeting (although some TDocs, particularly those created

during meetings, were uploaded during or soon after the meetings). **Appendix 10** at 10. Throughout and since my participation in 3GPP, it has been recommended that delegates attending a meeting download the relevant set of documents from the 3GPP file repository onto their personal computers prior to each meeting. **Appendix 10** at 8. Given that any interested member of the public could and was likely to subscribe to the Working Group email reflector, it would also have been simple to locate the location of relevant TDocs on the 3GPP server based on the information sent out to said email reflector.

52. 3GPP's public file repository provides a reliable mechanism for identifying the date and time a document was uploaded to the website and then available to download for public viewing. When a document is uploaded, the file server automatically assigns the document a time stamp—*i.e.*, an accurate and automatically computer-generated electronic record of when the document was uploaded—as part of the regular business practices of 3GPP. **Appendix 10** at 10 (3GPP FAQs). This has been the practice regarding uploading documents to the 3GPP file repository since 3GPP was inaugurated, and my personal experience confirms that the time stamps have always been a reliable way to determine when a file was uploaded to the 3GPP website and immediately available for public download.

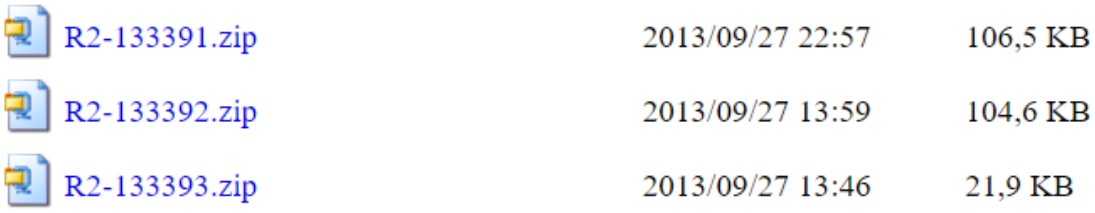
53. Following each 3GPP meeting, there would be post meeting discussion of various issues arising at the meeting, and the secretary would usually distribute a draft meeting report or the chairman's notes of the meeting via the corresponding email list,. *E.g.*, **Appendix 24**. Such emails would effectively inform subscribers that the meeting had taken place, would inform subscribers of the documents that had been treated (or not), and in the event that the meeting was a TSG plenary meeting, would serve as notice that new versions of specifications incorporating approved Change Requests, would shortly be made available on the 3GPP public server. Further, an interested member of the public following a certain topic would have known to check said report for related contributions.

IV. 3GPP EXHIBITS

A. EXHIBIT 1005: 3GPP R2-133392 "Discussion on SRB via SeNB for dual connectivity"

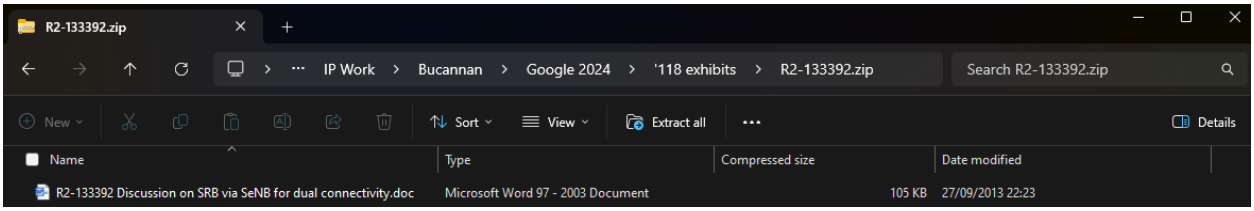
54. R2-133392 is a technical contribution submitted to 3GPP TSG RAN WG2, meeting #83bis, which was held between October 7 – 11, 2013. It follows the general naming format ("xminnzzzz") described in paragraph 39. Accordingly, "R2" indicates that the contribution was submitted to RAN WG2, "13" indicates the year (2013) that this technical contribution was submitted, and "3392" is the unique number that was assigned to this contribution document. It is titled "Discussion on SRB via SeNB for dual connectivity".

55. As I mention in paragraph 41 above, 3GPP meeting documents have always been and were in the 2013 to 2016 timeframe, made publicly available on the 3GPP public file server from where an interested member of the public exercising reasonable diligence could freely access them. To confirm the availability of R2-133392 on the 3GPP document server in 2013, I navigated to the 3GPP website at http://www.3gpp.org, selected "3GPP Groups" from the drop down menu, and then selected the "RAN2 – Radio Layer 2 and Layer 3 RRC" from the 3GPP Groups page, and the "Meeting documents" link to access the public file server where documents for the TSG-RAN Working Group 2 are stored, and from where I navigated to the documents for RAN WG2 #83bis. A true and correct copy of the relevant portion of the Documents directory listing produced by the file server website is provided below and in **Appendix 22** at 10.



56. The Docs directory index stated that R2-133392 was uploaded on "2013/09/27". I selected the link for "R2-133392.zip" and downloaded a zip file of the same name. The zip file contained a Microsoft Word document, "R2-133392

Discussion on SRB via SeNB for dual connectivity.doc", with a date stamp of "27/09/2013" (European date format) the same date that the zip file was uploaded[2].



57. A true and correct copy of the document within the zip file (R2-133392.zip) is provided as EX1005. Based on my experience, I understand that these date stamps mean that R2-133392.zip was uploaded to 3GPP's publicly available website on September 27, 2013, prior to the RAN WG2 #83bis meeting, and that any member of the public could have downloaded the zip file, extracted the Word document enclosed, and viewed the contents of said document without restriction on September 27, 2013 and thereafter. The report from RAN WG2 #83bis, made available on November 18, 2013 (**Appendix 21**), confirms the availability of R2-133392 at the meeting (**Appendix 23** at 113). I have no reason to believe that either the date stamp or the report from RAN WG2 #83bis are inaccurate. I have therefore

[2] The apparent later time of the date modified field for the Word document is explained by the time zone of the PC on which the Word document was last saved, prior to being compressed and uploaded, being later than the time-zone of the 3GPP server.

determined that R2-133392 was publicly available on the file server no later than September 27, 2013.

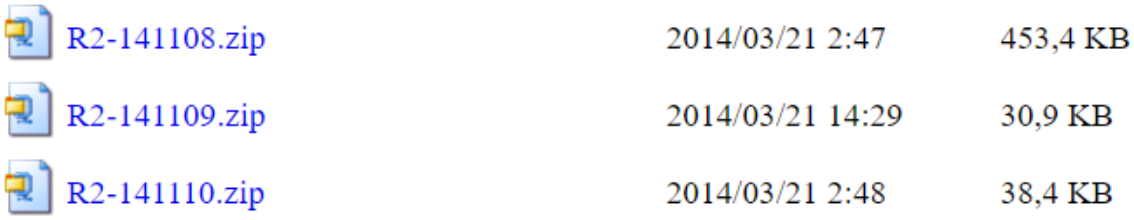
58. Based on the information above, it is my opinion that R2-133392 titled "Discussion on SRB via SeNB for dual connectivity" and provided as EX1005 was publicly available to download from the 3GPP file server no later than September 27, 2013 and could have been distributed thereafter without restriction. Further, it was publicly available at the 3GPP TSG RAN WG2 #83bis meeting held from October 7 – 11, 2013.

B. EXHIBIT 1006: 3GPP R2-141109 "Re-configuration failure in dual connectivity"

59. R2-141109 is a technical contribution submitted to 3GPP TSG RAN WG2, meeting #85bis, which was held between March 31 – April 4, 2014. It follows the general naming format ("xminnzzzz") described in paragraph 39. Accordingly, "R2" indicates that the contribution was submitted to RAN WG2, "14" indicates the year (2014) that this technical contribution was submitted, and "1109" is the unique number that was assigned to this contribution document. It is titled "Re-configuration failure in dual connectivity".

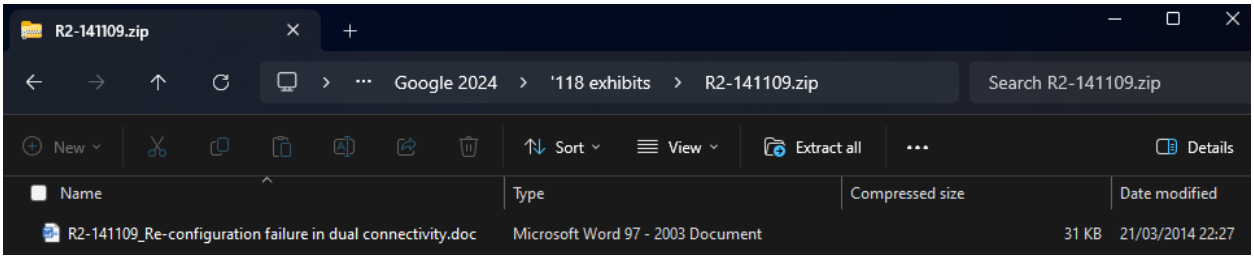
60. As I mention in paragraph 41 above, 3GPP meeting documents have always been and were in the 2013 to 2016 timeframe, made publicly available on the 3GPP public file server from where an interested member of the public exercising reasonable diligence could freely access them. To confirm the availability of R2-

141109 on the 3GPP document server in 2014, I navigated to the 3GPP website at http://www.3gpp.org, selected "3GPP Groups" from the drop down menu, and then selected the "RAN2 – Radio Layer 2 and Layer 3 RRC" from the 3GPP Groups page, and the "Meeting documents" link to access the public file server where documents for the TSG-RAN Working Group 2 are stored, and from where I navigated to the documents for RAN WG2 #85bis. A true and correct copy of the relevant portion of the Documents directory listing produced by the file server website is provided below and in **Appendix 25** at 3.



61. The Docs directory index stated that R2-141109 was uploaded on "2014/03/21". I selected the link for "R2-141109.zip" and downloaded a zip file of the same name. The zip file contained a Microsoft Word document, "R2-141109 Re-configuration failure in dual connectivity.doc", with a date stamp of "21/03/2014" (European date format) the same date that the zip file was uploaded[3].

[3] The apparent later time of the date modified field for the Word document is explained by the time zone of the PC on which the Word document was last saved,



62. A true and correct copy of the document within the zip file (R2-141109.zip) is provided as EX1006. Based on my experience, I understand that these date stamps mean that R2-141109.zip was uploaded to 3GPP's publicly available website on March 21, 2014, prior to the RAN WG2 #85bis meeting, and that any member of the public could have downloaded the zip file, extracted the Word document enclosed, and viewed the contents of said document without restriction on March 21, 2014 and thereafter. The report from RAN WG2 #85bis confirms the availability of R2-141109 at the meeting (**Appendix 26** at 50). I have no reason to believe that either the date stamp or the report from RAN WG2 #85bis are inaccurate. I have therefore determined that R2-141109 was publicly available on the file server no later than March 21, 2014.

63. Based on the information above, it is my opinion that R2-141109 titled "Re-configuration failure in dual connectivity" and provided as EX1006 was

prior to being compressed and uploaded, being later than the time-zone of the 3GPP server.

publicly available to download from the 3GPP file server no later than March 21, 2014 and could have been distributed thereafter without restriction. Further, it was publicly available at the 3GPP TSG RAN WG2 #85bis meeting held from March 31 – April 4, 2014.

C. EXHIBIT 1009: 3GPP TS 36.300 v12.8.0 (2015-12) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description; Stage 2 (Release 12)

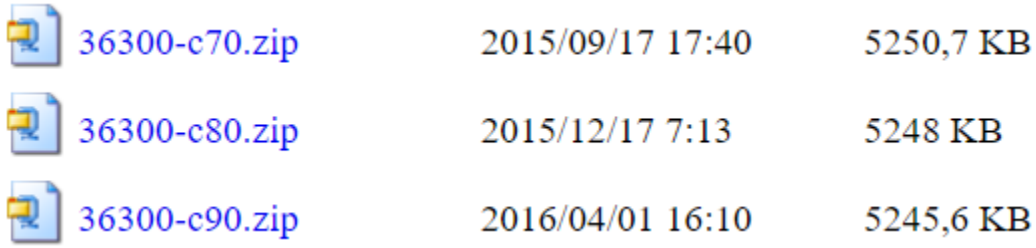
64. 3GPP TS 36.300 v12.8.0 is a Technical Specification titled "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description; Stage 2 (Release 12)".

65. The date on the face of the specification ("2015-12") corresponds to the year (2015) and month (December) that this version of the specification having been approved by 3GPP TSG RAN was made publicly available.

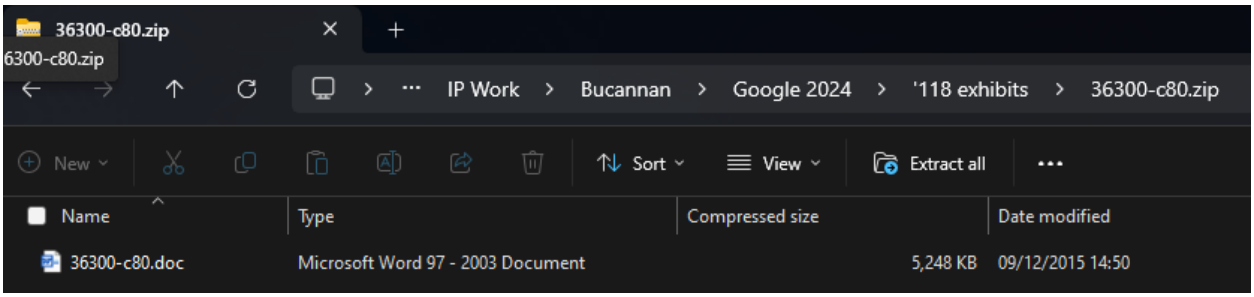
66. 3GPP TS 36.300 v12.8.0 being an approved version of the Release 12 E-UTRAN overall description stage 2, was approved by TSG RAN #70 held December 7 – 11, 2015. An interested member of the public would know that the latest version of an approved specification or report would be available following the plenary meeting responsible for that specification (in this case TSG RAN) in accordance with 3GPP standard practice as described in paragraphs 31. The approval of the TS 36.300 v12.8.0 is confirmed by the approval of the Change Requests to TS

36.300 v12.7.0 documented in the meeting report from TSG RAN #70 (**Appendix 27** at 174, 175).

67. The 3GPP file server is and always has been open to all and free from restriction such as username or password. By way of example of how an interested member of the public could access the TS 36.300 v12.8.0 technical specification from the 3GPP website, I accessed the file server by going to the 3GPP website at http://www.3gpp.org/, selected "Specifications & Technologies" from the menu bar, and then selected "Specifications by series" from the dropdown menu. I then selected the "36 Series" link to access the public file server where the specifications are stored. I then searched for "36.300" in the specification number search bar, and for the TS 36.300 specification selected the eyeglasses icon that says "See details" when a cursor is placed on it. From there, I selected "Click to see all versions of this specification," which took me to the archive housing all versions of TS 36.300 found at the following URL: https://www.3gpp.org/ftp/Specs/archive/36_series/36.300. A true and correct copy of the relevant portion of the directory listing produced by the file server website is provided below and in **Appendix 28** at 3



68. The archive directory index stated that TS 36.300 v12.8.0 was uploaded on "2015/12/17". Selecting the link for "36300-c80.zip", I downloaded a zip file of the same name. The zip file contained a Microsoft Word document with the filename "36300-c80" and having a date stamp of "09/12/2015" (European date format). An excerpt of the zip file directory is provided below.



69. I have confirmed that the Word document with the filename "36300-c80" is TS 36.300 v12.8.0. A true and correct copy of the compiled Microsoft Word documents with the filename "36300-c80" is the TS 36.300 v12.8.0 that is provided in Ex-1009.

70. Based on my experience, I understand these date stamps to mean that 36300-c80.zip was uploaded to 3GPP's publicly available website on December 17, 2015, and that an interested member of the public could have downloaded the zip file, extracted the Word document enclosed, viewed the contents of the Word document, and further disseminated said document without restriction on December 17, 2015 thereafter.

D. EXHIBIT 1010: 3GPP TS 36.331 v12.8.0 (2015-12) 3rd Generation Partnership Project; Technical Specification Group Radio Access

Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol specification (Release 12)

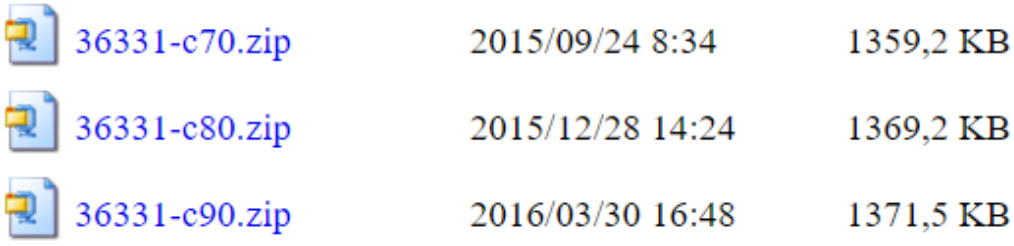
71. 3GPP TS 36.331 v12.8.0 is a Technical Specification titled "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol specification (Release 12)".

72. The date on the face of the specification ("2015-12") corresponds to the year (2015) and month (December) that this version of the specification having been approved by 3GPP TSG RAN was made publicly available.

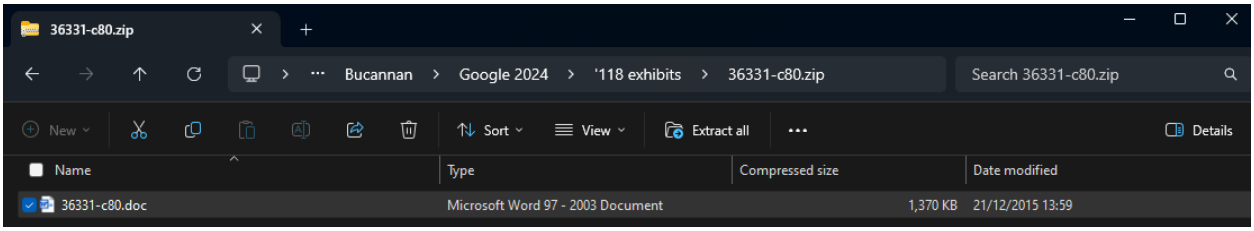
73. 3GPP TS 36.331 v12.8.0 being an approved version of the Release 12 E-UTRAN RRC specification, was approved by TSG RAN #70 held December 7 – 11, 2015. An interested member of the public would know that the latest version of an approved specification or report would be available following the plenary meeting responsible for that specification (in this case TSG RAN) in accordance with 3GPP standard practice as described in paragraphs 31. The approval of the TS 36.331 v12.8.0 is confirmed by the approval of the Change Requests to TS 36.331 v12.7.0 documented in the meeting report from TSG RAN #70 (**Appendix 27** at 181, 182).

74. The 3GPP file server is and always has been open to all and free from restriction such as username or password. By way of example of how an interested member of the public could access the TS 36.331 v12.8.0 technical specification

from the 3GPP website, I accessed the file server by going to the 3GPP website at http://www.3gpp.org/, selected "Specifications & Technologies" from the menu bar, and then selected "Specifications by series" from the dropdown menu. I then selected the "36 Series" link to access the public file server where the specifications are stored. I then searched for "36.331" in the specification number search bar, and for the TS 36.331 specification selected the eyeglasses icon that says "See details" when a cursor is placed on it. From there, I selected "Click to see all versions of this specification," which took me to the archive housing all versions of TS 36.331 found at the following URL: https://www.3gpp.org/ftp/Specs/archive/36_series/36.331. A true and correct copy of the relevant portion of the directory listing produced by the file server website is provided below and in **Appendix 29** at 3



75. The archive directory index stated that TS 36.331 v12.8.0 was uploaded on "2015/12/28". Selecting the link for "36331-c80.zip", I downloaded a zip file of the same name. The zip file contained a Microsoft Word document with the filename "36331-c80" and having a date stamp of "21/12/2015" (European date format). An excerpt of the zip file directory is provided below.



76. I have confirmed that the Word document with the filename "36331-c80" is TS 36.331 v12.8.0. A true and correct copy of the compiled Microsoft Word documents with the filename "36331-c80" is the TS 36.331 v12.8.0 that is provided in Ex-1010.

77. Based on my experience, I understand these date stamps to mean that 36331-c80.zip was uploaded to 3GPP's publicly available website on December 28, 2015, and that an interested member of the public could have downloaded the zip file, extracted the Word document enclosed, viewed the contents of the Word document, and further disseminated said document without restriction on December 28, 2015 thereafter.

V. CONCLUSION

78. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that, if required, I will make myself available for cross-examination to take place within the United States, during the time allotted for cross-examination.

79. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: December 18, 2024

Craig Bishop

3GPP TSG-RAN WG2 Meeting #83b R2-133392
Ljubljana, Slovenia, 7th-11th October 2013

Agenda Item: 7.2.2
Source: Fujitsu
Title: Discussion on SRB via SeNB for dual connectivity
Document for: Discussion and Decision

1. Introduction

In the last RAN2 meeting, “RAN2 agrees to use Control Plane option C1 as baseline for dual connectivity” [1]. For the issue whether or not signalling can be transmitted via SeNB, even through some contributions have mentioned that [2, 3], it was not discussed separately and RAN2 only agreed that “L2 transport of these messages depends on the chosen UP architecture and the intended solution” [4]. So in this contribution, we will address this issue. Firstly, we will provide the usage scenarios for configuring SRB via SeNB. Secondly we check the candidate user plan architectures to find the feasibility of configuring SRB via SeNB. Then, we briefly review the impaction of configuring SRB via SeNB on the current specification. Finally we propose RAN2 to discuss configuring SRB via SeNB for dual connectivity and study the issues listed.

2. Discussion

2.1 Usage Scenario

Small cell scenario 1

In small cell scenario 1, to assure the UE can receive RRC signalling timely, configuring SRB via SeNB is necessary. One example is shown in figure 1. In figure 1, small cell C2 is surrounded by macro cell C1. If one UE moves from left to right along the dashed line, after it arrives at point a, it enters into CRE area of small cell C2 and may be configured with TDM-based dual connectivity, then data and/or signalling could be transmitted by small cell. If the UE continues moving into the central area of small cell C2 , for example between point b and c, and C2 doesn’t apply ABS [5], the UE then has less possibility to receive the data or signalling from C1 correctly due to interference from C2. Especially if the UE is a low speed terminal, the time when the UE can’t receive the RRC signalling from C1 will be long. In this case, transmission of RRC signalling by C2 is the only way to go.

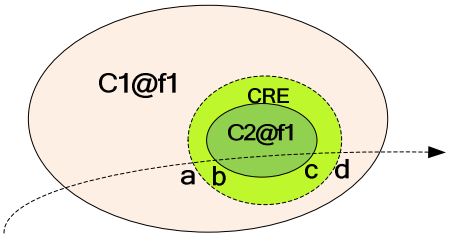


Fig. 1 One example of RRC signalling transmission via SeNB in small cell scenario 1

Small cell scenario 2

In small cell scenario 2, configuration SRB via SeNB is also required. For example, in figure 2, one small cell C2 is not completely covered by the overlaid macro cell C1. When the UE moves into area only covered by C2 (the right half of C2), if the eNB decides to reconfigure the UE, the RRC message can only be conveyed by small cell C2.

Petitioners' Exhibit 1005
Google et al. v. KT Corporation et al.
IPR2025-00290
Page 44 of 1515

Another example is handover scenario in small cell scenario 2 as shown in figure 3, wherein small cell C3 is not completely covered by any overlaid macro cell and located in between two macro cells C1 and C2. If one UE moves from left to right along the dashed line, after it arrives at point “a”, it can be configured with dual connectivity. When the UE enters into the overlapped area covered by both C1 and C2, for example, between point b and c, because of the intra-frequency interference between C1 and C2, it is better the important RRC signalling, such as HO command and measurement report, is transmitted/received via C3 to/from the UE. In case too late HO happens, for example, HO command has not issued or received successfully when the UE has entered into the overlapped area covered by both C2 and C3, for example, between point c and d, then (the retransmitted)HO command can be transmitted to the UE via C3. In this way, HO failure can be avoided and mobility performance will be enhanced.

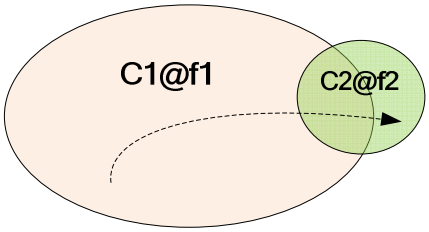


Fig. 2 One example of signalling transmission by SeNB in scenario 2 (small cell is uncovered)

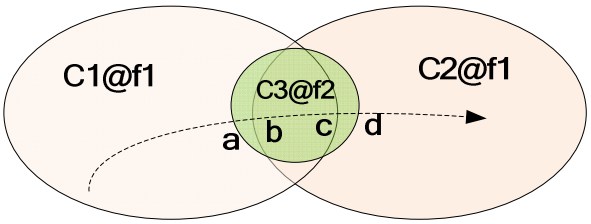


Fig. 3 Another example of signalling transmission by SeNB in scenario 2 (HO scenario)

In the above scenarios, allowing RRC signalling being transmitted by SeNB can assure that the UE can always receive the RRC signalling in the coverage of dual connectivity, especially when the MeNB coverage is not available. Considering SRB is the only bearer to convey RRC signalling, we have the following observation:

Observation 1: Configuring SRB via SeNB can assure the UE can always receive the RRC signalling in the coverage of dual connectivity, especially when the MeNB coverage is not available.

2.2 UP Architecture Support

In the last RAN2 meeting, UP architecture options 1A, 2A, 2C, 3C and 3D were selected as the possible direction of UP architecture. With option 1A, S1-U is terminated in SeNB and data forwarding from MeNB to SeNB is not required. If SRBs for MeNB and SeNB also take this protocol architecture, that is: “RRC signalling forwarding” is not required, CP architecture option C1 can’t be realized. Therefore, if we prefer that UP and CP have the same L2 protocol architecture for the reason of simplicity, UP architecture option 1A can’t support configuring SRB via SeNB.

Meanwhile, in the other UP architecture options (2A, 2C, 3C and 3D), data forwarding from MeNB to SeNB is required via Xn interface. If we simply take the same protocol architecture as UP for CP, “RRC signalling” is forwarded from MeNB to SeNB, which is exactly required by option C1. So, UP options 2A, 2C, 3C and 3D can support to configure SRB via SeNB.

To setup SRB via SeNB, with UP option 2A, 2C, 3C and 3D, the network side can configure it by SRB in MeNB. For an example, in figure 4, when MeNB determines that it is necessary to setup SRB via SeNB according to the measurement report and/or the network deployment related information, it will send one Xn message to request SeNB to add SRB via it. After MeNB receives the Xn message including the confirmation on SRB setup from SeNB, it will send *RRCConnectionReconfiguration* message via the SRB in MeNB to UE. Then after UE has finished configuration of SRB via SeNB, it will respond with *RRCConnectionReconfigurationComplete* message to MeNB.

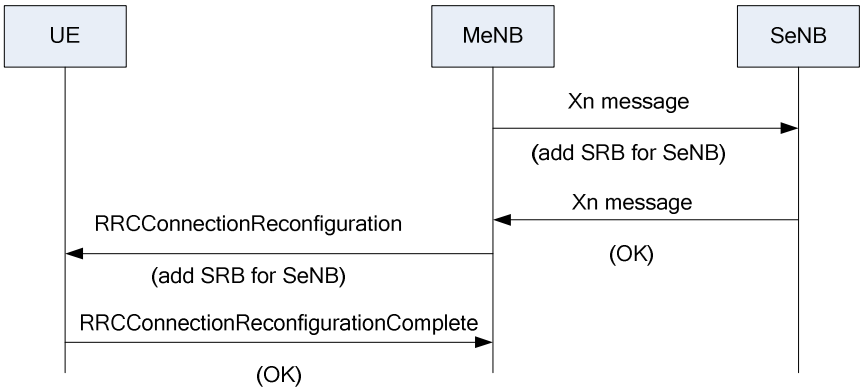


Fig. 4 The work flow for setup SRB via SeNB

Observation 2: If we take same L2 protocol architecture as UP for CP, with UP options 2A, 2C, 3C and 3D, SRB via SeNB can be configured.

Since in small cell scenario 1 and 2, configuring SRB via SeNB is necessary if one of the UP architecture options (2A, 2C, 3C and 3D) is selected as UP architecture baseline, we propose RAN2 to discuss configuring SRB via SeNB for dual connectivity.

Proposal 1: RAN2 is kindly asked to discuss to configure SRB via SeNB for dual connectivity if one of the UP architecture options (2A, 2C, 3C and 3D) is selected as UP architecture baseline.

2.3 Impaction

Introducing SRB via SeNB will impact current specification on several aspects. We need further study on the following issues:

SRB management: If configuration of SRB via SeNB is allowed, would it be setup when dual connectivity is configured or on demand? After having been setup, would SRB via SeNB be released when dual connectivity is released or on demand?

RLM & RLF: If SRB via SeNB is configured, whether or not the UE needs to perform RLM for the link of SeNB? Furthermore, if RLM is performed for SeNB link, how to handling RLF for UE?

Proposal 2: If configuration of SRB via SeNB is allowed, it is proposed that RAN2 further study its impaction on SRB management, RLM and RLF.

3. Conclusion

With the above discussion, we propose below:

Proposal 1: RAN2 is kindly asked to discuss to configure SRB via SeNB for dual connectivity if one of the UP architecture options (2A, 2C, 3C and 3D) is selected as UP architecture baseline.

Proposal 2: If configuration of SRB via SeNB is allowed, it is proposed that RAN2 further study its impaction on SRB management, RLM and RLF.

Reference

[1] R2-13xxxx, Chairman report_RAN2_83
[2] R2-132469, “Performance of Control Plane Diversity”, MediaTek

[3] R2-132858, “Dual Connectivity SRB options, for Signaling Load Reduction”, Qualcomm
[4] TR 36.842 v.0.3.0, “Study on Small Cell Enhancements for E-UTRA and E-UTRAN – Higher layer aspects”
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Agenda Item: **7.1.2**

Source: **CMCC**

Title: **RRC reconfiguration failure in dual connectivity**

Document for: **Discussion and Decision**

1 Introduction

Dual Connectivity (DC) has been discussed extensively [1], while there are still many issues that needs to be addressed in details. One of these issues is on the RRC reconfiguration procedure, especially on the handling of RRC reconfiguration failure case.

In this contribution, we try to resolve this issue.

2 Discussion

2.1 Existing mechanism on RRC reconfiguration failure

There is a basic principle on the RRC reconfiguration failure since Rel-8, i.e. no partial success/failure. This means if the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, as extracted [2]

5.3.5.5 Reconfiguration failure

The UE shall:

1> if the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message:

2> continue using the configuration used prior to the reception of *RRCConnectionReconfiguration* message;

2> if security has not been activated:

3> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause other;

2> else:

3> initiate the connection re-establishment procedure as specified in 5.3.7, upon which the connection reconfiguration procedure ends;

This UE behaviour is also specified in the RRC re-establishment procedure [2]:

5.3.7.2 Initiation

The UE shall only initiate the procedure when AS security has been activated. The UE initiates the procedure when one of the following conditions is met:

1> upon detecting radio link failure, in accordance with 5.3.11; or

1> upon handover failure, in accordance with 5.3.5.6; or

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1> upon mobility from E-UTRA failure, in accordance with 5.4.3.5; or

1> upon integrity check failure indication from lower layers; or

1> upon an RRC connection reconfiguration failure, in accordance with 5.3.5.5;

In CA, the same principle and UE behaviour are applied regardless the Pcell and Scell (re)configuration.

However, the situation may change with regard to the dual connectivity.

2.2 Issue in RRC reconfiguration failure in DC

According to the current agreements on DC, the MeNB manage the UE control plane, i.e. the MeNB takes care the UE with RRC signalling including RRC reconfiguration. The SeNB also participates in the UE RRC configuration by providing the respective RRC configurations/contexts in RRC containers to the MeNB through the X2 interface, as shown in below Figure 1.

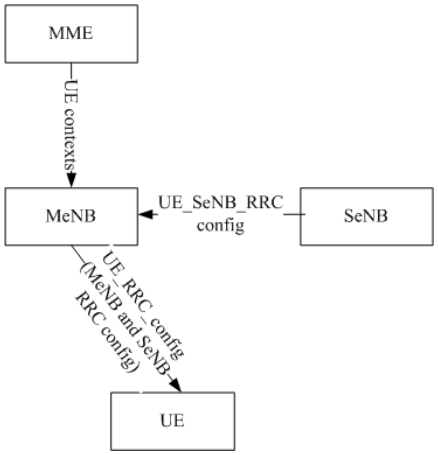


Figure 1: C-Plane in dual connectivity

Due to whatever reason, there might be a RRC reconfiguration failure scenario where the UE is unable to comply with part of the configuration. Assuming the AS security has been activated for the UE in DC, otherwise the UE should perform the actions upon leaving RRC_CONNECTED. Given the AS security has been activated, we can further elaborate this scenario into three cases:

- **Case 1**: UE is unable to comply the MeNB configuration only (i.e. UE is able to comply the SeNB configuration)
- **Case 2**: UE is unable to comply the SeNB configuration only (i.e. UE is able to comply the MeNB configuration)
- **Case 3**: UE is able to comply neither the MeNB nor the SeNB configuration

So far there is no UE behaviour specified for resolving the above cases while these issues should be addressed in Rel-12 DC.

2.3 Solutions to resolve the RRC reconfiguration failure in DC

Based on the cases described in section 2.2, we further discuss the potential solutions in this section.

According to the current agreements on DC, the MeNB manage the UE control plane, i.e. the MeNB takes care the UE with RRC signalling including RRC reconfiguration.

For case 1, it seems reasonable that the UE should adopt the existing behaviour, i.e. the UE should initiate the RRC re-establishment procedure. This is also straightforward since only the MeNB manages the RRC connection as well as generates and maintains the RRC procedure and message to the UE. So, if the UE is not able to comply the MeNB configuration, the UE has no other choice than initiates the RRC re-establishment. In this case, the MeNB is most likely to be selected as the target for the UE re-establishment.

For case 2, a simple way is to adopt the same behaviour as the existing procedure, i.e. the UE initiates the RRC re-establishment procedure. However, this mechanism is not reasonable since the UE and the MeNB can still work well even if there is no SeNB configuration. Note the MeNB and SeNB manage respective scheduling and radio resource independently. Without the SeNB configuration, the UE and the MeNB can still communicate to each other. Therefore, If the UE must stop its communication with MeNB and initiate the RRC re-establishment just because of the un-successful configuration with SeNB in this case, it may result in a bad user experience due to unnecessary transmission interruption. A more logical alternative is that the UE still maintain its communication with MeNB and reports its uncomplying configuration status of SeNB to the MeNB, then a modification of the concerning configuration may take place.

For case 3, it is clear that the UE should initiate the RRC re-establishment procedure since neither the MeNB nor the SeNB can maintain the RRC connection with the UE.

Therefore, we propose:

Proposal 1: If the UE is unable to comply the MeNB configuration, regardless of the SeNB configuration, the UE should initiate the RRC re-establishment procedure.

Proposal 2: If the UE is able to comply the MeNB configuration and is unable to comply the SeNB configuration, the UE should not initiate the RRC re-establishment procedure.

Proposal 3: If the UE is able to comply the MeNB configuration and is unable to comply the SeNB configuration, the UE should report its uncomplying configuration status of SeNB to the MeNB.

3 Conclusions

Based on the discussion, our proposals are provided as follows:

Proposal 1: If the UE is unable to comply the MeNB configuration, regardless of the SeNB configuration, the UE should initiate the RRC re-establishment procedureB.

Proposal 2: If the UE is able to comply the MeNB configuration and is unable to comply the SeNB configuration, the UE should not initiate the RRC re-establishment procedure.

Proposal 3: If the UE is able to comply the MeNB configuration and is unable to comply the SeNB configuration, the UE should report its uncomplying configuration status of SeNB to the MeNB.

4 References

[1] RAN2-85 Prague - Chairman notes.14-02-14_17-09-40

[2] 3GPP TS 36.331. RRC Protocol Specification.

3GPP TS 36.300 V12.8.0 (2015-12)

Technical Specification

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and Evolved Universal Terrestrial Radio Access Network
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Overall description;
Stage 2
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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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1 Scope

The present document provides an overview and overall description of the E-UTRAN radio interface protocol architecture. Details of the radio interface protocols are specified in companion specifications of the 36 series.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 25.913: "Requirements for Evolved UTRA (E-UTRA) and Evolved UTRAN (E-UTRAN)".

[3] 3GPP TS 36.201: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; General description".

[4] 3GPP TS 36.211:"Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[5] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[6] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[7] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements".

[8] IETF RFC 4960 (09/2007): "Stream Control Transmission Protocol".

[9] 3GPP TS 36.302: "Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer".

[10] Void

[11] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".

[12] 3GPP TS 36.306: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities".

[13] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".

[14] 3GPP TS 36.322: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification".

[15] 3GPP TS 36.323: "Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification".

[16] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".

[17] 3GPP TS 23.401: "Technical Specification Group Services and System Aspects; GPRS enhancements for E-UTRAN access".

[18] 3GPP TR 24.801: "3GPP System Architecture Evolution (SAE); CT WG1 aspects".

[19] 3GPP TS 23.402: "3GPP System Architecture Evolution: Architecture Enhancements for non-3GPP accesses".

[20] 3GPP TR 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[21] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); "Requirements for support of radio resource management".

[22] 3GPP TS 33.401: "3GPP System Architecture Evolution: Security Architecture".

[23] 3GPP TS 23.272: "Circuit Switched Fallback in Evolved Packet System; Stage 2".

[24] Void.

[25] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

[26] 3GPP TS 23.003: "Numbering, addressing and identification".

[27] 3GPP TR 25.922: "Radio Resource Management Strategies".

[28] 3GPP TS 23.216: "Single Radio voice Call continuity (SRVCC); Stage 2".

[29] 3GPP TS 32.421: "Subscriber and equipment trace: Trace concepts and requirements".

[30] 3GPP TS 32.422: "Subscriber and equipment trace; Trace control and configuration management".

[31] 3GPP TS 32.423: "Subscriber and equipment trace: Trace data definition and management".

[32] 3GPP TS 25.346: "Universal Mobile Telecommunications System (UMTS); Introduction of the Multimedia Broadcast/Multicast Service (MBMS) in the Radio Access Network (RAN); Stage 2".

[33] 3GPP TS 22.220: "Service Requirements for Home NodeBs and Home eNodeBs".

[34] 3GPP TS 22.268: "Public Warning System (PWS) Requirements".

[35] IETF RFC 3168 (09/2001): "The Addition of Explicit Congestion Notification (ECN) to IP".

[36] 3GPP TS 25.446: "MBMS synchronisation protocol (SYNC)".

[37] 3GPP TS 22.168: "Earthquake and Tsunami Warning System (ETWS) requirements; Stage 1".

[38] 3GPP TR 25.306: " UE Radio Access capabilities".

[39] Void.

[40] 3GPP TS 29.274: "Tunnelling Protocol for Control Plane (GTPv2-C); Stage 3".

[41] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[42] 3GPP TS 36.423: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP)".

[43] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

[44] 3GPP TS 36.443: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); M2 Application Protocol (M2AP)".

[45] 3GPP TS 36.444: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); M3 Application Protocol (M3AP)".

[46] 3GPP TS 36.420: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 general aspects and principles".

[47] 3GPP TS 29.281: "General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)"

[48] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description"

[49] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs"

[50] 3GPP TR 36.816: "Evolved Universal Terrestrial Radio Access (E-UTRA); Study on signalling and procedure for interference avoidance for in-device coexistence".

[51] 3GPP TS 36.305: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Stage 2 functional specifications of User Equipment (UE) positioning in E-UTRAN".

[52] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[53] 3GPP TS 33.320: "Security of Home Node B (HNB) / Home evolved Node B (HeNB)".

[54] 3GPP TS 23.251: "Technical Specification Group Services and System Aspects; Network Sharing; Architecture and functional description".

[55] 3GPP TS 23.139: "3GPP system – fixed broadband access network interworking".

[56] 3GPP TS 23.007: "Technical Specification Group Core Network and Terminals; Restoration procedures".

[57] 3GPP TS 23.682: "Architecture enhancements to facilitate communications with packet data networks and applications".

[58] 3GPP TS 24.312: "Access Network Discovery and Selection Function (ANDSF) Management Object (MO) ".

[59] 3GPP TR 36.842: "Study on Small Cell enhancements for E-UTRA and E-UTRAN; Higher layer aspects"

[60] 3GPP TR 36.932: "Scenarios and Requirements for Small Cell Enhancements for E-UTRA and E-UTRAN".

[61] 3GPP TS 36.425: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 interface user plane protocol".

[62] 3GPP TS 23.303: "Technical Specification Group Services and System Aspects; Proximity-based services (ProSe)"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

Access Control: the process that checks whether a UE is allowed to access and to be granted services in a closed cell.

Carrier frequency: center frequency of the cell.

Cell: combination of downlink and optionally uplink resources. The linking between the carrier frequency of the downlink resources and the carrier frequency of the uplink resources is indicated in the system information transmitted on the downlink resources.

Cell Group: in dual connectivity, a group of serving cells associated with either the MeNB or the SeNB.

CSG Cell: a cell broadcasting a CSG indicator set to true and a specific CSG identity.

CSG ID Validation: the process that checks whether the CSG ID received via handover messages is the same as the one broadcast by the target E-UTRAN.

CSG member cell: a cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN and for which the CSG whitelist of the UE includes an entry comprising cell's CSG ID and the respective PLMN identity.

Dual Connectivity: mode of operation of a UE in RRC_CONNECTED, configured with a Master Cell Group and a Secondary Cell Group.

E-RAB: an E-RAB uniquely identifies the concatenation of an S1 Bearer and the corresponding Data Radio Bearer. When an E-RAB exists, there is a one-to-one mapping between this E-RAB and an EPS bearer of the Non Access Stratum as defined in [17].

Frequency layer: set of cells with the same carrier frequency.

Handover: procedure that changes the serving cell of a UE in RRC_CONNECTED.

Hybrid cell: a cell broadcasting a CSG indicator set to false and a specific CSG identity. This cell is accessible as a CSG cell by UEs which are members of the CSG and as a normal cell by all other UEs.

Local Home Network: as defined in TS 23.401 [17].

Master Cell Group: in dual connectivity, a group of serving cells associated with the MeNB, comprising of the PCell and optionally one or more SCells.

Master eNB: in dual connectivity, the eNB which terminates at least S1-MME.

MCG bearer: in dual connectivity, a bearer whose radio protocols are only located in the MeNB to use MeNB resources only.

MBMS-dedicated cell: cell dedicated to MBMS transmission. MBMS-dedicated cell is not supported in this release.

MBMS/Unicast-mixed: cell supporting both unicast and MBMS transmissions.

Membership Verification: The process that checks whether a UE is a member or non-member of a hybrid cell.

PLMN ID Check: the process that checks whether a PLMN ID is the RPLMN identity or an EPLMN identity of the UE.

Power saving mode: Mode configured and controlled by NAS that allows the UE to reduce its power consumption, as defined in TS 24.301 [20], TS 23.401 [17], TS 23.682 [57].

Primary Timing Advance Group: Timing Advance Group containing the PCell. In this specification, Primary Timing Advance Group refers also to Timing Advance Group containing the PSCell unless explicitly stated otherwise.

Public Safety ProSe Carrier: Carrier frequency for public safety sidelink communication.

SCG bearer: in dual connectivity, a bearer whose radio protocols are only located in the SeNB to use SeNB resources.

Secondary Cell Group: in dual connectivity, a group of serving cells associated with the SeNB, comprising of PSCell and optionally one or more SCells.

Secondary eNB: in dual connectivity, the eNB that is providing additional radio resources for the UE but is not the Master eNB.

Secondary Timing Advance Group: Timing Advance Group containing neither the PCell nor PSCell.

Sidelink: UE to UE interface for sidelink communication and sidelink discovery. The Sidelink corresponds to the PC5 interface as defined in TS 23.303 [62].

Sidelink Control period: Period over which resources are allocated in a cell for sidelink control information and sidelink data transmissions. The Sidelink Control period corresponds to the PSCCH period as defined in TS 36.213 [6].

Sidelink communication: AS functionality enabling ProSe Direct Communication as defined in TS 23.303 [62], between two or more nearby UEs, using E-UTRA technology but not traversing any network node.

Sidelink discovery: AS functionality enabling ProSe Direct Discovery as defined in TS 23.303 [62], using E-UTRA technology but not traversing any network node.

Split bearer: in dual connectivity, a bearer whose radio protocols are located in both the MeNB and the SeNB to use both MeNB and SeNB resources.

Timing Advance Group: a group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

1xCSFB	Circuit Switched Fallback to 1xRTT
ABS	Almost Blank Subframe
ACK	Acknowledgement
ACLR	Adjacent Channel Leakage Ratio
AM	Acknowledged Mode
AMBR	Aggregate Maximum Bit Rate
ANDSF	Access Network Discovery and Selection Function
ANR	Automatic Neighbour Relation
ARQ	Automatic Repeat Request
ARP	Allocation and Retention Priority
AS	Access Stratum
BCCH	Broadcast Control Channel
BCH	Broadcast Channel
BSR	Buffer Status Report
C/I	Carrier-to-Interference Power Ratio
CAZAC	Constant Amplitude Zero Auto-Correlation
CA	Carrier Aggregation
CBC	Cell Broadcast Center
CC	Component Carrier
CG	Cell Group
CIF	Carrier Indicator Field
CMAS	Commercial Mobile Alert Service
CMC	Connection Mobility Control
CP	Cyclic Prefix
CoMP	Coordinated Multi Point
C-plane	Control Plane
C-RNTI	Cell RNTI
CQI	Channel Quality Indicator
CRC	Cyclic Redundancy Check
CRE	Cell Range Extension
CRS	Cell-specific Reference Signal
CSA	Common Subframe Allocation
CSG	Closed Subscriber Group
CSI	Channel State Information
CSI-IM	CSI interference measurement
CSI-RS	CSI reference signal
DC	Dual Connectivity
DCCH	Dedicated Control Channel
DeNB	Donor eNB
DFTS	DFT Spread OFDM
DL	Downlink
DRB	Data Radio Bearer
DRX	Discontinuous Reception
DTCH	Dedicated Traffic Channel
DTX	Discontinuous Transmission
DwPTS	Downlink Pilot Time Slot
EAB	Extended Access Barring
ECGI	E-UTRAN Cell Global Identifier
ECM	EPS Connection Management
EMM	EPS Mobility Management
E-CID	Enhanced Cell-ID (positioning method)
eIMTA	Enhanced Interference Management and Traffic Adaptation
eHRPD	enhanced High Rate Packet Data

eNB	E-UTRAN NodeB
EPC	Evolved Packet Core
EPDCCH	Enhanced Physical Downlink Control Channel
EPS	Evolved Packet System
E-RAB	E-UTRAN Radio Access Bearer
ETWS	Earthquake and Tsunami Warning System
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
FDD	Frequency Division Duplex
FDM	Frequency Division Multiplexing
GERAN	GSM EDGE Radio Access Network
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile communication
GBR	Guaranteed Bit Rate
GP	Guard Period
GRE	Generic Routing Encapsulation
GUMMEI	Globally Unique MME Identifier
GUTI	Globally Unique Temporary Identifier
GWCN	GateWay Core Network
HARQ	Hybrid ARQ
(H)eNB	eNB or HeNB
HO	Handover
HRPD	High Rate Packet Data
HSDPA	High Speed Downlink Packet Access
ICIC	Inter-Cell Interference Coordination
IDC	In-Device Coexistence
IP	Internet Protocol
ISM	Industrial, Scientific and Medical
KPAS	Korean Public Alert System
LB	Load Balancing
LCG	Logical Channel Group
LCR	Low Chip Rate
LCS	LoCation Service
LIPA	Local IP Access
LHN	Local Home Network
LHN ID	Local Home Network ID
LMU	Location Measurement Unit
LPPa	LTE Positioning Protocol Annex
L-GW	Local Gateway
LTE	Long Term Evolution
MAC	Medium Access Control
MBMS	Multimedia Broadcast Multicast Service
MBR	Maximum Bit Rate
MBSFN	Multimedia Broadcast multicast service Single Frequency Network
MCCH	Multicast Control Channel
MCE	Multi-cell/multicast Coordination Entity
MCG	Master Cell Group
MCH	Multicast Channel
MCS	Modulation and Coding Scheme
MDT	Minimization of Drive Tests
MeNB	Master eNB
MIB	Master Information Block
MIMO	Multiple Input Multiple Output
MME	Mobility Management Entity
MSA	MCH Subframe Allocation
MSI	MCH Scheduling Information
MSP	MCH Scheduling Period
MTCH	Multicast Traffic Channel
NACK	Negative Acknowledgement
NAS	Non-Access Stratum
NCC	Next Hop Chaining Counter
NH	Next Hop key

NNSF	NAS Node Selection Function
NR	Neighbour cell Relation
NRT	Neighbour Relation Table
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
OPI	Offload Preference Indicator
OTDOA	Observed Time Difference Of Arrival (positioning method)
P-GW	PDN Gateway
P-RNTI	Paging RNTI
PA	Power Amplifier
PAPR	Peak-to-Average Power Ratio
PBCH	Physical Broadcast CHannel
PBR	Prioritised Bit Rate
PCC	Primary Component Carrier
PCCH	Paging Control Channel
PCell	Primary Cell
PCFICH	Physical Control Format Indicator CHannel
PCH	Paging Channel
PCI	Physical Cell Identifier
PDCCH	Physical Downlink Control CHannel
PDSCH	Physical Downlink Shared CHannel
PDCP	Packet Data Convergence Protocol
PDN	Packet Data Network
PDU	Protocol Data Unit
PHICH	Physical Hybrid ARQ Indicator CHannel
PHY	Physical layer
PLMN	Public Land Mobile Network
PMCH	Physical Multicast CHannel
PRACH	Physical Random Access CHannel
PRB	Physical Resource Block
ProSe	Proximity based Services
PSBCH	Physical Sidelink Broadcast CHannel
PSC	Packet Scheduling
PSCCH	Physical Sidelink Control CHannel
PSCell	Primary SCell
PSDCH	Physical Sidelink Discovery CHannel
PSM	Power Saving Mode
PSSCH	Physical Sidelink Shared CHannel
PUCCH	Physical Uplink Control CHannel
PUSCH	Physical Uplink Shared CHannel
pTAG	Primary Timing Advance Group
PWS	Public Warning System
QAM	Quadrature Amplitude Modulation
QCI	QoS Class Identifier
QoS	Quality of Service
R-PDCCH	Relay Physical Downlink Control CHannel
RA-RNTI	Random Access RNTI
RAC	Radio Admission Control
RACH	Random Access Channel
RAT	Radio Access Technology
RB	Radio Bearer
RBC	Radio Bearer Control
RF	Radio Frequency
RIBS	Radio-interface based synchronization
RIM	RAN Information Management
RLC	Radio Link Control
RN	Relay Node
RNC	Radio Network Controller
RNL	Radio Network Layer
RNTI	Radio Network Temporary Identifier
ROHC	Robust Header Compression
RRC	Radio Resource Control

RRM	Radio Resource Management
RU	Resource Unit
S-GW	Serving Gateway
S1-MME	S1 for the control plane
SCC	Secondary Component Carrier
SCell	Secondary Cell
SCG	Secondary Cell Group
SeNB	Secondary eNB
SI	System Information
SIB	System Information Block
SIPTO	Selected IP Traffic Offload
SIPTO@LN	Selected IP Traffic Offload at the Local Network
SI-RNTI	System Information RNTI
S1-U	S1 for the user plane
SAE	System Architecture Evolution
SAP	Service Access Point
SC-FDMA	Single Carrier – Frequency Division Multiple Access
SCH	Synchronization Channel
SCTP	Stream Control Transmission Protocol
SDF	Service Data Flow
SDMA	Spatial Division Multiple Access
SDU	Service Data Unit
SeGW	Security Gateway
SFN	System Frame Number
S-GW	Serving GateWay
SBCCH	Sidelink Broadcast Control Channel
SL-BCH	Sidelink Broadcast Channel
SL-DCH	Sidelink Discovery Channel
SL-RNTI	Sidelink RNTI
SL-SCH	Sidelink Shared Channel
STCH	Sidelink Traffic Channel
SPID	Subscriber Profile ID for RAT/Frequency Priority
SR	Scheduling Request
SRB	Signalling Radio Bearer
SU	Scheduling Unit
sTAG	Secondary Timing Advance Group
TA	Tracking Area
TAG	Timing Advance Group
TB	Transport Block
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TDM	Time Division Multiplexing
TEID	Tunnel Endpoint Identifier
TFT	Traffic Flow Template
TM	Transparent Mode
TNL	Transport Network Layer
TTI	Transmission Time Interval
UE	User Equipment
UL	Uplink
UM	Unacknowledged Mode
UMTS	Universal Mobile Telecommunication System
U-plane	User plane
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network
UpPTS	Uplink Pilot Time Slot
VRB	Virtual Resource Block
WLAN	Wireless Local Area Network
X2 GW	X2 GateWay
X2-C	X2-Control plane
X2-U	X2-User plane

4 Overall architecture

The E-UTRAN consists of eNBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME interface and to the Serving Gateway (S-GW) by means of the S1-U interface. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNBs.

The E-UTRAN architecture is illustrated in Figure 4 below.

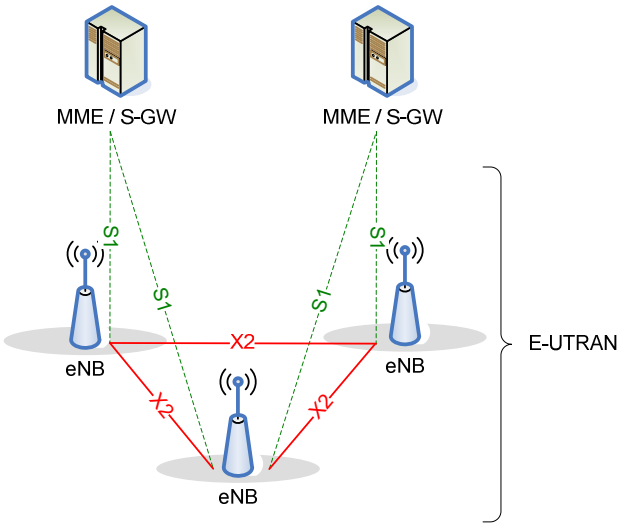


Figure 4-1: Overall Architecture

If the eNB supports SIPTO@LN with collocated L-GW, it shall support an S5 interface towards the S-GW and an SGi interface towards the IP network. See section 4.8.2 for the details of the architecture and functions in case SIPTO@LN with collocated L-GW is supported.

The E-UTRAN may also comprise LMUs (Location Measurement Unit) (see [51]) used for Uplink positioning.

4.1 Functional Split

The eNB hosts the following functions:

- Functions for Radio Resource Management: Radio Bearer Control, Radio Admission Control, Connection Mobility Control, Dynamic allocation of resources to UEs in uplink, downlink and sidelink (scheduling);
- IP header compression and encryption of user data stream;
- Selection of an MME at UE attachment when no routing to an MME can be determined from the information provided by the UE;
- Routing of User Plane data towards Serving Gateway;
- Scheduling and transmission of paging messages (originated from the MME);
- Scheduling and transmission of broadcast information (originated from the MME or O&M);
- Measurement and measurement reporting configuration for mobility and scheduling;
- Scheduling and transmission of PWS (which includes ETWS and CMAS) messages (originated from the MME);
- CSG handling;
- Transport level packet marking in the uplink;

- S-GW relocation without UE mobility, as defined in TS 23.401 [17];
- SIPTO@LN handling;
- Optionally registering with the X2 GW (if used).

The DeNB hosts the following functions in addition to the eNB functions:

- S1/X2 proxy functionality for supporting RNs;
- S11 termination and S-GW/P-GW functionality for supporting RNs.

The MME hosts the following functions (see 3GPP TS 23.401 [17]):

- NAS signalling;
- NAS signalling security;
- AS Security control;
- Inter CN node signalling for mobility between 3GPP access networks;
- Idle mode UE Reachability (including control and execution of paging retransmission);
- Tracking Area list management (for UE in idle and active mode);
- PDN GW and Serving GW selection;
- MME selection for handovers with MME change;
- SGSN selection for handovers to 2G or 3G 3GPP access networks;
- Roaming;
- Authentication;
- Bearer management functions including dedicated bearer establishment;
- Support for PWS (which includes ETWS and CMAS) message transmission;
- Optionally performing paging optimisation;
- S-GW relocation without UE mobility, as defined in TS 23.401 [17].

NOTE 1: The MME should not filter the PAGING message based on the CSG IDs towards macro eNBs.

The Serving Gateway (S-GW) hosts the following functions (see 3GPP TS 23.401 [17]):

- The local Mobility Anchor point for inter-eNB handover;
- Mobility anchoring for inter-3GPP mobility;
- E-UTRAN idle mode downlink packet buffering and initiation of network triggered service request procedure;
- Lawful Interception;
- Packet routeing and forwarding;
- Transport level packet marking in the uplink and the downlink;
- Accounting on user and QCI granularity for inter-operator charging;
- UL and DL charging per UE, PDN, and QCI.

The PDN Gateway (P-GW) hosts the following functions (see 3GPP TS 23.401 [17]):

- Per-user based packet filtering (by e.g. deep packet inspection);
- Lawful Interception;

- UE IP address allocation;
- Transport level packet marking in the uplink and the downlink;
- UL and DL service level charging, gating and rate enforcement;
- DL rate enforcement based on APN-AMBR;

This is summarized on the figure below where yellow boxes depict the logical nodes, white boxes depict the functional entities of the control plane and blue boxes depict the radio protocol layers.

NOTE 2: There is no logical E-UTRAN node other than the eNB needed for RRM purposes.

NOTE 3: MBMS related functions in E-UTRAN are described separately in subclause 15.

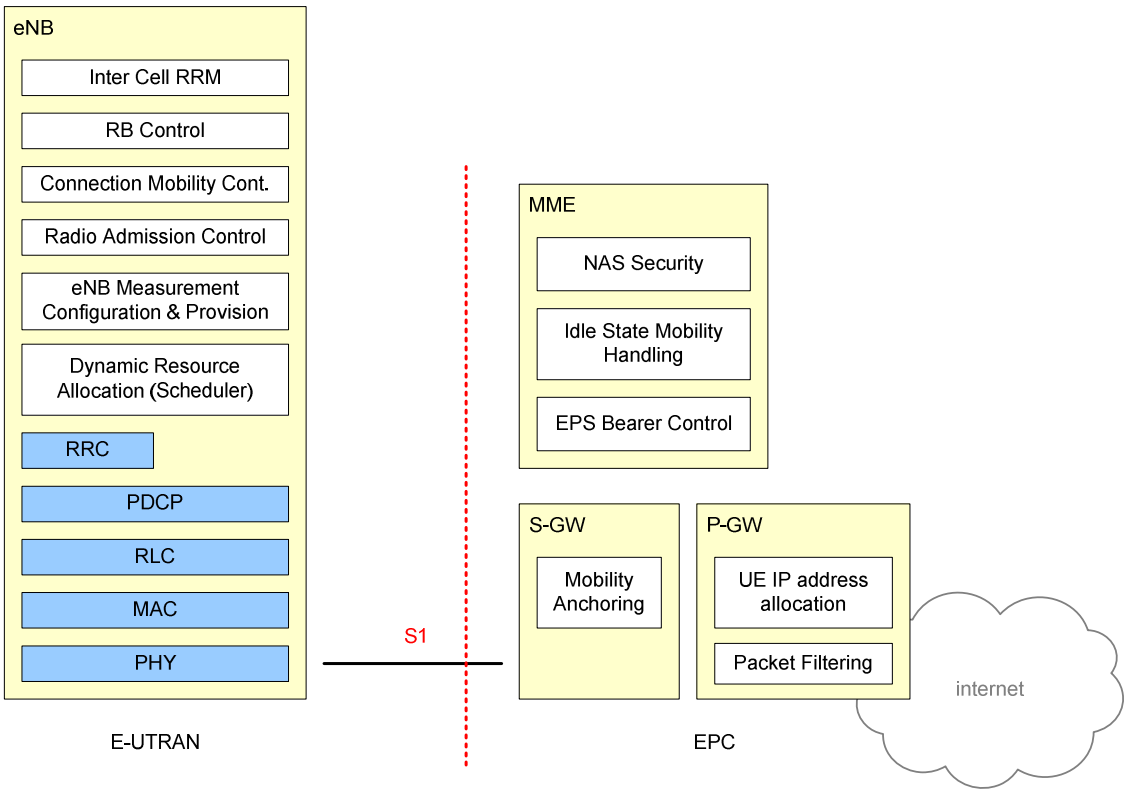


Figure 4.1-1: Functional Split between E-UTRAN and EPC

4.2 Void

4.2.1 Void

4.2.2 Void

4.3 Radio Protocol architecture

In this subclause, the radio protocol architecture of E-UTRAN is given for the user plane and the control plane.

4.3.1 User plane

The figure below shows the protocol stack for the user-plane, where PDCP, RLC and MAC sublayers (terminated in eNB on the network side) perform the functions listed for the user plane in subclause 6, e.g. header compression, ciphering, scheduling, ARQ and HARQ.

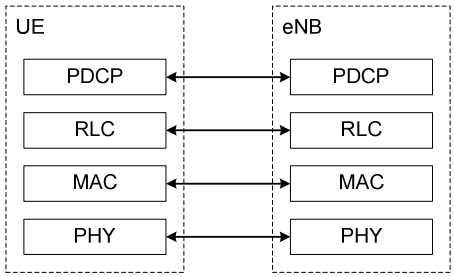


Figure 4.3.1-1: User-plane protocol stack

4.3.2 Control plane

The figure below shows the protocol stack for the control-plane, where:

- PDCP sublayer (terminated in eNB on the network side) performs the functions listed for the control plane in subclause 6, e.g. ciphering and integrity protection;
- RLC and MAC sublayers (terminated in eNB on the network side) perform the same functions as for the user plane;
- RRC (terminated in eNB on the network side) performs the functions listed in subclause 7, e.g.:
  - Broadcast;
  - Paging;
  - RRC connection management;
  - RB control;
  - Mobility functions;
  - UE measurement reporting and control.
- NAS control protocol (terminated in MME on the network side) performs among other things:
  - EPS bearer management;
  - Authentication;
  - ECM-IDLE mobility handling;
  - Paging origination in ECM-IDLE;
  - Security control.

NOTE: The NAS control protocol is not covered by the scope of this TS and is only mentioned for information.

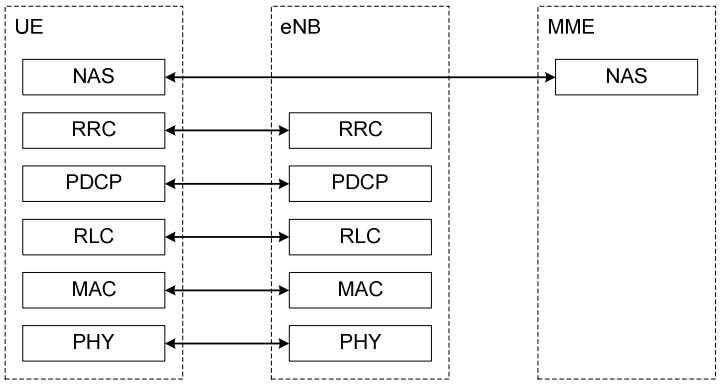


Figure 4.3.2-1: Control-plane protocol stack

4.4 Synchronization

Diverse methods and techniques are preferred depending on synchronization requirements. As no single method can cover all E-UTRAN applications a logical port at eNB may be used for reception of timing and/or frequency and/or phase inputs pending to the synchronization method chosen.

4.5 IP fragmentation

Fragmentation function in IP layer on S1 and X2 shall be supported.

Configuration of S1-U (X2-U) link MTU in the eNB according to the MTU of the network domain the node belongs to shall be considered as a choice at network deployment. The network may employ various methods to handle IP fragmentation, but the specific methods to use are implementation dependant.

4.6 Support of HeNBs

4.6.1 Architecture

Figure 4.6.1-1 shows a logical architecture for the HeNB that has a set of S1 interfaces to connect the HeNB to the EPC.

The configuration and authentication entities as shown here should be common to HeNBs and HNBs.

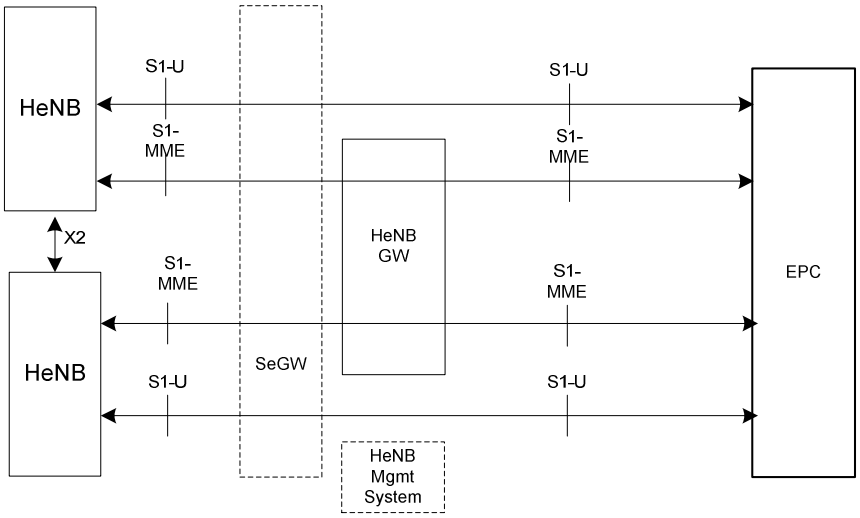


Figure 4.6.1-1: E-UTRAN HeNB Logical Architecture

The E-UTRAN architecture may deploy a Home eNB Gateway (HeNB GW) to allow the S1 interface between the HeNB and the EPC to support a large number of HeNBs in a scalable manner. The HeNB GW serves as a concentrator for the C-Plane, specifically the S1-MME interface. The S1-U interface from the HeNB may be terminated at the HeNB GW, or a direct logical U-Plane connection between HeNB and S-GW may be used (as shown in Figure 4.6.1-1).

The S1 interface is defined as the interface:

- Between the HeNB GW and the Core Network;
- Between the HeNB and the HeNB GW;
- Between the HeNB and the Core Network;
- Between the eNB and the Core Network.

The HeNB GW appears to the MME as an eNB. The HeNB GW appears to the HeNB as an MME. The S1 interface between the HeNB and the EPC is the same, regardless whether the HeNB is connected to the EPC via a HeNB GW or not.

The HeNB GW shall connect to the EPC in a way that inbound and outbound mobility to cells served by the HeNB GW shall not necessarily require inter MME handovers. One HeNB serves only one cell.

The functions supported by the HeNB shall be the same as those supported by an eNB (with possible exceptions e.g. NNSF) and the procedures run between a HeNB and the EPC shall be the same as those between an eNB and the EPC (with possible exceptions e.g. S5 procedures in case of LIPA support).

X2-based HO involving HeNBs is allowed as shown in Table 4.6.1-1.

Table 4.6.1-1: X2-based HO support

Source	Target	Notes
eNB or any HeNB	open access HeNB	
eNB, or any HeNB	hybrid access HeNB	
hybrid access HeNB or closed access HeNB	closed access HeNB	Only applies for same CSG ID and PLMN, and if the UE is a member of the CSG cell.
Any HeNB	eNB	

This version of the specification supports X2-connectivity between HeNBs, independent of whether any of the involved HeNBs is connected to a HeNB GW.

The overall E-UTRAN architecture with deployed HeNB GW and X2 GW is shown below.

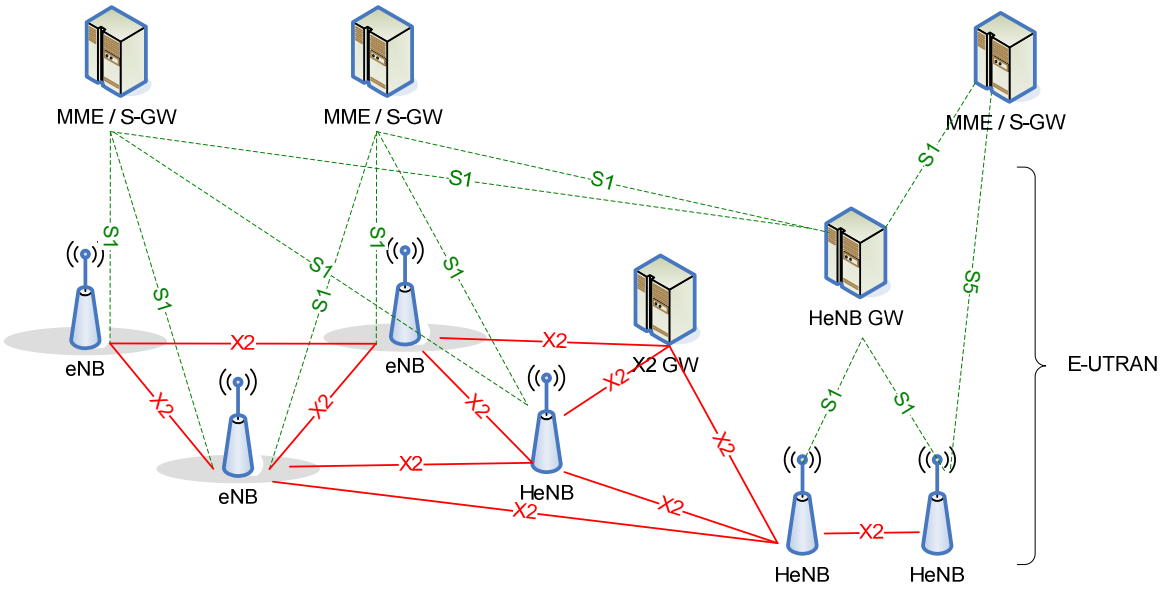


Figure 4.6.1-2: Overall E-UTRAN Architecture with deployed HeNB GW and X2 GW.

NOTE: In the figure above, a HeNB operating in LIPA mode has been represented with its S5 interface. X2-based HO involving HeNBs is supported according to Table 4.6.1-1.

If the HeNB supports the LIPA function, it shall support an S5 interface towards the S-GW and an SGi interface towards the residential/IP network. See section 4.6.5 for the details of the architecture and functions in case of LIPA support.

If the HeNB supports SIPTO@LN with collocated L-GW, it shall support an S5 interface towards the S-GW and an SGi interface towards the IP network. The S5 interface does not go via the HeNB GW, even when present. All other functions are described in section 4.8.2.

4.6.2 Functional Split

A HeNB hosts the same functions as an eNB as described in section 4.1, with the following additional specifics in case of connection to the HeNB GW:

- Discovery of a suitable Serving HeNB GW;
- A HeNB shall only connect to a single HeNB GW at one time, namely no S1 Flex function shall be used at the HeNB:
  - The HeNB will not simultaneously connect to another HeNB GW, or another MME.
- The TAC and PLMN ID used by the HeNB shall also be supported by the HeNB GW;
- Selection of an MME at UE attachment is hosted by the HeNB GW instead of the HeNB. Upon reception of the GUMMEI from a UE, the HeNB shall include it in the INITIAL UE MESSAGE message; upon reception of the GUMMEI Type from the UE, the HeNB shall also include it in the message if supported and supported by the HeNB GW.
- HeNBs may be deployed without network planning. A HeNB may be moved from one geographical area to another and therefore it may need to connect to different HeNB GWs depending on its location;
- Signalling the GUMMEI of the Source MME to the HeNB GW in the S1 PATH SWITCH REQUEST message.

Regardless of HeNB GW connection:

- The HeNB may support the LIPA function. See section 4.6.5 for details.
- The HeNB may support Fixed Broadband Access network interworking function to signal Tunnel Information to the MME via INITIAL UE MESSAGE message, PATH SWITCH REQUEST message and HANDOVER NOTIFY message as specified in TS 23.139 [55]. The Tunnel Information includes the HeNB IP address, the UDP port if NAT/NAPT is detected.
- In case an X2 GW is used, the HeNB registers with the X2 GW at power on or after any change of TNL address(es).

The HeNB GW hosts the following functions:

- Relaying UE-associated S1 application part messages between the MME serving the UE and the HeNB serving the UE, except the UE CONTEXT RELEASE REQUEST message received from the HeNB with an explicit GW Context Release Indication. In that case, the HeNB GW terminates the S1 UE Context Release Request procedure and releases the UE context if it determines that the UE identified by the received UE S1AP IDs is no longer served by an HeNB attached to it. Otherwise it ignores the message.
  - In case of S1 INITIAL CONTEXT SETUP REQUEST message and S1 HANDOVER REQUEST message, informing the HeNB about any GUMMEI corresponding to the serving MME, the MME UE S1AP ID assigned by the MME and the MME UE S1AP ID assigned by the HeNB GW for the UE. In case of S1 PATH SWITCH REQUEST ACKNOWLEDGE message, informing the HeNB about the MME UE S1AP ID assigned by the MME and the MME UE S1AP ID assigned by the HeNB GW for the UE.
  - In case of S1 INITIAL UE MESSAGE message, S1 PATH SWITCH REQUEST and S1 HANDOVER REQUEST ACKNOWLEDGE message, verifying, as defined in TS33.320 [53], for a closed HeNB, that the indicated cell access mode and CSG ID are valid for that HeNB.
- Terminating non-UE associated S1 application part procedures towards the HeNB and towards the MME. In case of S1 SETUP REQUEST message, verifying, as defined in TS33.320 [53], that the identity used by the HeNB is valid and determining whether the access mode of the HeNB is closed or not. In case of S1 PWS RESTART INDICATION message, verifying, as defined in TS 33.320 [53], that the indicated cell identity is valid and replacing the HeNB ID by the HeNB GW ID before sending the PWS RESTART INDICATION message to the MME.
  - Upon receiving an OVERLOAD message, the HeNB GW should send the OVERLOAD message towards the HeNB(s) including in the message the identities of the affected MME node.

Note: If a HeNB GW is deployed, non-UE associated procedures shall be run between HeNBs and the HeNB GW and between the HeNB GW and the MME.

- Optionally terminating S1-U interface with the HeNB and with the S-GW.
- Supporting TAC and PLMN ID used by the HeNB.
- X2 interfaces shall not be established between the HeNB GW and other nodes.
- Routing the S1 PATH SWITCH REQUEST message towards the MME based on the GUMMEI of the source MME received from the HeNB.
- Selection of an IP version to be used for S1-U, if a requested ERAB configuration contains two transport layer addresses of different versions.

A list of CSG IDs may be included in the PAGING message. If included, the HeNB GW may use the list of CSG IDs for paging optimization.

The X2 GW hosts the following functions:

- routing the X2AP X2 MESSAGE TRANSFER message to target eNB or HeNB based on the routing information received in the X2AP X2 MESSAGE TRANSFER message.
- informing the relevant (H)eNBs upon detecting that the signalling (i.e. SCTP) connection to a (H)eNB is unavailable. The relevant (H)eNBs are the ones which had an "X2AP association" with this (H)eNB via the X2 GW when the signalling connection became unavailable.
- Mapping the TNL address(es) of a (H)eNB to its corresponding Global (H)eNB ID and maintaining the association.

In addition to functions specified in section 4.1, the MME hosts the following functions:

- Access control for UEs that are members of Closed Subscriber Groups (CSG):
  - In case of handovers to CSG cells, access control is based on the target CSG ID of the selected target PLMN provided to the MME by the serving E-UTRAN (see 3GPP TS 23.401 [17]).
- Membership Verification for UEs handing over to hybrid cells:
  - In case of handovers to hybrid cells the MME performs Membership Verification based on UE's selected target PLMN, cell access mode related information and the CSG ID of the target cell provided by the source E-UTRAN in S1 handover, or provided by the target E-UTRAN in X2 handover (see 3GPP TS 23.401 [17]).
- CSG membership status signalling to the E-UTRAN in case of attachment/handover to hybrid cells and in case of the change of membership status when a UE is served by a CSG cell or a hybrid cell.
- Supervising the E-UTRAN action after the change in the membership status of a UE.
- In case of a HeNB directly connected:
  - verifying as defined in TS33.320 [53], that the identity used by the HeNB is valid when receiving the S1 SETUP REQUEST message and determining whether the access mode of the HeNB is closed or not;
  - verifying as defined in TS 33.320 [53], for a closed HeNB, that the indicated cell access mode and CSG ID are valid when receiving the S1 INITIAL UE MESSAGE message, the S1 PATH SWITCH REQUEST and the S1 HANDOVER REQUEST ACKNOWLEDGE message;
  - and verifying, as defined in TS 33.320 [53], that the indicated HeNB identity is valid when receiving the S1 PWS RESTART INDICATION message.
- Routing of handover messages, MME configuration transfer messages and MME Direct Information Transfer messages towards HeNB GWs based on the TAI contained in these messages.

NOTE: If routing ambiguities are to be avoided, a TAI used in a HeNB GW should not be reused in another HeNB GW.

NOTE: The MME or HeNB GW should not include the list of CSG IDs for paging when sending the paging message directly to an un-trusted HeNB or eNB.

- The MME may support the LIPA function with HeNB. See details of this support in section 4.6.5.
- The MME may support fixed Broadband Access network interworking with HeNB as specified in TS23.139 [55].
- The MME may send two transport layer addresses of different versions only in case of HeNB GW which does not terminate user plane.

4.6.3 Interfaces

4.6.3.1 Protocol Stack for S1 User Plane

The S1-U data plane is defined between the HeNB, HeNB GW and the S-GW. The figures below show the S1-U protocol stack with and without the HeNB GW.

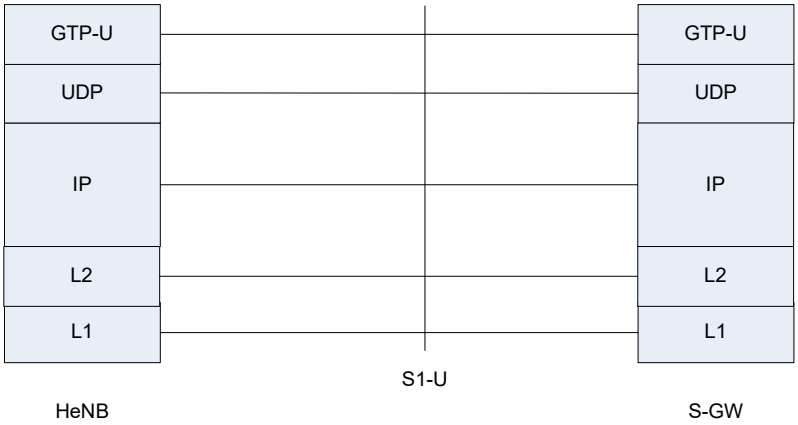


Figure 4.6.3.1-1: User plane for S1-U interface for HeNB without HeNB GW

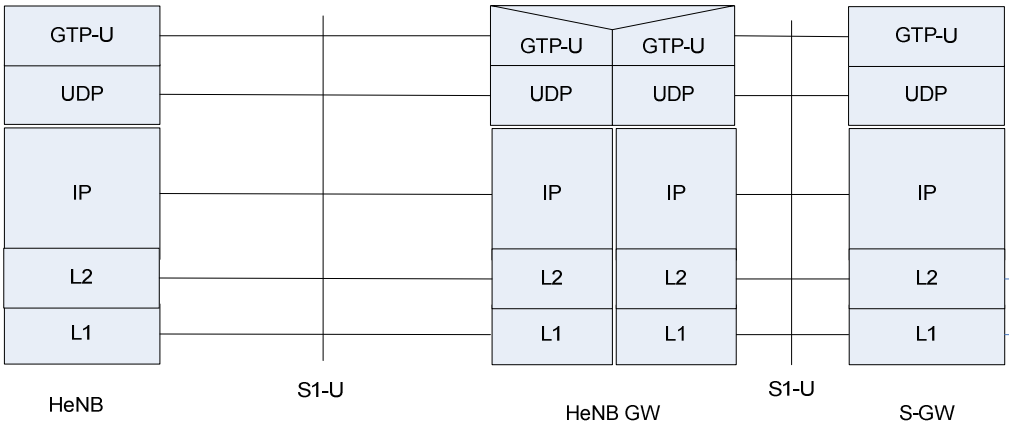


Figure 4.6.3.1-2: User plane for S1-U interface for HeNB with HeNB GW

The HeNB GW may optionally terminate the user plane towards the HeNB and towards the S-GW, and relay User Plane data between the HeNB and the S-GW.

4.6.3.2 Protocol Stacks for S1 Control Plane

The two figures below show the S1-MME protocol stacks with and without the HeNB GW.

When the HeNB GW is not present (Fig. 4.6.3.2-1), all the S1-AP procedures are terminated at the HeNB and the MME.

When present (Fig. 4.6.3.2-2), the HeNB GW shall terminate the non-UE-dedicated procedures – both with the HeNB, and with the MME. The HeNB GW relays Control Plane data between the HeNB and the MME. The scope of any protocol function associated to a non-UE-dedicated procedure shall be between HeNB and HeNB GW and/or between HeNB GW and MME.

Any protocol function associated to an UE-dedicated-procedure shall reside within the HeNB and the MME only.

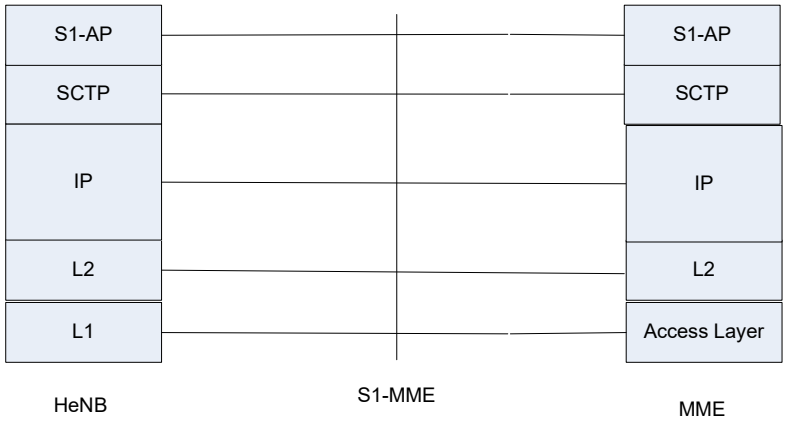


Figure 4.6.3.2-1: Control plane for S1-MME Interface for HeNB to MME without the HeNB GW

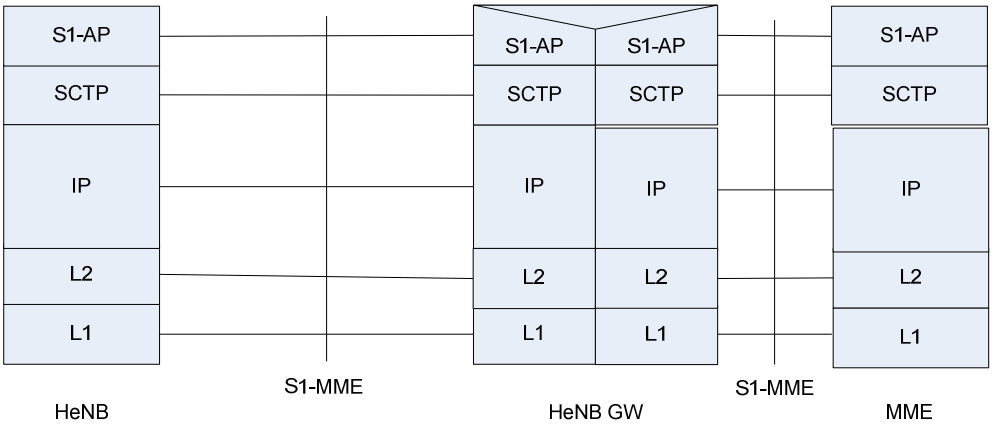


Figure 4.6.3.2-2: Control plane for S1-MME Interface for HeNB to MME with the HeNB GW

4.6.3.3 Protocol Stack for S5 interface

The protocol stack for the S5 interface can be found in TS 29.281 [47] for the user plane and in TS 29.274 [40] for the control plane.

4.6.3.4 Protocol Stack for SGi interface

The protocol stack for the SGi interface can be found in TS 29.061 [41].

4.6.3.5 Protocol Stack for X2 User Plane and X2 Control Plane

The protocol stack for X2 User Plane and X2 Control Plane is reported in Section 6.4 of TS 36.420 [46].

4.6.4 Void

4.6.5 Support of LIPA with HeNB

Figure 4.6.5-1 shows the logical architecture for the HeNB when it supports the LIPA function.

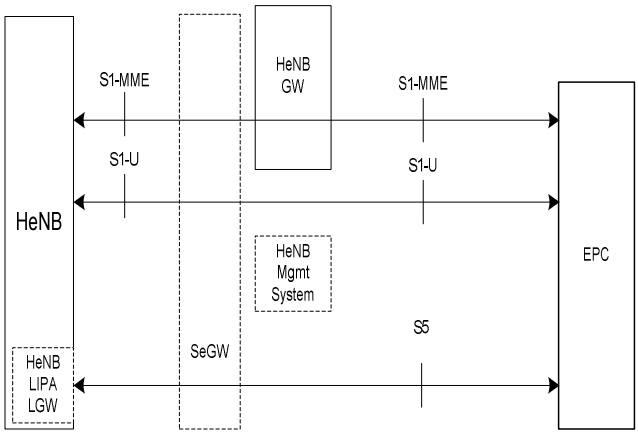


Figure 4.6.5-1: E-UTRAN - HeNB operating in LIPA mode - Logical Architecture

For a LIPA PDN connection, the HeNB sets up and maintains an S5 connection to the EPC.

The S5 interface does not go via the HeNB GW, even when present.

Requirements on the secure backhaul link for the S5 interface are specified in TS 33.320 [53].

The mobility of the LIPA PDN connection is not supported in this release of the specification. The LIPA connection is always released at outgoing handover as described in TS23.401 [17]. The L-GW function in the HeNB triggers this release over the S5 interface.

In case of LIPA support, the HeNB supports the following additional functions, regardless of the presence of a HeNB GW:

- transfer of the collocated L-GW IP address of the HeNB over S1-MME to the EPC at every idle-active transition;
- transfer of the collocated L-GW IP address of the HeNB over S1-MME to the EPC within every Uplink NAS Transport procedure;
- support of basic P-GW functions in the collocated L-GW function such as support of the SGi interface corresponding to LIPA;
- additional support of first packet sending, buffering of subsequent packets, internal direct L-GW - HeNB user path management and in sequence packet delivery to the UE;
- support of the necessary restricted set of S5 procedures corresponding to the strict support of LIPA function as specified in TS 23.401 [17];
- notification to the EPC of the collocated L-GW uplink TEID(s) or GRE key(s) for the LIPA bearer(s) over S5 interface within the restricted set of procedures to be forwarded over S1-MME and further used by the HeNB as "correlation id" for correlation purposes between the collocated L-GW function and the HeNB;
- in case of outgoing handover triggering the L-GW function to release the LIPA PDN connection and only handing over the non-LIPA E-RABs.

In case of LIPA support, the MME may support the following additional functions:

- verification of UE authorization to request LIPA activation for the requested APN at this CSG and transfer of the received collocated L-GW IP address;

- transfer of the "correlation id" i.e. collocated L-GW uplink TEID or GRE key to the HeNB within the UE context setup procedure and E-RAB setup procedure;
- verification of whether the LIPA PDN connection has been released during the handover procedure, as specified in TS 23.401 [17];
- deactivation of the LIPA PDN connection of an idle-mode UE if it detects that the UE has moved out of the coverage area of the HeNB collocated with L-GW function, as specified in TS 23.401 [17].

4.6.6 Support of X2 GW

Figure 4.6.6-1 shows the logical architecture when X2-connectivity via the X2 GW is supported.

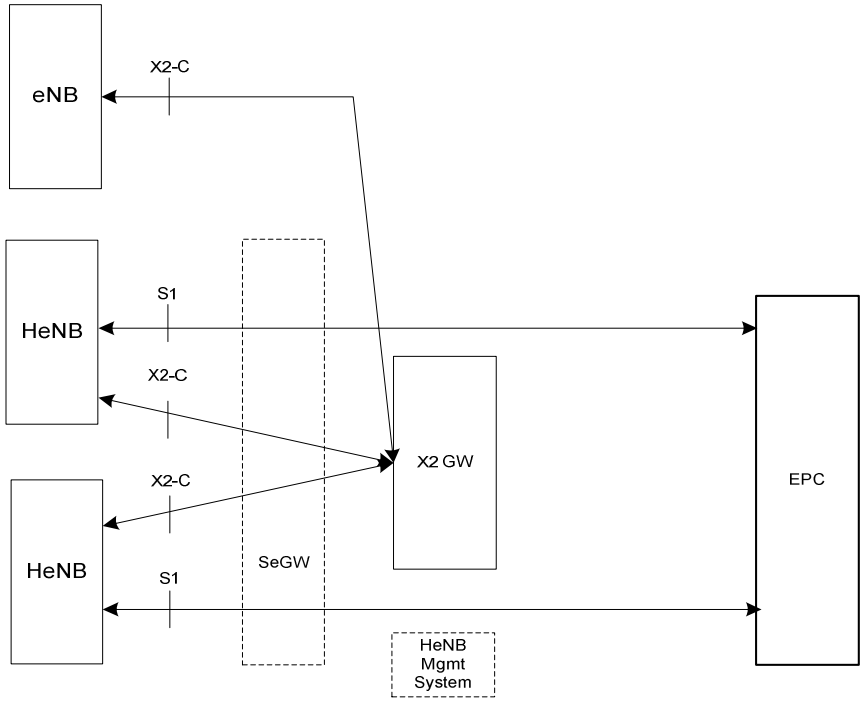


Figure 4.6.6-1: E-UTRAN operating with X2 GW - Logical Architecture

Support for the X2 GW relies on following principles:

- A HeNB connects to a single X2 GW only. Each HeNB is preconfigured with information about which X2 GW it connects to, e.g. an IP address of the X2 GW.
- There is no limitation on the number of X2 GWs an eNB may connect to.
- The X2 GW does not terminate X2AP procedures except for the X2AP Message Transfer procedure, but it initiates the X2 Release procedure and the X2 Error Indication procedure.
- This version of the specification does not support an interface between two X2 GWs. The routing of X2AP messages via more than one X2 GW (i.e. more than two SCTP hops) is not allowed.
- X2AP contexts only exist in the two peer (H)eNBs (same as without X2 GW). The peer X2AP contexts define an "X2AP association" between peer (H)eNBs which spans over two SCTP associations (one per each hop).
- The X2 GW puts no constraints on the X2 user plane interface (X2-U).
- For each (H)eNB connected to the X2 GW, the X2 GW maintains the association information, i.e. the mapping of the Global eNB ID to the TNL address(es). The registration procedure, described in Sec. 4.6.6.4, is used to update the association information in the X2 GW.

4.6.6.1 Enhanced TNL Address Discovery

In case of Enhanced TNL Address Discovery is used with the X2 GW, in addition to the procedures specified in section 22.3.6.1, the following also applies.

- During HeNB initiated Enhanced TNL address discovery procedure, the HeNB may include the IP address of the X2 GW to which the HeNB connected in the eNB CONFIGURATION TRANSFER message thus indicating its X2 GW support capability. Upon the reception of the IP address of the X2 GW, the candidate eNB may include in its reply the received IP address of the X2 GW thus indicating the support of indirect X2 via the indicated X2 GW.

- During the eNB or HeNB initiated Enhanced TNL address discovery procedure towards an HeNB, the candidate HeNB may include in its reply the IP address of the X2 GW to which the candidate HeNB connected thus indicating the support of indirect X2 via the indicated X2 GW.

4.6.6.2 Routing of X2AP messages

When a (H)eNB sends an X2AP message (except the X2AP X2 MESSAGE TRANSFER message) to a peer node via the X2 GW, the (H)eNB encapsulates the X2AP message in an X2AP X2 MESSAGE TRANSFER message, adds the routing information, then sends the X2AP X2 MESSAGE TRANSFER message to the X2 GW. The routing information includes both Target (H)eNB ID and source (H)eNB ID. The X2 GW routes the message based on the target (H)eNB ID. The source (H)eNB ID is used by the destination (H)eNB node to reply.

4.6.6.3 (H)eNB unavailability

Upon the detection that the signalling (i.e. SCTP) connection to a (H)eNB is unavailable, the X2 GW initiates the X2 Release procedure to inform the relevant (H)eNBs. The relevant (H)eNBs are the ones which had an "X2AP association" with this (H)eNB via the X2 GW when the signalling connection became unavailable.

4.6.6.4 (H)eNB registration

Registration of a (H)eNB is performed by initiating the X2AP Message Transfer procedure towards the X2 GW signalling a Source (H)eNB ID, no Target (H)eNB ID, and no X2AP Message in the X2AP MESSAGE TRANSFER message. Upon receipt of this message, the X2 GW saves the association information, i.e. the mapping of the received Global eNB ID to the TNL address(es) of the originating (H)eNB.

4.7 Support for relaying

4.7.1 General

E-UTRAN supports relaying by having a Relay Node (RN) wirelessly connect to an eNB serving the RN, called Donor eNB (DeNB), via a modified version of the E-UTRA radio interface, the modified version being called the Un interface.

The RN supports the eNB functionality meaning it terminates the radio protocols of the E-UTRA radio interface, and the S1 and X2 interfaces. From a specification point of view, functionality defined for eNBs, e.g. RNL and TNL, also applies to RNs unless explicitly specified. RNs do not support NNSF.

In addition to the eNB functionality, the RN also supports a subset of the UE functionality, e.g. physical layer, layer-2, RRC, and NAS functionality, in order to wirelessly connect to the DeNB.

NOTE: Inter-cell handover of the RN is not supported.

NOTE: It is up to implementation when the RN starts or stops serving UEs.

NOTE: An RN may not use another RN as its DeNB.

4.7.2 Architecture

The architecture for supporting RNs is shown in Figure 4.7.2-1. The RN terminates the S1, X2 and Un interfaces. The DeNB provides S1 and X2 proxy functionality between the RN and other network nodes (other eNBs, MMEs and S-GWs). The S1 and X2 proxy functionality includes passing UE-dedicated S1 and X2 signalling messages as well as GTP data packets between the S1 and X2 interfaces associated with the RN and the S1 and X2 interfaces associated with other network nodes. Due to the proxy functionality, the DeNB appears as an MME (for S1-MME), an eNB (for X2) and an S-GW (for S1-U) to the RN.

In phase II of RN operation (see subclause 4.7.6.3), the DeNB also embeds and provides the S-GW/P-GW-like functions needed for the RN operation. This includes creating a session for the RN and managing EPS bearers for the RN, as well as terminating the S11 interface towards the MME serving the RN.

The RN and DeNB also perform mapping of signalling and data packets onto EPS bearers that are setup for the RN. The mapping is based on existing QoS mechanisms defined for the UE and the P-GW.

In phase II of RN operation (see subclause 4.7.6.3), the P-GW functions in the DeNB allocate an IP address for the RN for the O&M which may be different than the S1 IP address of the DeNB.

If the RN address is not routable to the RN O&M domain, it shall be reachable from the RN O&M domain (e.g. via NAT).

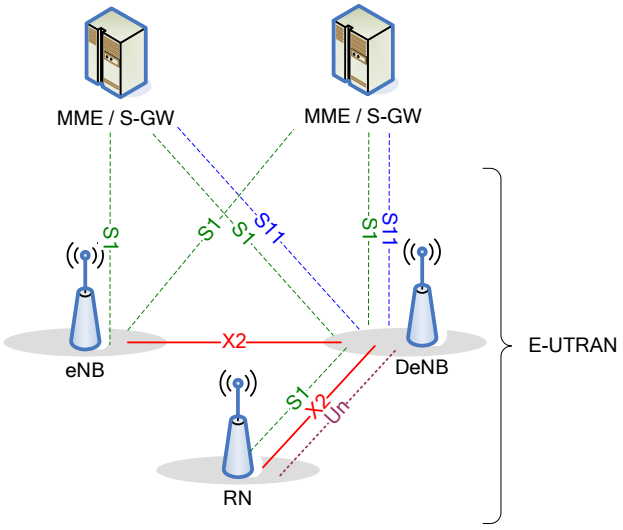


Figure 4.7.2-1: Overall E-UTRAN Architecture supporting RNs

4.7.3 S1 and X2 user plane aspects

The S1 user plane protocol stack for supporting RNs is shown in Figure 4.7.3-1. There is a GTP tunnel associated with each UE EPS bearer, spanning from the S-GW associated with the UE to the DeNB, which is switched to another GTP tunnel in the DeNB, going from the DeNB to the RN (one-to-one mapping).

The X2 user plane protocol stack for supporting RNs is shown in Figure 4.7.3-2. There is a GTP forwarding tunnel associated with each UE EPS bearer subject to forwarding, spanning from the other eNB to the DeNB, which is switched to another GTP tunnel in the DeNB, going from the DeNB to the RN (one-to-one mapping).

The S1 and X2 user plane packets are mapped to radio bearers over the Un interface. The mapping can be based on the QCI associated with the UE EPS bearers. UE EPS bearer with similar QoS can be mapped to the same Un radio bearer.

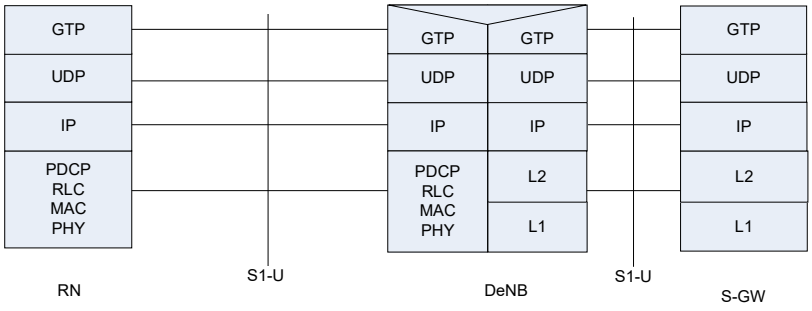


Figure 4.7.3-1: S1 user plane protocol stack for supporting RNs

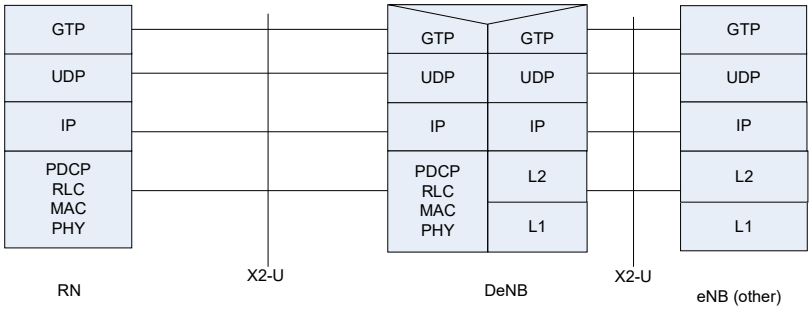


Figure 4.7.3-2: X2 user plane protocol stack for supporting RNs

4.7.4 S1 and X2 control plane aspects

The S1 control plane protocol stack for supporting RNs is shown in Figure 4.7.4-1. There is a single S1 interface relation between each RN and its DeNB, and there is one S1 interface relation between the DeNB and each MME in the MME pool. The DeNB processes and forwards all S1 messages between the RN and the MMEs for all UE-dedicated procedures. The processing of S1-AP messages includes modifying S1-AP UE IDs, Transport Layer address and GTP TEIDs but leaves other parts of the message unchanged.

All non-UE-dedicated S1-AP procedures are terminated at the DeNB, and handled locally between the RN and the DeNB, and between the DeNB and the MME(s). Upon reception of an S1 non-UE-dedicated message from an MME, the DeNB may trigger corresponding S1 non-UE-dedicated procedure(s) to the RN(s). If more than one RN is involved, the DeNB may wait and aggregate the response messages from all involved RNs before responding to the MME. Upon reception of an S1 non-UE-dedicated message from an RN, the DeNB may trigger associated S1 non-UE-dedicated procedure(s) to the MME(s). In case of the RESET procedure, the DeNB does not need to wait for the response message(s) from the MME(s) or RN(s) before responding with the RESET ACKNOWLEDGE message to the originating node. Upon reception of a PAGING message, the DeNB sends the PAGING message toward the RN(s) which support any tracking area(s) indicated in the List of TAIs. Upon reception of an S1 MME overload message, the DeNB sends the MME overload message towards the RN(s), including in the message the identities of the affected CN node. Upon reception of the GUMMEI from a UE, the RN shall include it in the INITIAL UE MESSAGE message; upon reception of the GUMMEI Type from the UE, the RN shall also include it in the message.

The X2 control plane protocol stack for supporting RNs is shown in Figure 4.7.4-2. There is a single X2 interface relation between each RN and its DeNB. In addition, the DeNB may have X2 interface relations to neighbouring eNBs. The DeNB processes and forwards all X2 messages between the RN and other eNBs for all UE-dedicated procedures. The processing of X2-AP messages includes modifying S1/X2-AP UE IDs, Transport Layer address and GTP TEIDs but leaves other parts of the message unchanged.

All non-UE-dedicated X2-AP procedures are terminated at the DeNB, and handled locally between the RN and the DeNB, and between the DeNB and other eNBs. Upon reception of an X2 non cell related non-UE-associated message from RN or neighbour eNB, the DeNB may trigger associated non-UE-dedicated X2-AP procedure(s) to the neighbour eNB or RN(s). Upon reception of an X2 cell related non-UE-dedicated message from RN or neighbour eNB, the DeNB may pass associated information to the neighbour eNB or RN(s) based on the included cell information. If one or more RN(s) are involved, the DeNB may wait and aggregate the response messages from all involved nodes to respond to the originating node. Further, parallel Cell Activation procedures are not allowed on each X2 interface instance. The processing of Resource Status Reporting Initiation/ Resource Status Reporting messages includes modification of measurement ID.

The S1 and X2 interface signalling packets are mapped to radio bearers over the Un interface.

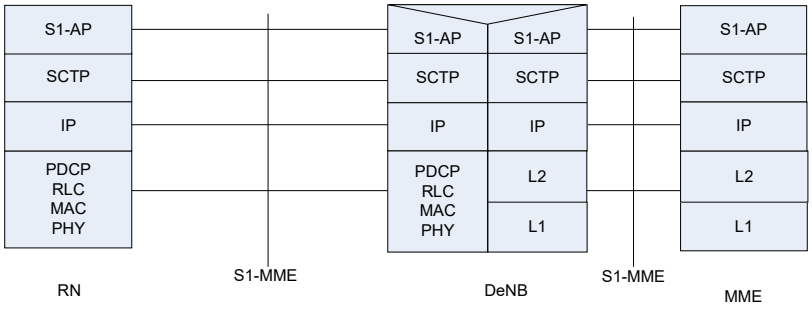


Figure 4.7.4-1: S1 control plane protocol stack for supporting RNs

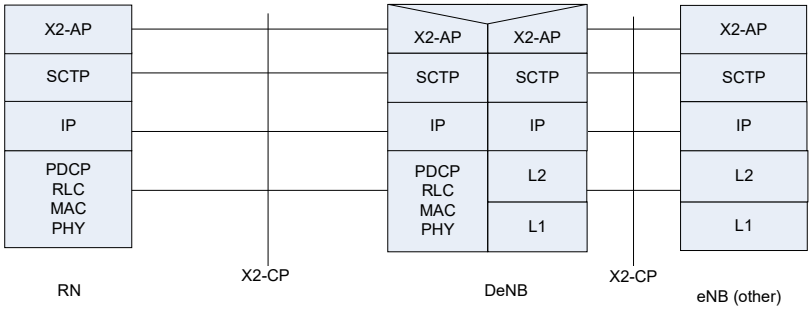


Figure 4.7.4-2: X2 control plane protocol stack for supporting RNs

4.7.5 Radio protocol aspects

The RN connects to the DeNB via the Un interface using the same radio protocols and procedures as a UE connecting to an eNB. The control plane protocol stack is shown in Figure 4.7.5-1 and the user plane protocol stack is shown in Figure 4.7.5-2.

The following relay-specific functionalities are supported:

- the RRC layer of the Un interface has functionality to configure and reconfigure an RN subframe configuration through the RN reconfiguration procedure (e.g. DL subframe configuration and an RN-specific control channel) for transmissions between an RN and a DeNB. The RN may request such a configuration from the DeNB during the RRC connection establishment, and the DeNB may initiate the RRC signalling for such configuration. The RN applies the configuration immediately upon reception;

NOTE: The RN subframe configuration on the Un interface can be temporarily misaligned with the MBSFN subframes configured in the RN cell due to the RN subframe configuration; i.e. a new subframe configuration can be applied earlier by the RN on Un than in the RN cell.

- the RRC layer of the Un interface has functionality to send updated system information in a dedicated message to an RN with an RN subframe configuration. The RN applies the received system information immediately;

- the PDCP layer of the Un interface has functionality to provide integrity protection for the user plane. The integrity protection is configured per DRB.

To support PWS towards UEs, the RN receives the relevant information over S1. The RN should hence ignore DeNB system information relating to PWS.

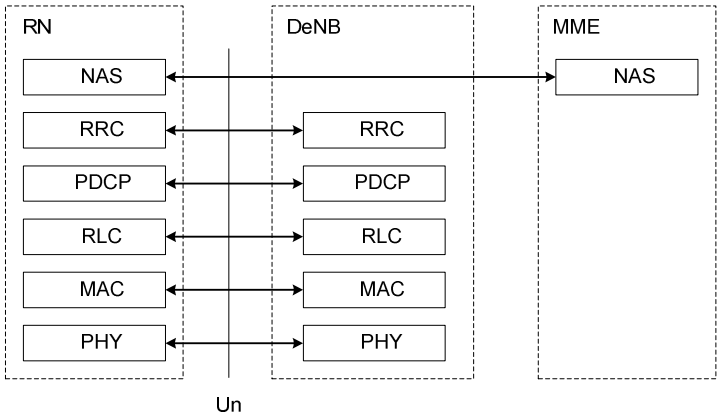


Figure 4.7.5-1: Radio control plane protocol stack for supporting RNs

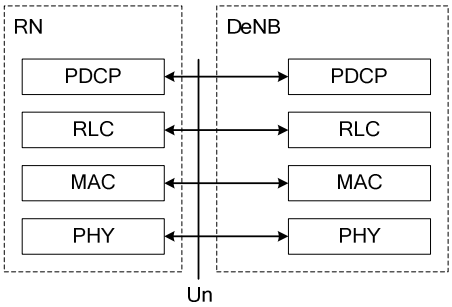


Figure 4.7.5-2: Radio user plane protocol stack for supporting RNs

4.7.6 Signalling procedures

4.7.6.1 RN attach procedure

Figure 4.7.6.1-1 shows a simplified version of the attach procedure for the RN. The procedure is the same as the normal UE attach procedure TS 23.401 [17] with the exception that:

- The DeNB has been made aware of which MMEs support RN functionality via the S1 Setup Response message earlier received from the MMEs;
- The RN sends an RN indication to the DeNB during RRC connection establishment;
- After receiving the RN indication from the RN, the DeNB sends the RN indicator and the IP address of the S-GW/P-GW function embedded in the DeNB, within the Initial UE Message, to an MME supporting RN functionality;
- MME selects S-GW/P-GW for the RN based on the IP address included in the Initial UE Message;
- During the attach procedure, the EPC checks if the RN is authorised for relay operation; only if the RN is authorised, the EPC accepts the attach and sets up a context with the DeNB; otherwise the EPC rejects the attach.

The RN is preconfigured with information about which cells (DeNBs) it is allowed to access.

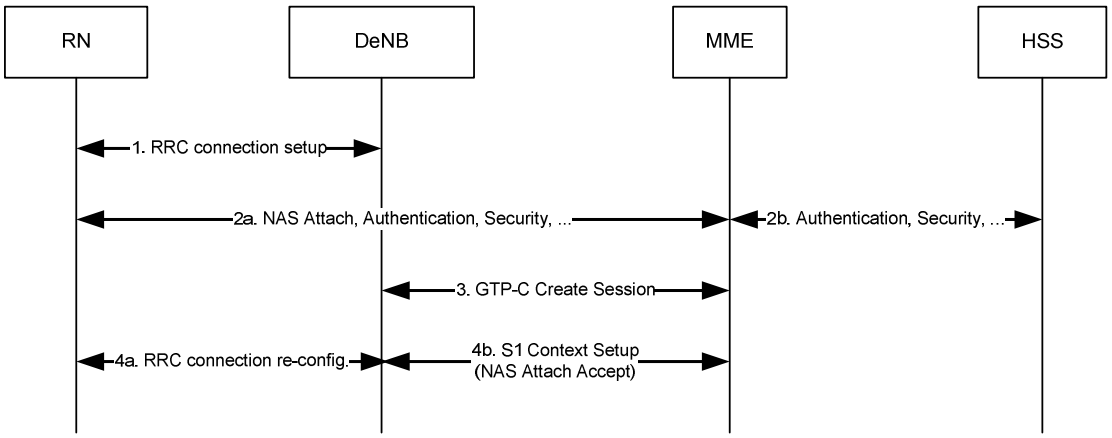


Figure 4.7.6.1-1: RN attach procedure

4.7.6.2 E-RAB activation/modification

Figure 4.7.6.2-1 shows a simplified version of the DeNB-initiated bearer activation/modification procedure. This procedure can be used by the DeNB to change the EPS bearer allocation for the RN. The procedure is the same as the normal network-initiated bearer activation/modification procedure TS 23.401 [17] with the exception that the S-GW/P-GW functionality (steps 1 and 6) is performed by the DeNB.

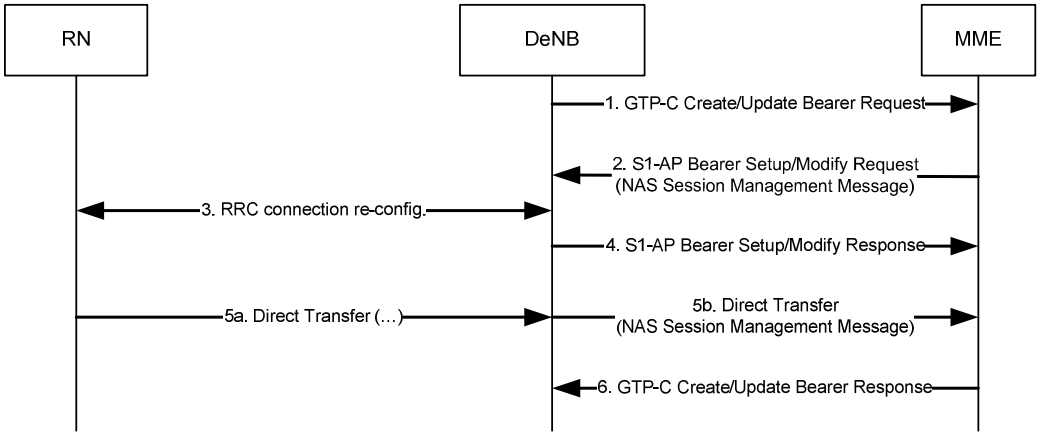


Figure 4.7.6.2-1: DeNB-initiated bearer activation/modification procedure

4.7.6.3 RN startup procedure

Figure 4.7.6.3-1 shows a simplified version of the startup procedure for the RN. The procedure is based on the normal UE attach procedure TS 23.401 [17] and it consists of the following two phases:

I. Phase I: Attach for RN preconfiguration.
The RN attaches to the E-UTRAN/EPC as a UE at power-up and retrieves initial configuration parameters, including the list of DeNB cells, from RN OAM. After this operation is complete, the RN detaches from the network as a UE and triggers Phase II. The MME performs the S-GW and P-GW selection for the RN as a normal UE.

II. Phase II: Attach for RN operation.
The RN connects to a DeNB selected from the list acquired during Phase I to start relay operations. For this purpose, the normal RN attach procedure described in section 4.7.6.1 is applied. After the DeNB initiates setup

of bearer for S1/X2, the RN initiates the setup of S1 and X2 associations with the DeNB (see section 4.7.4). In addition, the DeNB may initiate an RN reconfiguration procedure via RRC signalling for RN-specific parameters.
After the S1 setup, the DeNB performs the S1 eNB Configuration Update procedure(s), if the configuration data for the DeNB is updated due to the RN attach. After the X2 setup, the DeNB performs the X2 eNB Configuration Update procedure(s) to update the cell information.
In this phase the RN cells' ECGIs are configured by RN OAM.

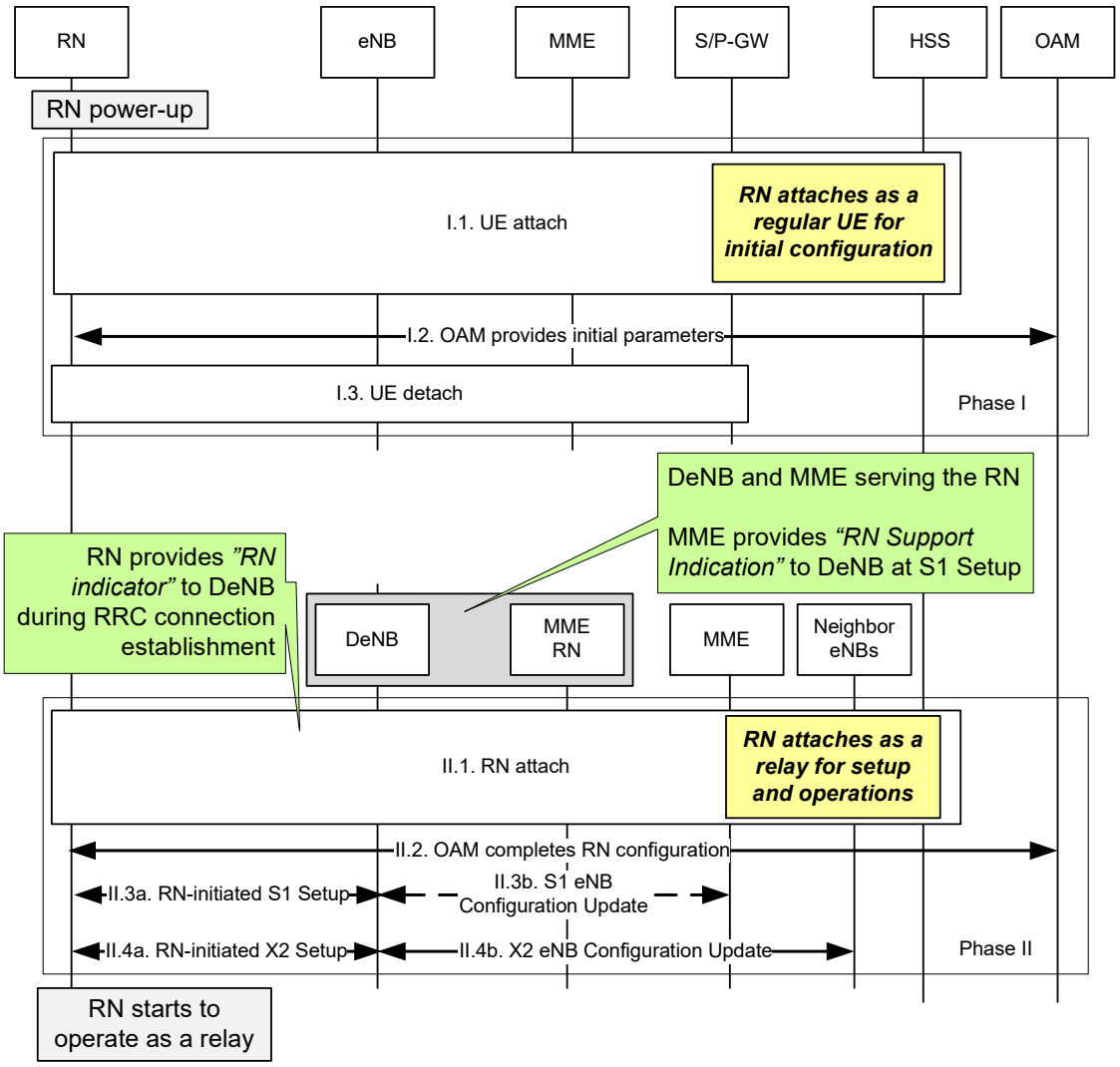


Figure 4.7.6.3-1: RN startup procedure

4.7.6.4 RN detach procedure

Figure 4.7.6.4-1 shows a simplified version of the detach procedure for the RN operation in case no UE is connected to the RN cells.

1. The detach procedure is the same as the normal UE detach procedure TS 23.401 [17].
2. The DeNB performs the X2 eNB Configuration Update procedure(s) to update the cell information.
3 The DeNB performs the S1 eNB Configuration Update procedure(s), if the configuration data for the DeNB is updated due to the RN detach.

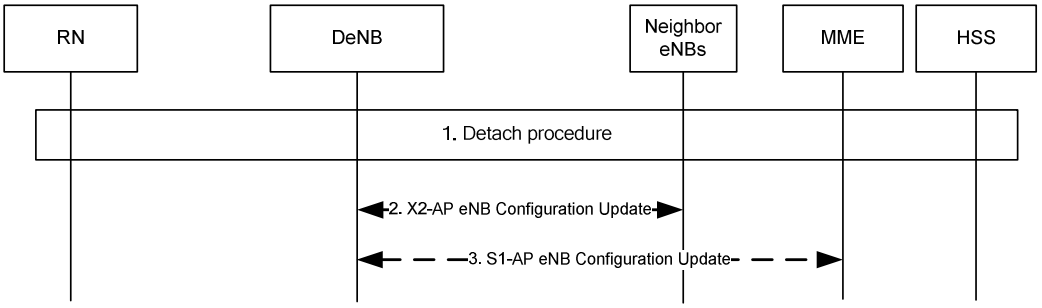


Figure 4.7.6.4-1: RN detach procedure

4.7.6.5 Neighbouring Information Transfer

The X2 eNB Configuration Update procedure (see section 20.2.2.8) is used by the DeNB to also transfer application level configuration data of a single neighbouring eNB to the RN. Upon reception of an ENB CONFIGURATION UPDATE message, if the served cells contained in the message belong to the neighbour eNB rather than the DeNB, the RN shall regard the X2 interface between DeNB and the neighbour eNB as available. The RN will update the X2 availability, the corresponding GU Group ID and other information of the neighbour eNB according to the message.

4.7.6.6 Mobility to or from RN

In case of Handover between RN and neighbour eNB, in addition to the procedures specified in section 10.1.2.1.1, the following also applies.

- The DeNB may inform the RN of any GUMMEI of the UE's serving MME in the INITIAL CONTEXT SETUP REQUEST and S1 HANDOVER REQUEST messages. Considering this information as well as the GU Group ID of the neighbour eNB and the X2 interface availability between DeNB and neighbour eNB, the RN initiates either S1 or X2 handover for the UE. In case the GUMMEI information is not available to the RN, the RN attempts X2 handover for the UE (see section 19.2.2.5); upon X2 handover failure, S1 handover may be initiated.

- The S1/X2 HANDOVER REQUEST is received by the DeNB, which reads the target cell ID from the message, finds the target node corresponding to the target cell ID, and forwards the message toward the target node if appropriate.

4.7.7 Relay Node OAM Aspects

4.7.7.1 Architecture

Each RN sends alarms and traffic counter information to its OAM system, from which it receives commands, configuration data and software downloads (e.g. for equipment software upgrades). This transport connection between each RN and its OAM, using IP, is provided by the DeNB; the reference architecture is shown in Figure 4.7.7.1-1. RN OAM traffic is transported over the Un interface, and it shares resources with the rest of the traffic, including UEs attached to the DeNB. The secure connection between the RN and its OAM may be direct or hop-by-hop, i.e. involving intermediate hops trusted by the operator for this purpose.

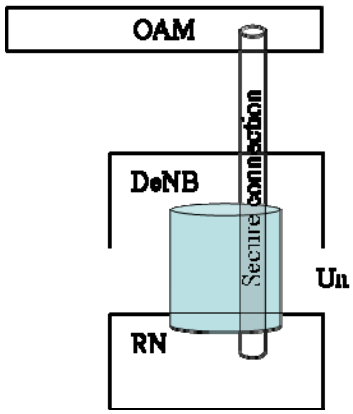


Figure 4.7.7.1-1: Relay OAM architecture.

It has to be noted that Figure 4.7.7.1-1 refers to normal operating conditions for the RN, i.e. after the initial start-up phase has been completed. The case where the secure connection between the RN and the OAM does not go through the DeNB, e.g. during the initial start-up phase, is not precluded.

4.7.7.2 OAM Traffic QoS Requirements

Alarms in the RN generate bursts of high-priority traffic, to be transported in real time. Traffic counters generate bursts of traffic, but their transport need not be real-time. Configuration messages from OAM to the RN will also generate small bursts of traffic, possibly with lower priority than alarms but still delay-sensitive: when a configuration is committed on the OAM, the time interval between the commitment and the effect on the equipment shall be small.

Alarm messages and commands should be transported on a high-priority bearer, while counters may be transported on a lower priority bearer. There is no need to specify a new QCI value other than those already standardized.

Alarm messages and commands may be mapped over a dedicated bearer or over the same bearer that carries S1 and/or X2 messages between the RN and the DeNB.

OAM software download to the RN may generate larger amounts of data, but both the required data rate and the priority of this kind of traffic are much lower than in the case of alarms, commands and counters. OAM software downloads may be mapped to a dedicated, non-GBR bearer, or transported together with the user plane traffic. If a dedicated bearer is used, it is FFS whether it shall be present at all times, or its setup should be event-triggered (software upgrades are triggered by the operator).

4.7.7.3 Security Aspects

Refer to section D.2.5 of TS 33.401 [22] for details on secure management procedures for RN.

4.7.7.4 Void

4.7.7.5 OAM Requirements for Configuration Parameters

4.7.7.5.1 Parameters Associated with Relay Bearer Mapping

OAM provides the appropriate support to configure a QCI-to-DSCP mapping function at the relay node which is used to control the mapping in uplink of Uu bearer(s) of different QCI(s) to Un bearer(s).

4.8 Support of SIPTO at the Local Network

4.8.1 General

E-UTRAN supports SIPTO at the Local Network with a collocated L-GW in the eNB or a standalone GW (with S-GW and L-GW collocated), as specified in TS 23.401 [17].

4.8.2 SIPTO at the Local Network with collocated L-GW

Figure 4.8.2-1 shows the logical architecture for the eNB when it supports SIPTO@LN with a collocated L-GW.

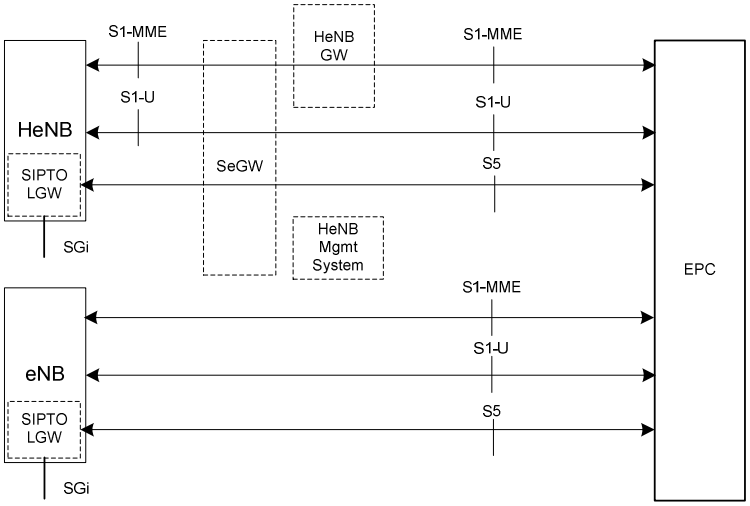


Figure 4.8.2-1: E-UTRAN - SIPTO@LN with collocated L-GW - Logical Architecture

For a SIPTO@LN PDN connection, the eNB sets up and maintains an S5 connection to the EPC.

The mobility of the SIPTO@LN PDN connection is not supported in this release of the specification. The SIPTO@LN PDN connection is released after a handover is performed, and the collocated L-GW in the source eNB triggers the release over the S5 interface, as described in TS 23.401 [17].

In case of SIPTO@LN with collocated L-GW support, the eNB supports the following additional functions:

- transfer of the collocated L-GW IP address of the eNB over S1-MME to the EPC at every idle-active transition;
- transfer of the collocated L-GW IP address of the eNB over S1-MME to the EPC within every Uplink NAS Transport procedure;
- support of basic P-GW functions in the collocated L-GW such as support of the SGi interface corresponding to SIPTO@LN;
- additional support of first packet sending, buffering of subsequent packets, internal direct L-GW-eNB user path management and in sequence packet delivery to the UE;
- support of the necessary restricted set of S5 procedures corresponding to the support of SIPTO@LN function as specified in TS 23.401 [17];
- notification to the EPC of the collocated L-GW uplink TEID(s) or GRE key(s) for the SIPTO@LN bearer(s) over S5 interface within the restricted set of procedures to be forwarded over S1-MME and further used by the eNB as "SIPTO correlation id" for correlation purposes between the collocated L-GW and the eNB;
- triggering SIPTO@LN PDN connection release by the collocated L-GW after a handover is performed, as specified in TS 23.401 [17].

In case of SIPTO@LN with collocated L-GW support, the MME supports the following additional functions:

- SIPTO@LN activation for the requested APN based on SIPTO permissions in the subscription data and received collocated L-GW IP address;
- transfer of the "SIPTO correlation id" to the eNB via the initial context setup procedure and E-RAB setup procedure;
- release of the SIPTO@LN PDN connection of an idle-mode UE when the UE moves away from the coverage area of the eNB, as specified in TS 23.401 [17].

4.8.3 Support for SIPTO@LN with Stand-Alone Gateway

SIPTO@LN is supported using a stand-alone gateway (with co-located S-GW and L-GW) deployed in the local network. The MME may decide to trigger S-GW relocation without UE mobility, as specified in TS 23.401 [17]. Mobility for the SIPTO@LN PDN connection is not supported in this release: the SIPTO@LN PDN connection shall be released after handover, unless the source and target eNBs are in the same LHN (i.e. they have the same LHN ID), as specified in TS 23.401 [17].

In case of SIPTO@LN support with stand-alone gateway, the eNB supports the following additional functions:

- signalling of its LHN ID to the MME in the INITIAL UE MESSAGE, UPLINK NAS TRANSPORT, HANDOVER NOTIFY and PATH SWITCH REQUEST messages;
- support for MME-triggered S-GW relocation without UE mobility through the E-RAB MODIFY REQUEST message.

In case of SIPTO@LN support with stand-alone gateway, the MME supports the following additional functions:

- SIPTO@LN PDN activation for the requested APN based on subscription data and received LHN ID;
- S-GW relocation without UE mobility.

4.9 Support for Dual Connectivity

4.9.1 General

E-UTRAN supports Dual Connectivity (DC) operation whereby a multiple Rx/Tx UE in RRC_CONNECTED is configured to utilise radio resources provided by two distinct schedulers, located in two eNBs connected via a non-ideal backhaul over the X2 interface (see TR 36.842 [59] and TR 36.932 [60]). The overall E-UTRAN architecture as specified in section 4 and depicted in Figure 4-1 is applicable for DC as well. eNBs involved in DC for a certain UE may assume two different roles: an eNB may either act as an MeNB or as an SeNB. In DC a UE is connected to one MeNB and one SeNB.

4.9.2 Radio Protocol Architecture

In DC, the radio protocol architecture that a particular bearer uses depends on how the bearer is setup. Three bearer types exist: MCG bearer, SCG bearer and split bearer. Those three bearer types are depicted on Figure 4.9.2-1 below. RRC is located in MeNB and SRBs are always configured as MCG bearer type and therefore only use the radio resources of the MeNB.

NOTE: DC can also be described as having at least one bearer configured to use radio resources provided by the SeNB.

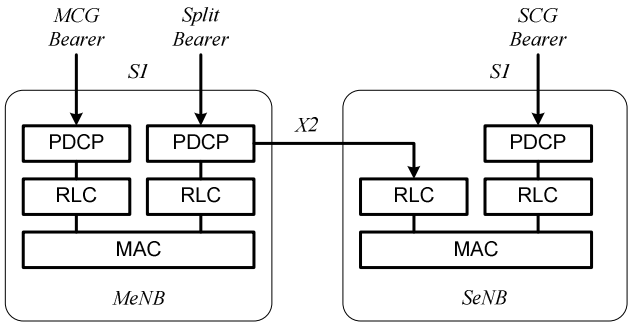


Figure 4.9.2-1: Radio Protocol Architecture for Dual Connectivity

4.9.3 Network Interfaces

4.9.3.1 E-UTRAN Control Plane for Dual Connectivity

Inter-eNB control plane signalling for DC is performed by means of X2 interface signalling. Control plane signalling towards the MME is performed by means of S1 interface signalling.

There is only one S1-MME connection per DC UE between the MeNB and the MME. Each eNB should be able to handle UEs independently, i.e. provide the PCell to some UEs while providing SCell(s) for SCG to others. Each eNB involved in DC for a certain UE controls its radio resources and is primarily responsible for allocating radio resources of its cells. Respective coordination between MeNB and SeNB is performed by means of X2 interface signalling.

Figure 4.9.3.1-1 shows C-plane connectivity of eNBs involved in DC for a certain UE: the S1-MME is terminated in MeNB and the MeNB and the SeNB are interconnected via X2-C.

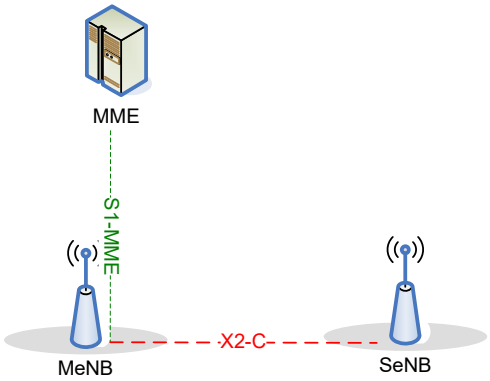


Figure 4.9.3.1-1: C-Plane connectivity of eNBs involved in Dual Connectivity

4.9.3.2 E-UTRAN User Plane for Dual Connectivity

For dual connectivity two different user plane architectures are allowed: one in which the S1-U only terminates in the MeNB and the user plane data is transferred from MeNB to SeNB using the X2-U, and a second architecture where the S1-U can terminate in the SeNB. Figure 4.9.3.2-1 shows different U-plane connectivity options of eNBs involved in DC for a certain UE.

Different bearer options can be configured with different user plane architectures. U-plane connectivity depends on the bearer option configured:

- For MCG bearers, the S1-U connection for the corresponding bearer(s) to the S-GW is terminated in the MeNB. The SeNB is not involved in the transport of user plane data for this type of bearer(s) over the Uu.
- For split bearers, the S1-U connection to the S-GW is terminated in the MeNB. PDCP data is transferred between the MeNB and the SeNB via X2-U. The SeNB and MeNB are involved in transmitting data of this bearer type over the Uu.
- For SCG bearers, the SeNB is directly connected with the S-GW via S1-U. The MeNB is not involved in the transport of user plane data for this type of bearer(s) over the Uu.

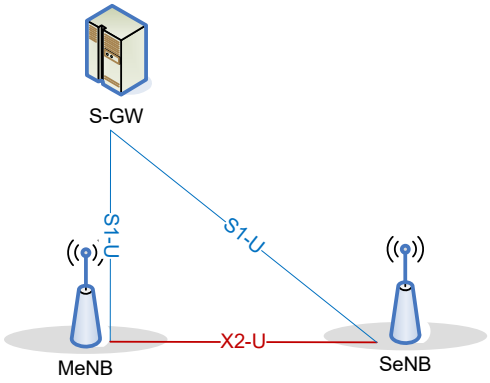


Figure 4.9.3.2-1: U-Plane connectivity of eNBs involved in Dual Connectivity

NOTE: if only MCG and split bearers are configured, there is no S1-U termination in the SeNB.

5 Physical Layer for E-UTRA

Downlink and uplink transmissions are organized into radio frames with 10 ms duration. Two radio frame structures are supported:

- Type 1, applicable to FDD;
- Type 2, applicable to TDD.

Frame structure Type 1 is illustrated in Figure 5.1-1. Each 10 ms radio frame is divided into ten equally sized sub-frames. Each sub-frame consists of two equally sized slots. For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain.

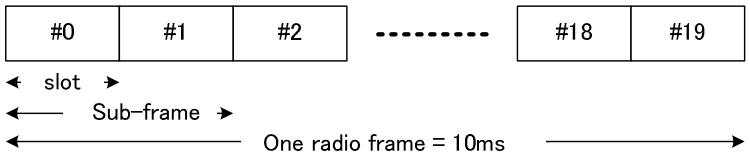


Figure 5.1-1: Frame structure type 1

Frame structure Type 2 is illustrated in Figure 5.1-2. Each 10 ms radio frame consists of two half-frames of 5 ms each. Each half-frame consists of eight slots of length 0.5 ms and three special fields: DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is configurable subject to the total length of DwPTS, GP and UpPTS being equal to 1ms. Both 5ms and 10ms switch-point periodicity are supported. Subframe 1 in all configurations and subframe 6 in configuration with 5ms switch-point periodicity consist of DwPTS, GP and UpPTS. Subframe 6 in configuration with 10ms switch-point periodicity consists of DwPTS only. All other subframes consist of two equally sized slots.

For TDD, GP is reserved for downlink to uplink transition. Other Subframes/Fields are assigned for either downlink or uplink transmission. Uplink and downlink transmissions are separated in the time domain.

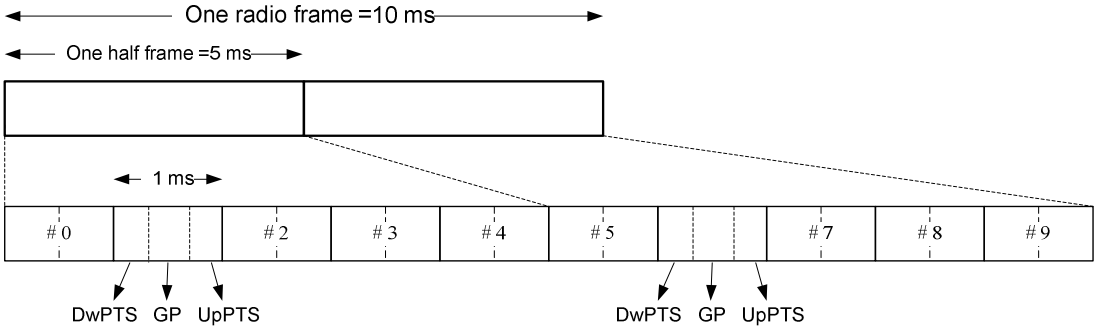


Figure 5.1-2: Frame structure type 2 (for 5ms switch-point periodicity)

Table 5.1-1: Uplink-downlink allocations.

Configuration	Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Sidelink transmissions are defined for sidelink discovery and sidelink communication between UEs. The sidelink transmissions use the same frame structure as the frame structure that is defined for uplink and downlink when UEs are in network coverage; however, the sidelink transmission are restricted to a sub-set of the uplink resources in time and frequency domain.

The physical channels of E-UTRA are:

Physical broadcast channel (PBCH)

- The coded BCH transport block is mapped to four subframes within a 40 ms interval;
- 40 ms timing is blindly detected, i.e. there is no explicit signalling indicating 40 ms timing;
- Each subframe is assumed to be self-decodable, i.e. the BCH can be decoded from a single reception, assuming sufficiently good channel conditions.

Physical control format indicator channel (PCFICH)

- Informs the UE and the RN about the number of OFDM symbols used for the PDCCHs;
- Transmitted in every downlink or special subframe.

Physical downlink control channel (PDCCH)

- Informs the UE and the RN about the resource allocation of PCH and DL-SCH, and Hybrid ARQ information related to DL-SCH;
- Carries the uplink scheduling grant;
- Carries the sidelink scheduling grant.

Enhanced physical downlink control channel (EPDCCH)

- Informs the UE about the resource allocation of DL-SCH, and Hybrid ARQ information related to DL-SCH;
- Carries the uplink scheduling grant;
- Carries the sidelink scheduling grant.

Physical Hybrid ARQ Indicator Channel (PHICH)

- Carries Hybrid ARQ ACK/NAKs in response to uplink transmissions.

Physical downlink shared channel (PDSCH)

- Carries the DL-SCH and PCH.

Physical multicast channel (PMCH)

- Carries the MCH.

Physical uplink control channel (PUCCH)

- Carries Hybrid ARQ ACK/NAKs in response to downlink transmission;
- Carries Scheduling Request (SR);
- Carries CSI reports.

Physical uplink shared channel (PUSCH)

- Carries the UL-SCH.

Physical random access channel (PRACH)

- Carries the random access preamble.

Relay physical downlink control channel (R-PDCCH)

- Informs the RN about the resource allocation of DL-SCH, and Hybrid ARQ information related to DL-SCH;
- Carries the uplink scheduling grant.

Physical sidelink broadcast channel (PSBCH)

- Carries system and synchronization related information, transmitted from the UE.

Physical sidelink discovery channel (PSDCH)

- Carries sidelink discovery message from the UE.

Physical sidelink control channel (PSCCH)

- Carries control from a UE for sidelink communication.

Physical sidelink shared channel (PSSCH)

- Carries data from a UE for sidelink communication.

5.1 Downlink Transmission Scheme

5.1.1 Basic transmission scheme based on OFDM

The downlink transmission scheme is based on conventional OFDM using a cyclic prefix. The OFDM sub-carrier spacing is Δf = 15 kHz. 12 consecutive sub-carriers during one slot correspond to one downlink *resource block*. In the frequency domain, the number of resource blocks, N_{RB}, can range from $N_{RB\text{-}min}$ = 6 to $N_{RB\text{-}max}$ = 110 per CC or per Cell in case of CA or DC.

In addition there is also a reduced sub-carrier spacingΔf_{low} = 7.5 kHz, only for MBMS-dedicated cell.

In the case of 15 kHz sub-carrier spacing there are two cyclic-prefix lengths, corresponding to seven and six OFDM symbols per slot respectively.

- Normal cyclic prefix: T_{CP} = 160×Ts (OFDM symbol #0) , T_{CP} = 144×Ts (OFDM symbol #1 to #6)
- Extended cyclic prefix: $T_{CP\text{-}e}$ = 512×Ts (OFDM symbol #0 to OFDM symbol #5)

  where $T_s = 1/(2048 \times \Delta f)$

In case of 7.5 kHz sub-carrier spacing, there is only a single cyclic prefix length $T_{CP\text{-}low}$ = 1024×Ts, corresponding to 3 OFDM symbols per slot.

In case of FDD, operation with half duplex from UE point of view is supported.

5.1.2 Physical-layer processing

The downlink physical-layer processing of transport channels consists of the following steps:

- CRC insertion: 24 bit CRC for PDSCH;
- Channel coding: Turbo coding based on QPP inner interleaving with trellis termination;
- Physical-layer hybrid-ARQ processing;
- Channel interleaving;
- Scrambling: transport-channel specific scrambling on DL-SCH, BCH, and PCH. Common MCH scrambling for all cells involved in a specific MBSFN transmission;
- Modulation: QPSK, 16QAM, 64QAM, and 256QAM;
- Layer mapping and pre-coding;

- Mapping to assigned resources and antenna ports.

5.1.3 Physical downlink control channels

The downlink control signalling (PDCCH) is located in the first n OFDM symbols where $n \leq 4$ and consists of:

- Transport format and resource allocation related to DL-SCH and PCH, and hybrid ARQ information related to DL-SCH;
- Transport format, resource allocation, and hybrid-ARQ information related to UL-SCH;
- Resource allocation information related to SL-SCH and PSCCH.

Transmission of control signalling from these groups is mutually independent.

Multiple physical downlink control channels are supported and a UE monitors a set of control channels.

Control channels are formed by aggregation of control channel elements, each control channel element consisting of a set of resource elements. Different code rates for the control channels are realized by aggregating different numbers of control channel elements.

QPSK modulation is used for all control channels.

Each separate control channel has its own set of x-RNTI.

There is an implicit relation between the uplink resources used for dynamically scheduled data transmission, or the DL control channel used for assignment, and the downlink ACK/NAK resource used for feedback.

The physical layer supports R-PDCCH for the relay.

The enhanced physical downlink control channel (EPDCCH) carries UE-specific signalling. It is located in UE-specifically configured physical resource blocks and consists of:

- Transport format, resource allocation, and hybrid ARQ information related to DL-SCH;
- Transport format, resource allocation, and hybrid-ARQ information related to UL-SCH;
- Resource allocation information related to SL-SCH and PSCCH.

Multiple EPDCCHs are supported and a UE monitors a set of EPDCCHs.

EPDCCHs are formed by aggregation of enhanced control channel elements, each enhanced control channel element consisting of a set of resource elements. Different code rates for EPDCCHs are realized by aggregating different numbers of enhanced control channel elements. An EPDCCH can use either localized or distributed transmission, differing in the mapping of enhanced control channel elements to the resource elements in the PRBs.

EPDCCH supports C-RNTI and SPS C-RNTI and SL-RNTI. If configured, EPDCCH is applicable in the same way as PDCCH unless otherwise specified.

5.1.4 Downlink Reference signal and synchronization signals

The downlink cell-specific reference signals consist of known reference symbols inserted in the first and third last OFDM symbol of each slot for antenna port 0 and 1. There is one cell-specific reference signal transmitted per downlink antenna port. The number of downlink antenna ports for the transmission of cell-specific reference signals equals 1, 2, or 4.

Physical layer provides 504 unique cell identities using Synchronization signals.

The downlink MBSFN reference signals consist of known reference symbols inserted every other sub-carrier in the 3rd, 7th and 11th OFDM symbol of sub-frame in case of 15kHz sub-carrier spacing and extended cyclic prefix.

In addition to cell-specific reference signals and MBSFN reference signals, the physical layer supports UE-specific reference signals, positioning reference signals, CSI reference signals, and discovery signals.

A UE may assume presence of the discovery signals consisting of cell-specific reference signals, primary and secondary synchronization signals, and configurable CSI reference signals.

5.1.5 Downlink multi-antenna transmission

Multi-antenna transmission with up to 8 transmit antennas is supported. The maximum number of codeword is two irrespective to the number of antennas with fixed mapping between code words to layers.

Spatial division multiplexing (SDM) of multiple modulation symbol streams to a single UE using the same time-frequency (-code) resource, also referred to as Single-User MIMO (SU-MIMO) is supported. When a MIMO channel is solely assigned to a single UE, it is known as SU-MIMO. Spatial division multiplexing of modulation symbol streams to different UEs using the same time-frequency resource, also referred to as MU-MIMO, is also supported.

In addition, the following techniques are supported:

- Code-book-based pre-coding with a single pre-coding feedback per full system bandwidth when the system bandwidth (or subset of resource blocks) is smaller or equal to12RB and per 5 adjacent resource blocks or the full system bandwidth (or subset of resource blocks) when the system bandwidth is larger than 12RB.
- Non-code-book-based pre-coding with or without pre-coding feedback.
- Rank adaptation with single rank feedback referring to full system bandwidth. Node B can override rank report.

5.1.6 MBSFN transmission

MBSFN is supported for the MCH transport channel. Multiplexing of transport channels using MBSFN and non-MBSFN transmission is done on a per-sub-frame basis. Additional reference symbols, transmitted using MBSFN are transmitted within MBSFN subframes.

5.1.7 Physical layer procedure

5.1.7.1 Link adaptation

Link adaptation (AMC: adaptive modulation and coding) with various modulation schemes and channel coding rates is applied to the shared data channel. The same coding and modulation is applied to all groups of resource blocks belonging to the same L2 PDU scheduled to one user within one TTI and within a single stream.

5.1.7.2 Power Control

Downlink power control can be used.

5.1.7.3 Cell search

Cell search is the procedure by which a UE acquires time and frequency synchronization with a cell and detects the Cell ID of that cell. E-UTRA cell search supports a scalable overall transmission bandwidth corresponding to 72 sub-carriers and upwards.

E-UTRA cell search is based on following signals transmitted in the downlink: the primary and secondary synchronization signals.

The primary and secondary synchronization signals are transmitted over the centre 72 sub-carriers in the first and sixth subframe of each frame.

Neighbour-cell search is based on the same downlink signals as initial cell search.

5.1.8 Physical layer measurements definition

The physical layer measurements to support mobility are classified as:

- within E-UTRAN (intra-frequency, inter-frequency);
- between E-UTRAN and GERAN/UTRAN (inter-RAT);
- between E-UTRAN and non-3GPP RAT (Inter 3GPP access system mobility);

For measurements within E-UTRAN two basic UE measurement quantities shall be supported:

- Reference signal received power (RSRP);

- Reference signal received quality (RSRQ).

RSRP measurement is based on the following signals:

- Cell-specific reference signals; or
- CSI reference signals in configured discovery signals.

5.1.9 Coordinated Multi-Point transmission

For DL CoMP, multiple transmission points are coordinated in their downlink data transmission.

The UE may be configured to measure and report the CSI of a set of non-zero power CSI-RS resources.

The UE may also be configured with one or more interference measurements. Each interference measurement is associated with one CSI-interference measurement (CSI-IM) resource, which is a set of REs on which the UE measures interference.

The UE may also be configured with multiple CSI processes. Each CSI process defines the CSI measurement associated with one non-zero power CSI-RS resource and one CSI-IM resource.

5.2 Uplink Transmission Scheme

5.2.1 Basic transmission scheme

For both FDD and TDD, the uplink transmission scheme is based on single-carrier FDMA, more specifically DFTS-OFDM. It also supports multi-cluster assignment of DFTS-OFDM.

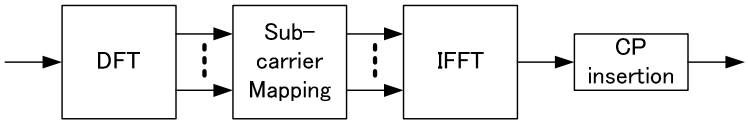


Figure 5.2.1-1: Transmitter scheme of SC-FDMA

The uplink sub-carrier spacing Δf = 15 kHz. The sub-carriers are grouped into sets of 12 consecutive sub-carriers, corresponding to the uplink resource blocks. 12 consecutive sub-carriers during one slot correspond to one uplink *resource block*. In the frequency domain, the number of resource blocks, N_{RB}, can range from $N_{RB\text{-}min}$ = 6 to $N_{RB\text{-}max}$ = 110 per carrier or per CC in case of CA or DC.

There are two cyclic-prefix lengths defined: Normal cyclic prefix and extended cyclic prefix corresponding to seven and six SC-FDMA symbol per slot respectively.

- Normal cyclic prefix: T_{CP} = 160×Ts (SC-FDMA symbol #0) , T_{CP} = 144×Ts (SC-FDMA symbol #1 to #6)
- Extended cyclic prefix: $T_{CP\text{-}e}$ = 512×Ts (SC-FDMA symbol #0 to SC-FDMA symbol #5)

5.2.2 Physical-layer processing

The uplink physical layer processing of transport channels consists of the following steps:

- CRC insertion: 24 bit CRC for PUSCH;
- Channel coding: turbo coding based on QPP inner interleaving with trellis termination;
- Physical-layer hybrid-ARQ processing;
- Scrambling: UE-specific scrambling;
- Modulation: QPSK, 16QAM, and 64QAM (64 QAM optional in UE);
- Mapping to assigned resources and antennas ports.

5.2.3 Physical uplink control channel

The PUCCH shall be mapped to a control channel resource in the uplink.

Depending on presence or absence of uplink timing synchronization, the uplink physical control signalling for scheduling request can differ.

In the case of time synchronization being present for the pTAG, the outband control signalling consists of:

- CSI;
- ACK/NAK;
- Scheduling Request (SR).

The CSI informs the scheduler about the current channel conditions as seen by the UE. If MIMO transmission is used, the CSI includes necessary MIMO-related feedback.

The HARQ feedback in response to downlink data transmission consists of a single ACK/NAK bit per transport block in case of non-bundling configuration.

PUCCH resources for SR and CSI reporting are assigned and can be revoked through RRC signalling. An SR is not necessarily assigned to UEs acquiring synchronization through the RACH (i.e. synchronised UEs may or may not have a dedicated SR channel). PUCCH resources for SR and CSI are lost when the UE is no longer synchronized.

PUCCH is transmitted on PCell only in carrier aggregation.

PUCCH is transmitted on PCell and PSCell in DC.

The physical layer supports simultaneous transmission of PUCCH and PUSCH.

5.2.4 Uplink Reference signal

For PUSCH demodulation, uplink demodulation reference signals are transmitted in the 4-th block of the slot in normal CP. Uplink demodulation reference signals are also transmitted for PUCCH demodulation. The uplink demodulation reference signals sequence length equals the size (number of sub-carriers) of the assigned resource.

The uplink reference signals are based on sequences having constant amplitude and zero autocorrelation.

Multiple reference signals can be created:

- Based on different base sequences;
- Different shifts of the same sequence;
- Different orthogonal sequences (OCC) on DM RS.

In addition to demodulation reference signals, the physical layer supports sounding reference signals (SRS).

5.2.5 Random access preamble

The physical layer random access burst consists of a cyclic prefix, a preamble, and a guard time during which nothing is transmitted.

The random access preambles are generated from Zadoff-Chu sequences with zero correlation zone, ZC-ZCZ, generated from one or several root Zadoff-Chu sequences.

5.2.6 Uplink multi-antenna transmission

The antenna configuration for uplink supports both SU-MIMO and MU-MIMO.

Closed loop and open loop types of adaptive antenna selection transmit diversity are supported for both FDD and TDD by physical layer.

The physical layer supports transmit diversity of some control formats.

5.2.7 Physical channel procedure

5.2.7.1 Link adaptation

Uplink link adaptation is used in order to guarantee the required minimum transmission performance of each UE such as the user data rate, packet error rate, and latency, while maximizing the system throughput.

Three types of link adaptation are performed according to the channel conditions, the UE capability such as the maximum transmission power and maximum transmission bandwidth etc., and the required QoS such as the data rate, latency, and packet error rate etc. Three link adaptation methods are as follows.

- Adaptive transmission bandwidth;
- Transmission power control;
- Adaptive modulation and channel coding rate.

5.2.7.2 Uplink Power control

Intra-cell power control: the power spectral density of the uplink transmissions can be influenced by the eNB. For DC, two types of power control modes are defined, mode 1 and mode 2 as specified in TS 36.213 [6]. A UE capable of DC supports at least power control mode 1 and the UE may additionally support power control mode 2. In both modes, the UE is configured with a minimum guaranteed power for each CG, as a ratio of the configured maximum UE output power Pcmax (see TS 36.101 [52]). In power control mode 1, UE allocates up to the minimum guaranteed power to each CG and any remaining power is shared across MCG and SCG on a per transmission basis according to a priority order based on UCI type. In power control mode 2, the UE reserves the minimum guaranteed power to each CG and any remaining power is first made available to the CG where transmission starts the earliest in time.

5.2.7.3 Uplink timing control

The timing advance is derived from the UL received timing and sent by the eNB to the UE which the UE uses to advance/delay its timings of transmissions to the eNB so as to compensate for propagation delay and thus time align the transmissions from different UEs with the receiver window of the eNB.

The timing advance command for each TAG is on a per need basis with a granularity in the step size of 0.52 μs ($16 \times T_s$).

5.2.8 Coordinated Multi-Point reception

For UL CoMP, multiple reception points are coordinated in their uplink data reception.

The UE may be configured with UE-specific parameters of PUSCH DMRS sequence and cyclic shift hopping, PUCCH sequence, and PUCCH region for hybrid-ARQ feedback. These UE-specific parameters can be configured independently of the physical cell identity of the UE's serving cell.

5.3 Transport Channels

The physical layer offers information transfer services to MAC and higher layers. The physical layer transport services are described by *how* and with what characteristics data are transferred over the radio interface. An adequate term for this is "Transport Channel".

NOTE: This should be clearly separated from the classification of *what* is transported, which relates to the concept of logical channels at MAC sublayer.

Downlink transport channel types are:

1. **Broadcast Channel (BCH)** characterised by:
   - fixed, pre-defined transport format;
   - requirement to be broadcast in the entire coverage area of the cell.
2. **Downlink Shared Channel (DL-SCH)** characterised by:
   - support for HARQ;

- support for dynamic link adaptation by varying the modulation, coding and transmit power;
- possibility to be broadcast in the entire cell;
- possibility to use beamforming;
- support for both dynamic and semi-static resource allocation;
- support for UE discontinuous reception (DRX) to enable UE power saving;

NOTE: the possibility to use slow power control depends on the physical layer.

3. **Paging Channel (PCH)** characterised by:
   - support for UE discontinuous reception (DRX) to enable UE power saving (DRX cycle is indicated by the network to the UE);
   - requirement to be broadcast in the entire coverage area of the cell;
   - mapped to physical resources which can be used dynamically also for traffic/other control channels.
4. **Multicast Channel (MCH)** characterised by:
   - requirement to be broadcast in the entire coverage area of the cell;
   - support for MBSFN combining of MBMS transmission on multiple cells;
   - support for semi-static resource allocation e.g. with a time frame of a long cyclic prefix.

Uplink transport channel types are:

1. **Uplink Shared Channel (UL-SCH)** characterised by:
   - possibility to use beamforming; (likely no impact on specifications)
   - support for dynamic link adaptation by varying the transmit power and potentially modulation and coding;
   - support for HARQ;
   - support for both dynamic and semi-static resource allocation.

NOTE: the possibility to use uplink synchronisation and timing advance depend on the physical layer.

2. **Random Access Channel(s) (RACH)** characterised by:
   - limited control information;
   - collision risk.

NOTE: The possibility to use open loop power control depends on the physical layer solution.

Sidelink transport channel types are:

1. **Sidelink broadcast channel (SL-BCH)** characterised by:
   - pre-defined transport format.
2. **Sidelink discovery channel (SL-DCH)** characterised by:
   - fixed size, pre-defined format periodic broadcast transmission;
   - support for both UE autonomous resource selection and scheduled resource allocation by eNB;
   - collision risk due to support of UE autonomous resource selection; no collision when UE is allocated dedicated resources by the eNB;
   - support for HARQ combining, but no support for HARQ feedback.

NOTE: the possibility to use uplink synchronisation and timing advance depends on the physical layer.

3. **Sidelink shared channel (SL-SCH)** characterised by:

   - support for broadcast transmission;
   - support for both UE autonomous resource selection and scheduled resource allocation by eNB;
   - collision risk due to support of UE autonomous resource selection; no collision when UE is allocated dedicated resources by the eNB;
   - support for HARQ combining, but no support for HARQ feedback;
   - support for dynamic link adaptation by varying the transmit power, modulation and coding.

NOTE: the possibility to use uplink synchronisation and timing advance depend on the physical layer.

5.3.1 Mapping between transport channels and physical channels

The figures below depict the mapping between transport and physical channels:

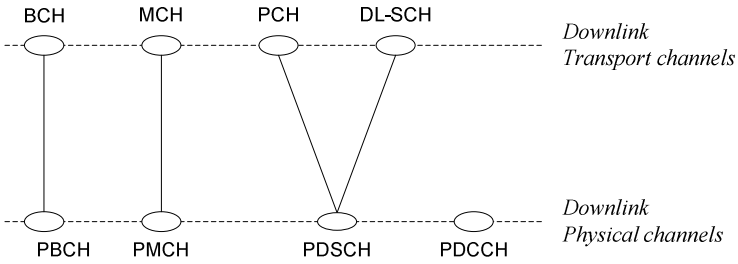


Figure 5.3.1-1: Mapping between downlink transport channels and downlink physical channels

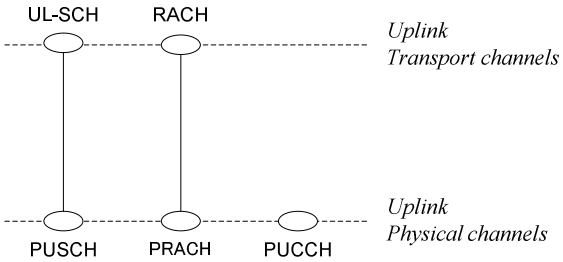


Figure 5.3.1-2: Mapping between uplink transport channels and uplink physical channels

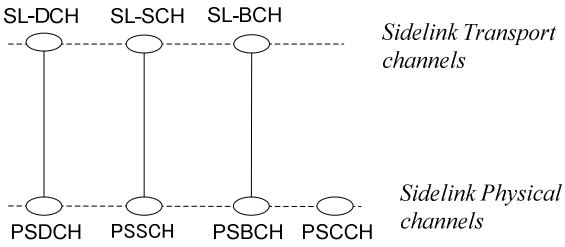


Figure 5.3.1-3: Mapping between sidelink transport channels and sidelink physical channels

5.4 E-UTRA physical layer model

The E-UTRAN physical layer model is captured in TS 36.302 [9].

5.4.1 Void

5.4.2 Void

5.5 Carrier Aggregation

In Carrier Aggregation (CA), two or more Component Carriers (CCs) are aggregated in order to support wider transmission bandwidths up to 100MHz. A UE may simultaneously receive or transmit on one or multiple CCs depending on its capabilities:

- A UE with single timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells sharing the same timing advance (multiple serving cells grouped in one TAG);
- A UE with multiple timing advance capability for CA can simultaneously receive and/or transmit on multiple CCs corresponding to multiple serving cells with different timing advances (multiple serving cells grouped in multiple TAGs). E-UTRAN ensures that each TAG contains at least one serving cell;
- A non-CA capable UE can receive on a single CC and transmit on a single CC corresponding to one serving cell only (one serving cell in one TAG).

CA is supported for both contiguous and non-contiguous CCs with each CC limited to a maximum of 110 Resource Blocks in the frequency domain using the Rel-8/9 numerology.

CA is supported both between same and different duplex CCs.

It is possible to configure a UE to aggregate a different number of CCs originating from the same eNB and of possibly different bandwidths in the UL and the DL:

- The number of DL CCs that can be configured depends on the DL aggregation capability of the UE;
- The number of UL CCs that can be configured depends on the UL aggregation capability of the UE;
- It is not possible to configure a UE with more UL CCs than DL CCs;
- In typical TDD deployments, the number of CCs and the bandwidth of each CC in UL and DL is the same.
- The number of TAGs that can be configured depends on the TAG capability of the UE.

CCs originating from the same eNB need not to provide the same coverage.

CCs shall be LTE Rel-8/9 compatible. Nevertheless, existing mechanisms (e.g. barring) may be used to avoid Rel-8/9 UEs to camp on a CC.

The spacing between centre frequencies of contiguously aggregated CCs shall be a multiple of 300 kHz. This is in order to be compatible with the 100 kHz frequency raster of Rel-8/9 and at the same time preserve orthogonality of the subcarriers with 15 kHz spacing. Depending on the aggregation scenario, the $n \times 300$ kHz spacing can be facilitated by insertion of a low number of unused subcarriers between contiguous CCs.

For TDD CA, the downlink/uplink configuration is identical across component carriers in the same band and may be the same or different across component carriers in different bands.

5.6 Sidelink

Sidelink comprises sidelink discovery and sidelink communication between UEs. Sidelink uses uplink resources and physical channel structure similar to uplink transmissions. However, some changes, noted below, are made to the physical channels.

5.6.1 Basic transmission scheme

Sidelink transmission uses the same basic transmission scheme as the UL transmission scheme. However, sidelink is limited to single cluster transmissions for all the sidelink physical channels. Further, sidelink uses a 1 symbol gap at the end of each sidelink sub-frame.

5.6.2 Physical-layer processing

The sidelink physical layer processing of transport channels differs from UL transmission in the following steps:

- Scrambling: for PSDCH and PSCCH, the scrambling is not UE-specific;
- Modulation: 64 QAM is not supported for sidelink.

5.6.3 Physical Sidelink control channel

PSCCH is mapped to the sidelink control resources.

PSCCH indicates resource and other transmission parameters used by a UE for PSSCH.

5.6.4 Sidelink reference signals

For PSDCH, PSCCH and PSSCH demodulation, reference signals similar to uplink demodulation reference signals are transmitted in the 4-th symbol of the slot in normal CP and in the 3rd symbol of the slot in extended cyclic prefix. The sidelink demodulation reference signals sequence length equals the size (number of sub-carriers) of the assigned resource.

For PSDCH and PSCCH, reference signals are created based on a fixed base sequence, cyclic shift and orthogonal cover code.

5.6.5 Physical channel procedure

5.6.5.1 Sidelink power control

For in-coverage operation, the power spectral density of the sidelink transmissions can be influenced by the eNB.

5.6.6 Physical layer measurements definition

For measurement on the sidelink, one basic UE measurement quantity shall be supported:

- Sidelink reference signal received power (S-RSRP).

6 Layer 2

Layer 2 is split into the following sublayers: Medium Access Control (MAC), Radio Link Control (RLC) and Packet Data Convergence Protocol (PDCP).

This subclause gives a high level description of the Layer 2 sub-layers in terms of services and functions. The three figures below depict the PDCP/RLC/MAC architecture for downlink, uplink and Sidelink, where:

- Service Access Points (SAP) for peer-to-peer communication are marked with circles at the interface between sublayers. The SAP between the physical layer and the MAC sublayer provides the transport channels. The SAPs between the MAC sublayer and the RLC sublayer provide the logical channels.
- The multiplexing of several logical channels (i.e. radio bearers) on the same transport channel (i.e. transport block) is performed by the MAC sublayer;
- In both uplink and downlink, when CA or DC is not configured, only one transport block is generated per TTI in the absence of spatial multiplexing;
- In Sidelink, only one transport block is generated per TTI.

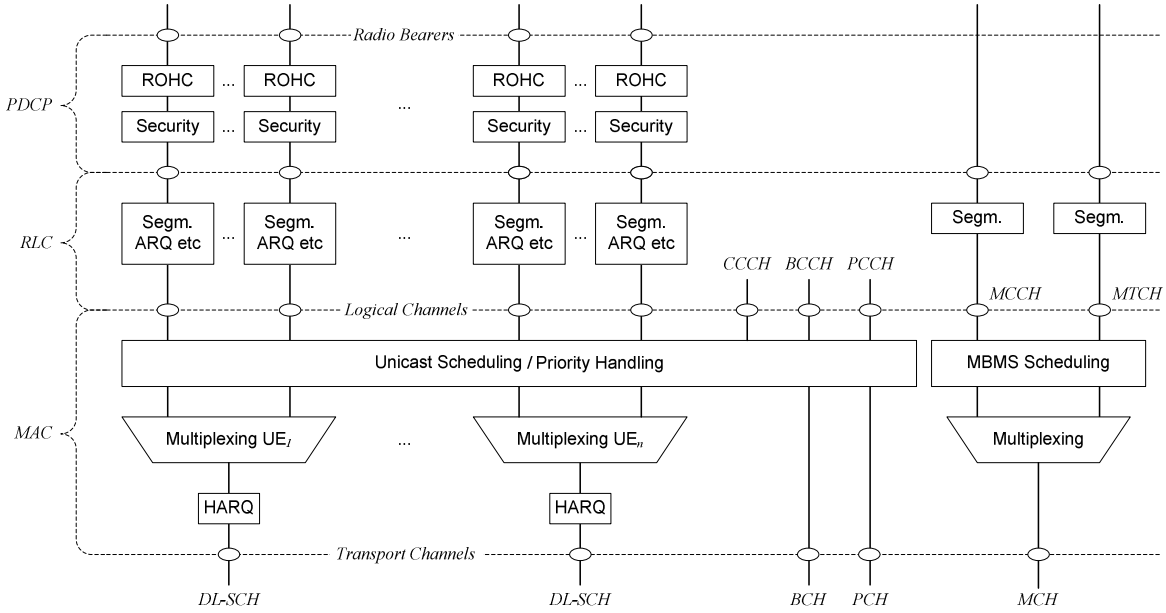


Figure 6-1: Layer 2 Structure for DL

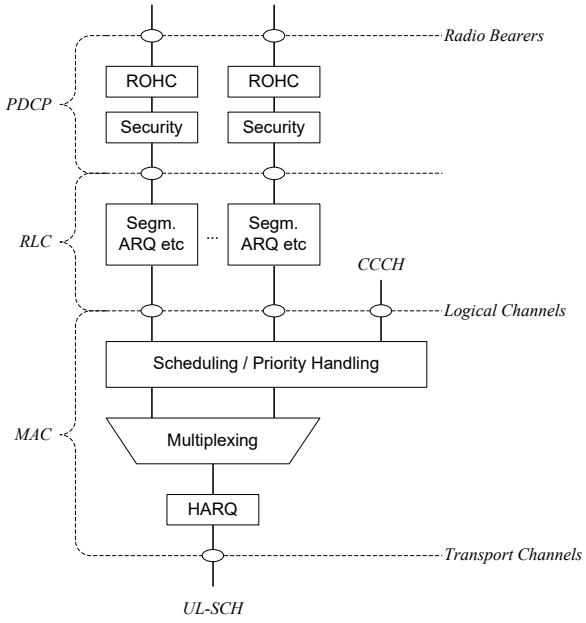


Figure 6-2: Layer 2 Structure for UL

NOTE: The eNB may not be able to guarantee that a L2 buffer overflow will never occur. If such overflow occurs, UE may discard packets in the L2 buffer.

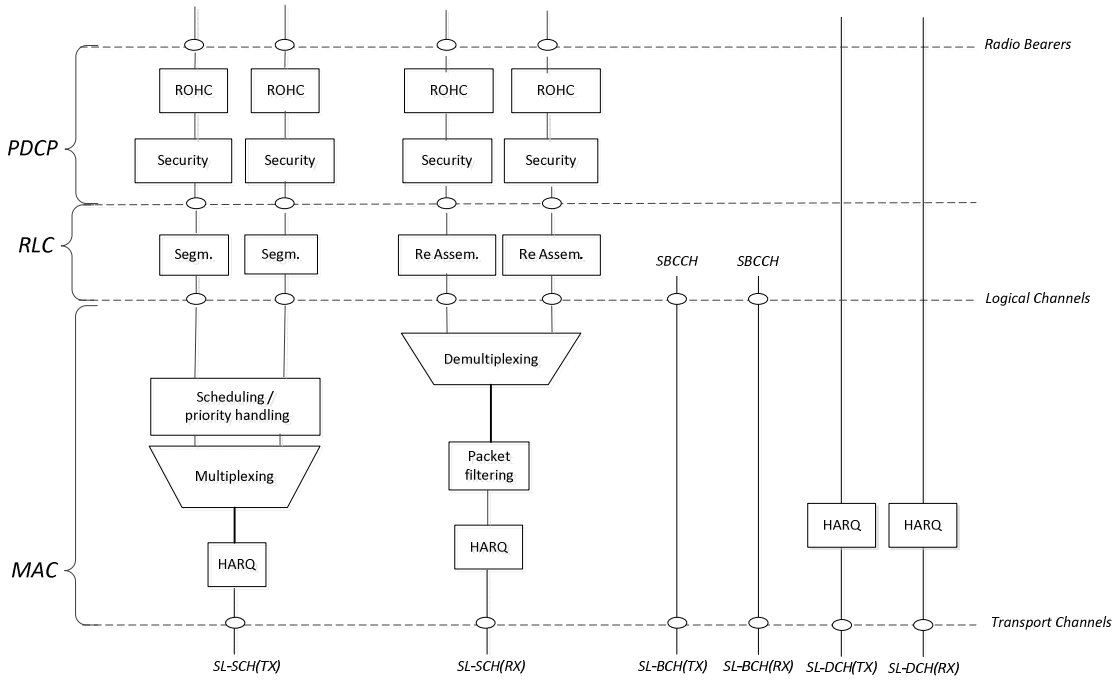


Figure 6-3: Layer 2 Structure for Sidelink

6.1 MAC Sublayer

This subclause provides an overview on services and functions provided by the MAC sublayer.

6.1.1 Services and Functions

The main services and functions of the MAC sublayer include:

- Mapping between logical channels and transport channels;
- Multiplexing/demultiplexing of MAC SDUs belonging to one or different logical channels into/from transport blocks (TB) delivered to/from the physical layer on transport channels;
- Scheduling information reporting;
- Error correction through HARQ;
- Priority handling between logical channels of one UE;
- Priority handling between UEs by means of dynamic scheduling;
- MBMS service identification;
- Transport format selection;
- Padding.

The sidelink specific services and functions of the MAC sublayer include:

- Radio resource selection;
- Packet filtering for sidelink communication.

6.1.2 Logical Channels

Different kinds of data transfer services as offered by MAC. Each logical channel type is defined by what type of information is transferred.

A general classification of logical channels is into two groups:

- Control Channels (for the transfer of control plane information);
- Traffic Channels (for the transfer of user plane information).

There is one MAC entity per CG. MAC generally consists of several function blocks (transmission scheduling functions, per UE functions, MBMS functions, MAC control functions, transport block generation…). Transparent Mode is only applied to BCCH, PCCH and SBCCH.

6.1.2.1 Control Channels

Control channels are used for transfer of control plane information only. The control channels offered by MAC are:

- **Broadcast Control Channel (BCCH)**

  A downlink channel for broadcasting system control information.

- **Paging Control Channel (PCCH)**

  A downlink channel that transfers paging information and system information change notifications. This channel is used for paging when the network does not know the location cell of the UE.

- **Common Control Channel (CCCH)**

  Channel for transmitting control information between UEs and network. This channel is used for UEs having no RRC connection with the network.

- **Multicast Control Channel (MCCH)**

  A point-to-multipoint downlink channel used for transmitting MBMS control information from the network to the UE, for one or several MTCHs. This channel is only used by UEs that receive or are interested to receive MBMS.

- **Dedicated Control Channel (DCCH)**

  A point-to-point bi-directional channel that transmits dedicated control information between a UE and the network. Used by UEs having an RRC connection.

- **Sidelink Broadcast Control Channel (SBCCH)**

  A sidelink channel for broadcasting sidelink system information from one UE to other UE(s). This channel is used only by sidelink communication capable UEs.

6.1.2.2 Traffic Channels

Traffic channels are used for the transfer of user plane information only. The traffic channels offered by MAC are:

- **Dedicated Traffic Channel (DTCH)**

  A Dedicated Traffic Channel (DTCH) is a point-to-point channel, dedicated to one UE, for the transfer of user information. A DTCH can exist in both uplink and downlink.

- **Multicast Traffic Channel (MTCH)**

  A point-to-multipoint downlink channel for transmitting traffic data from the network to the UE. This channel is only used by UEs that receive MBMS.

- **Sidelink Traffic Channel (STCH)**

  A Sidelink Traffic Channel (STCH) is a point-to-multipoint channel, for transfer of user information from one UE to other UEs. This channel is used only by sidelink communication capable UEs.

6.1.3 Mapping between logical channels and transport channels

6.1.3.1 Mapping in Uplink

The figure below depicts the mapping between uplink logical channels and uplink transport channels:

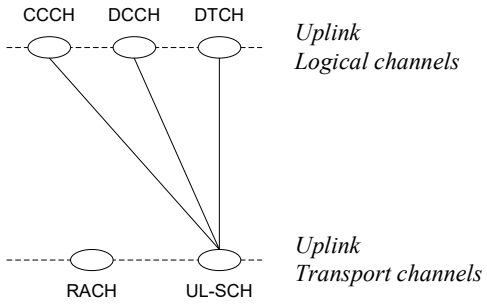


Figure 6.1.3.1-1: Mapping between uplink logical channels and uplink transport channels

In Uplink, the following connections between logical channels and transport channels exist:

- CCCH can be mapped to UL-SCH;
- DCCH can be mapped to UL- SCH;
- DTCH can be mapped to UL-SCH.

6.1.3.2 Mapping in Downlink

The figure below depicts the mapping between downlink logical channels and downlink transport channels:

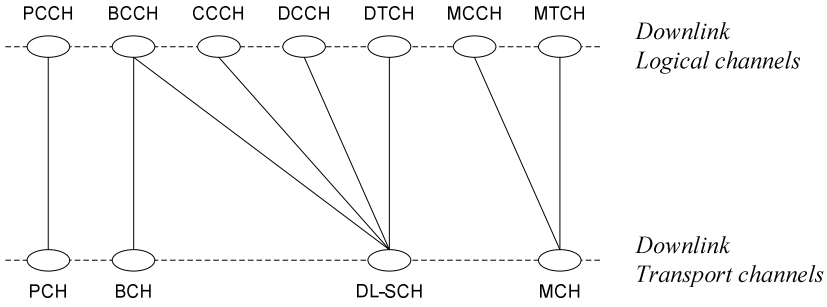


Figure 6.1.3.2-1: Mapping between downlink logical channels and downlink transport channels

In Downlink, the following connections between logical channels and transport channels exist:

- BCCH can be mapped to BCH;
- BCCH can be mapped to DL-SCH;
- PCCH can be mapped to PCH;
- CCCH can be mapped to DL-SCH;
- DCCH can be mapped to DL-SCH;
- DTCH can be mapped to DL-SCH;
- MTCH can be mapped to MCH;

- MCCH can be mapped to MCH.

6.1.3.3 Mapping in Sidelink

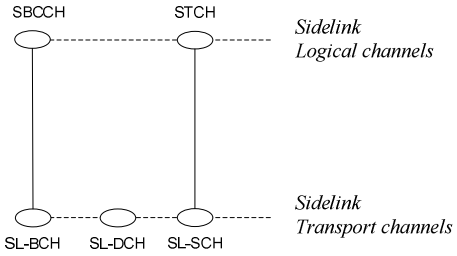


Figure 6.1.3.3-1: Mapping between Sidelink logical channels and Sidelink transport channels

In Sidelink, the following connections between logical channels and transport channels exist:

- STCH can be mapped to SL-SCH;
- SBCCH can be mapped to SL-BCH.

6.2 RLC Sublayer

This subclause provides an overview on services, functions and PDU structure provided by the RLC sublayer. Note that:

- The reliability of RLC is configurable: some radio bearers may tolerate rare losses (e.g. TCP traffic);
- Radio Bearers are not characterized by a fixed sized data unit (e.g. a fixed sized RLC PDU).

6.2.1 Services and Functions

The main services and functions of the RLC sublayer include:

- Transfer of upper layer PDUs;
- Error Correction through ARQ (only for AM data transfer);
- Concatenation, segmentation and reassembly of RLC SDUs (only for UM and AM data transfer);
- Re-segmentation of RLC data PDUs (only for AM data transfer);
- Reordering of RLC data PDUs (only for UM and AM data transfer);
- Duplicate detection (only for UM and AM data transfer);
- Protocol error detection (only for AM data transfer);
- RLC SDU discard (only for UM and AM data transfer);
- RLC re-establishment.

6.2.2 PDU Structure

Figure 6.2.2-1 below depicts the RLC PDU structure where:

- The PDU sequence number carried by the RLC header is independent of the SDU sequence number (i.e. PDCP sequence number);
- A red dotted line indicates the occurrence of segmentation;
- Because segmentation only occurs when needed and concatenation is done in sequence, the content of an RLC PDU can generally be described by the following relations:

- {0; 1} last segment of SDU_i + [0; n] complete SDUs + {0; 1} first segment of SDU_{i+n+1} ; or
- 1 segment of SDU_i .

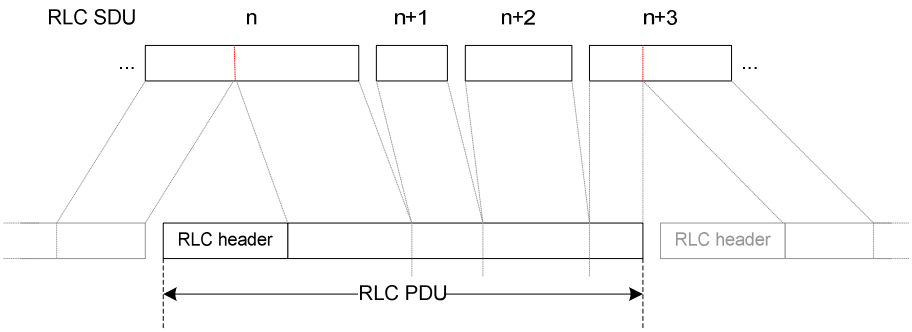


Figure 6.2.2-1: RLC PDU Structure

6.3 PDCP Sublayer

This subclause provides an overview on services, functions and PDU structure provided by the PDCP sublayer.

6.3.1 Services and Functions

The main services and functions of the PDCP sublayer for the user plane include:

- Header compression and decompression: ROHC only;
- Transfer of user data;
- In-sequence delivery of upper layer PDUs at PDCP re-establishment procedure for RLC AM;
- For split bearers in DC (only support for RLC AM): PDCP PDU routing for transmission and PDCP PDU reordering for reception;
- Duplicate detection of lower layer SDUs at PDCP re-establishment procedure for RLC AM;
- Retransmission of PDCP SDUs at handover and, for split bearers in DC, of PDCP PDUs at PDCP data-recovery procedure, for RLC AM;
- Ciphering and deciphering;
- Timer-based SDU discard in uplink.

NOTE: When compared to UTRAN, the *lossless DL RLC PDU size change* is not required.

The main services and functions of the PDCP for the control plane include:

- Ciphering and Integrity Protection;
- Transfer of control plane data.

6.3.2 PDU Structure

Figure 6.3.2-1 below depicts the PDCP PDU structure for user plane data, where:

- PDCP PDU and PDCP header are octet-aligned;
- PDCP header can be either 1 , 2 or 5 bytes long.

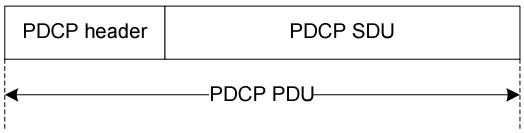


Figure 6.3.2-1: PDCP PDU Structure

The structures for control PDCP PDUs and for control plane PDCP data PDUs are specified in [15].

6.4 Carrier Aggregation

In case of CA, the multi-carrier nature of the physical layer is only exposed to the MAC layer for which one HARQ entity is required per serving cell;

- In both uplink and downlink, there is one independent hybrid-ARQ entity per serving cell and one transport block is generated per TTI per serving cell in the absence of spatial multiplexing. Each transport block and its potential HARQ retransmissions are mapped to a single serving cell.

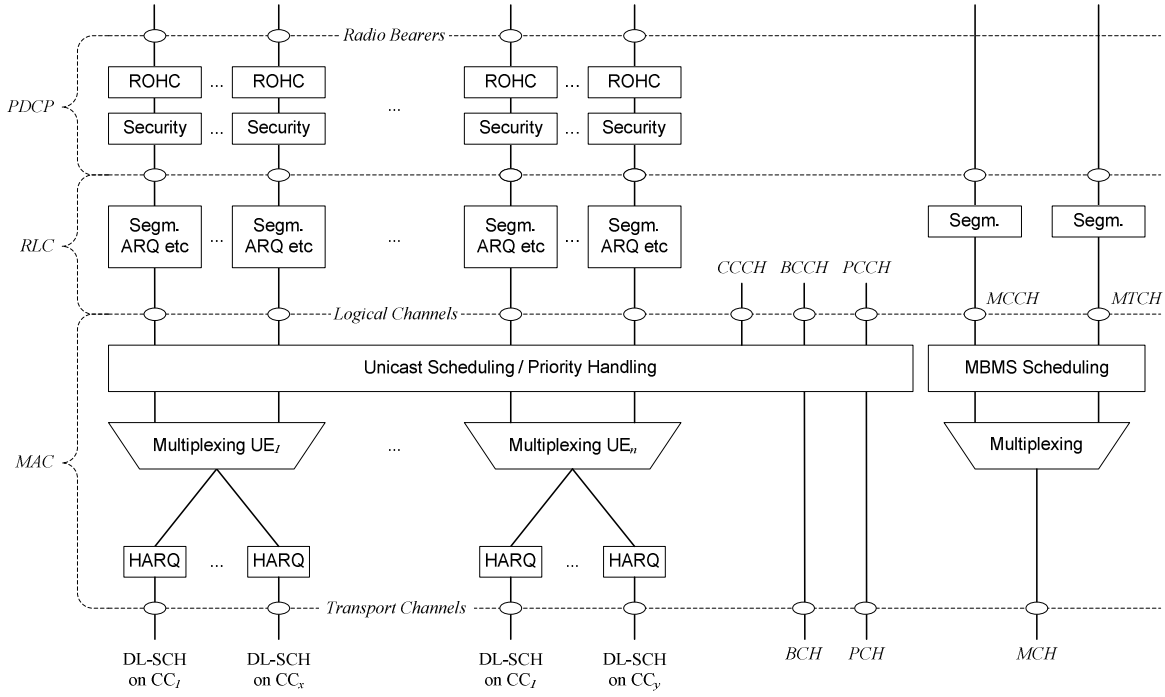


Figure 6.4-1: Layer 2 Structure for DL with CA configured

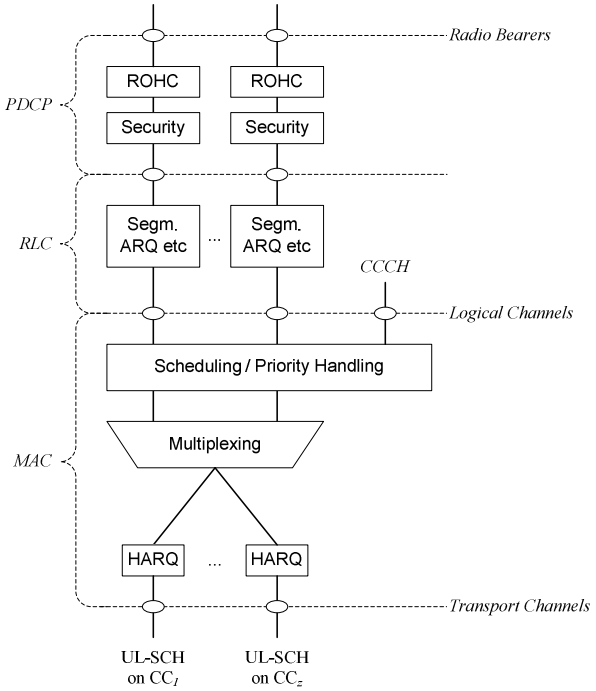


Figure 6.4-2: Layer 2 Structure for UL with CA configured

6.5 Dual Connectivity

In case of DC, the UE is configured with two MAC entities: one MAC entity for MeNB and one MAC entity for SeNB. Figure 6.5-1 below describes the layer 2 structure for the downlink when both CA and DC are configured. In order to simplify the figure, the BCH, PCH, MCH and corresponding logical channels are not included. Also, only UE_n is shown as having DC configured.

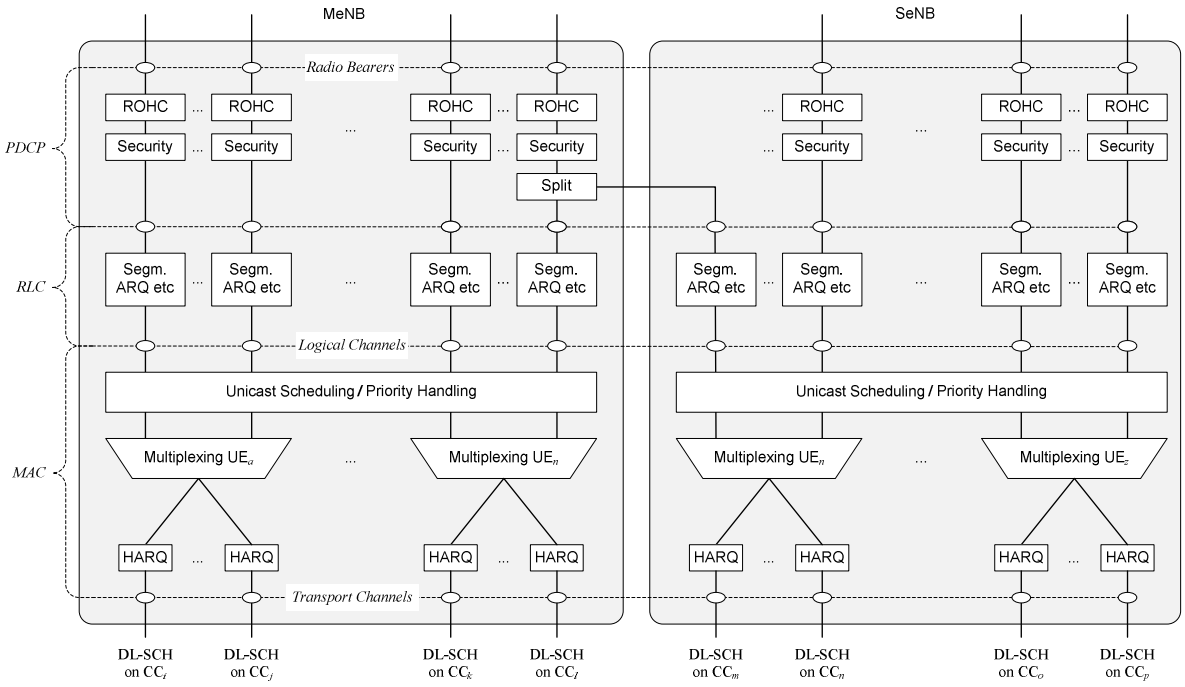


Figure 6.5-1: Layer 2 Structure for DL with CA and DC configured

Figure 6.5-2 below describes the layer 2 structure for the uplink when both CA and DC are configured. As explained in section 4.9.2, SRBs are always handled by the MeNB and as a result, CCCH is only shown for the MeNB. For a split bearer, UE is configured over which link the UE transmits UL PDCP PDUs by the MeNB. On the link which is not responsible for UL PDCP PDUs transmission, the RLC layer only transmits corresponding ARQ feedback for the downlink data.

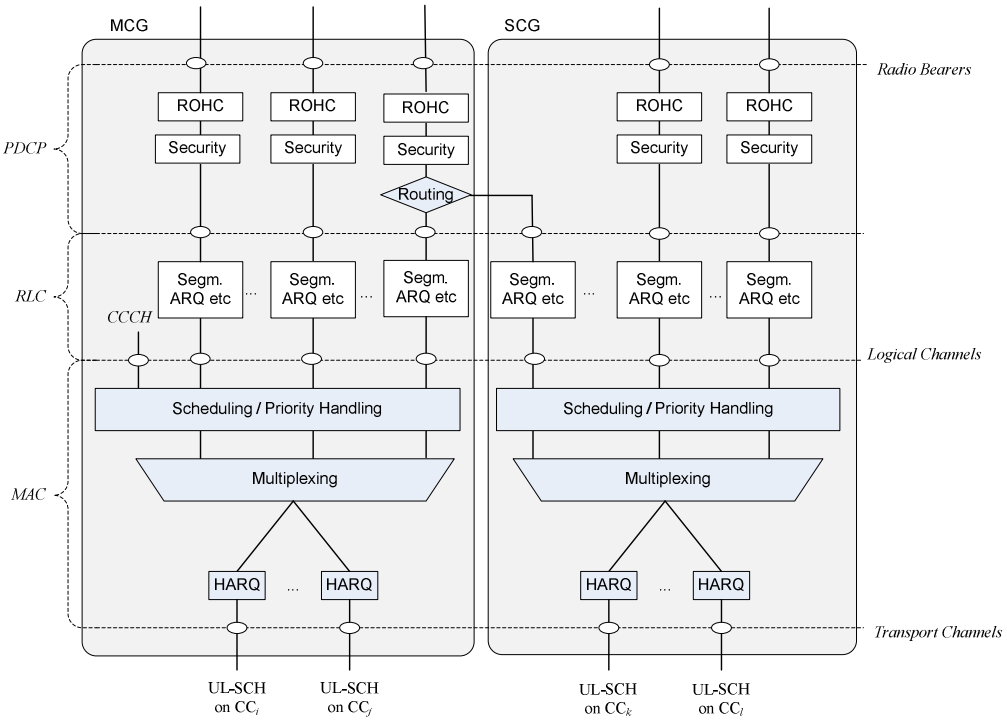


Figure 6.5-2: Layer 2 Structure for UL with CA and DC configured

7 RRC

This subclause provides an overview on services and functions provided by the RRC sublayer.

7.1 Services and Functions

The main services and functions of the RRC sublayer include:

- Broadcast of System Information related to the non-access stratum (NAS);
- Broadcast of System Information related to the access stratum (AS);
- Paging;
- Establishment, maintenance and release of an RRC connection between the UE and E-UTRAN including:
  - Allocation of temporary identifiers between UE and E-UTRAN;
  - Configuration of signalling radio bearer(s) for RRC connection:
    - Low priority SRB and high priority SRB.
- Security functions including key management;
- Establishment, configuration, maintenance and release of point to point Radio Bearers;

- Mobility functions including:
  - UE measurement reporting and control of the reporting for inter-cell and inter-RAT mobility;
  - Handover;
  - UE cell selection and reselection and control of cell selection and reselection;
  - Context transfer at handover.
- Notification and counting for MBMS services;
- Establishment, configuration, maintenance and release of Radio Bearers for MBMS services;
- QoS management functions;
- UE measurement reporting and control of the reporting;
- NAS direct message transfer to/from NAS from/to UE.

7.2 RRC protocol states & state transitions

RRC uses the following states:

- **RRC_IDLE**:
  - PLMN selection;
  - DRX configured by NAS;
  - Broadcast of system information;
  - Paging;
  - Cell re-selection mobility;
  - The UE shall have been allocated an id which uniquely identifies the UE in a tracking area;
  - No RRC context stored in the eNB;
  - Sidelink communication transmission and reception;
  - Sidelink discovery announcement and monitoring.
- **RRC_CONNECTED**:
  - UE has an E-UTRAN-RRC connection;
  - UE has context in E-UTRAN;
  - E-UTRAN knows the cell which the UE belongs to;
  - Network can transmit and/or receive data to/from UE;
  - Network controlled mobility (handover and inter-RAT cell change order to GERAN with NACC);
  - Neighbour cell measurements;
  - Sidelink communication transmission and reception;
  - Sidelink discovery announcement and monitoring;
  - At PDCP/RLC/MAC level:
    - UE can transmit and/or receive data to/from network;
    - UE monitors control signalling channel for shared data channel to see if any transmission over the shared data channel has been allocated to the UE;

- UE also reports channel quality information and feedback information to eNB;
- DRX period can be configured according to UE activity level for UE power saving and efficient resource utilization. This is under control of the eNB.

7.3 Transport of NAS messages

The AS provides reliable in-sequence delivery of NAS messages in a cell. During handover, message loss or duplication of NAS messages can occur.

In E-UTRAN, NAS messages are either concatenated with RRC messages or carried in RRC without concatenation. Upon arrival of concurrent NAS messages for the same UE requiring both concatenation with RRC for the high priority queue and also without concatenation for the lower priority queue, the messages are first queued as necessary to maintain in-sequence delivery.

In DL, when an EPS bearer establishment or release procedure is triggered, the NAS message should normally be concatenated with the associated RRC message. When the EPS bearer is modified and when the modification also depends on a modification of the radio bearer, the NAS message and associated RRC message should normally be concatenated. Concatenation of DL NAS with RRC message is not allowed otherwise. In uplink concatenation of NAS messages with RRC message is used only for transferring the initial NAS message during connection setup. Initial Direct Transfer is not used in E-UTRAN and no NAS message is concatenated with RRC connection request.

Multiple NAS messages can be sent in a single downlink RRC message during EPS bearer establishment or modification. In this case, the order of the NAS messages in the RRC message shall be kept the same as that in the corresponding S1-AP message in order to ensure the in-sequence delivery of NAS messages.

NOTE: NAS messages are integrity protected and ciphered by PDCP, in addition to the integrity protection and ciphering performed by NAS.

7.4 System Information

System information is divided into the *MasterInformationBlock* (MIB) and a number of *SystemInformationBlocks* (SIBs):

- *MasterInformationBlock* defines the most essential physical layer information of the cell required to receive further system information;
- *SystemInformationBlockType1* contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information blocks;
- *SystemInformationBlockType2* contains common and shared channel information;
- *SystemInformationBlockType3* contains cell re-selection information, mainly related to the serving cell;
- *SystemInformationBlockType4* contains information about the serving frequency and intra-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);
- *SystemInformationBlockType5* contains information about other E-UTRA frequencies and inter-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);
- *SystemInformationBlockType6* contains information about UTRA frequencies and UTRA neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);
- *SystemInformationBlockType7* contains information about GERAN frequencies relevant for cell re-selection (including cell re-selection parameters for each frequency);
- *SystemInformationBlockType8* contains information about CDMA2000 frequencies and CDMA2000 neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);
- *SystemInformationBlockType9* contains a home eNB name (HNB name);

- *SystemInformationBlockType10* contains an ETWS primary notification;
- *SystemInformationBlockType11* contains an ETWS secondary notification;
- *SystemInformationBlockType12* contains a CMAS warning notification;
- *SystemInformationBlockType13* contains MBMS-related information;
- *SystemInformationBlockType14* contains information about Extended Access Barring for access control;
- *SystemInformationBlockType15* contains information related to mobility procedures for MBMS reception;
- *SystemInformationBlockType16* contains information related to GPS time and Coordinated Universal Time (UTC);
- *SystemInformationBlockType17* contains information relevant for traffic steering between E-UTRAN and WLAN;
- *SystemInformationBlockType18* contains information related to sidelink communication;
- *SystemInformationBlockType19* contains information related to sidelink discovery.

The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH and dynamically carried on DL-SCH where they can be identified through the SI-RNTI (System Information RNTI). Both the MIB and *SystemInformationBlockType1* use a fixed schedule with a periodicity of 40 and 80 ms respectively while the scheduling of other SI messages is flexible and indicated by *SystemInformationBlockType1*.

The eNB may schedule DL-SCH transmissions concerning logical channels other than BCCH in the same subframe as used for BCCH. The minimum UE capability restricts the BCCH mapped to DL-SCH e.g. regarding the maximum rate.

The Paging message is used to inform UEs in RRC_IDLE and UEs in RRC_CONNECTED about a system information change.

System information may also be provided to the UE by means of dedicated signalling e.g. upon handover.

7.5 Carrier Aggregation

When CA is configured, the UE only has one RRC connection with the network. At RRC connection establishment/re-establishment/handover, one serving cell provides the NAS mobility information (e.g. TAI), and at RRC connection re-establishment/handover, one serving cell provides the security input. This cell is referred to as the Primary Cell (PCell). In the downlink, the carrier corresponding to the PCell is the Downlink Primary Component Carrier (DL PCC) while in the uplink it is the Uplink Primary Component Carrier (UL PCC).

Depending on UE capabilities, Secondary Cells (SCells) can be configured to form together with the PCell a set of serving cells. In the downlink, the carrier corresponding to an SCell is a Downlink Secondary Component Carrier (DL SCC) while in the uplink it is an Uplink Secondary Component Carrier (UL SCC).

The configured set of serving cells for a UE therefore always consists of one PCell and one or more SCells:

- For each SCell the usage of uplink resources by the UE in addition to the downlink ones is configurable (the number of DL SCCs configured is therefore always larger than or equal to the number of UL SCCs and no SCell can be configured for usage of uplink resources only);
- From a UE viewpoint, each uplink resource only belongs to one serving cell;
- The number of serving cells that can be configured depends on the aggregation capability of the UE (see subclause 5.5);
- PCell can only be changed with handover procedure (i.e. with security key change and RACH procedure);
- PCell is used for transmission of PUCCH;
- Unlike SCells, PCell cannot be de-activated (see subclause 11.2);
- Re-establishment is triggered when PCell experiences RLF, not when SCells experience RLF;

- NAS information is taken from PCell.

The reconfiguration, addition and removal of SCells can be performed by RRC. At intra-LTE handover, RRC can also add, remove, or reconfigure SCells for usage with the target PCell. When adding a new SCell, dedicated RRC signalling is used for sending all required system information of the SCell i.e. while in connected mode, UEs need not acquire broadcasted system information directly from the SCells.

7.6 Dual Connectivity

In DC, the configured set of serving cells for a UE consists of two subsets: the Master Cell Group (MCG) containing the serving cells of the MeNB, and the Secondary Cell Group (SCG) containing the serving cells of the SeNB.

When a UE is configured with CA in the MCG, the same principles as described in subclause 7.5 apply to MCG.

For SCG, the following principles are applied:

- At least one cell in SCG has a configured UL CC and one of them, named PSCell, is configured with PUCCH resources;
- When SCG is configured, there is always at least one SCG bearer or one Split bearer;
- Upon detection of a physical layer problem or a random access problem on PSCell, or the maximum number of RLC retransmissions has been reached associated with the SCG, or upon detection of an access problem on PSCell (T307 expiry) during SCG change:
  - RRC connection Re-establishment procedure is not triggered;
  - All UL transmissions towards all cells of the SCG are stopped;
  - MeNB is informed by the UE of SCG failure type;
  - For split bearer, the DL data transfer over the MeNB is maintained.
- Only the RLC AM bearer can be configured for the split bearer;
- Like PCell, PSCell cannot be de-activated (see subclause 11.2);
- PSCell can only be changed with SCG change (i.e. with security key change and RACH procedure);
- Neither direct bearer type change between Split bearer and SCG bearer nor simultaneous configuration of SCG and Split bearer are supported.

With respect to the interaction between MeNB and SeNB, the following principles are applied:

- Logical channel identities are independently allocated by the MeNB and the SeNB.
- The MeNB maintains the RRM measurement configuration of the UE and may, e.g. based on received measurement reports or traffic conditions or bearer types, decide to ask a SeNB to provide additional resources (serving cells) for a UE.
- Upon receiving the request from the MeNB, a SeNB may create the container that will result in the configuration of additional serving cells for the UE (or decide that it has no resource available to do so).
- For UE capability coordination, the MeNB provides (part of) the AS configuration and the UE capabilities to the SeNB.
- The MeNB and the SeNB exchange information about UE configuration by means of RRC containers (inter-node messages) carried in X2 messages.
- The SeNB may initiate a reconfiguration of its existing serving cells (e.g., PUCCH towards the SeNB).
- The SeNB decides which cell is the PSCell within the SCG.
- The MeNB does not change the content of the RRC configuration provided by the SeNB.
- In the case of the SCG addition and SCG SCell addition, the MeNB may provide the latest measurement results for the SCG cell(s).

- Both MeNB and SeNB know the SFN and subframe offset of each other by OAM, e.g., for the purpose of DRX alignment and identification of measurement gap.

When adding a new SCG SCell, dedicated RRC signalling is used for sending all required system information of the cell as for CA described in sub-clause 7.5, except for the SFN acquired from MIB of the PSCell of SCG.

8 E-UTRAN identities

8.1 E-UTRAN related UE identities

The following E-UTRAN related UE identities are used at cell level:

- C-RNTI: unique identification used for identifying RRC Connection and scheduling;
- Semi-Persistent Scheduling C-RNTI: unique identification used for semi-persistent scheduling;
- Temporary C-RNTI: identification used for the random access procedure;
- TPC-PUSCH-RNTI: identification used for the power control of PUSCH;
- TPC-PUCCH-RNTI: identification used for the power control of PUCCH;
- SL-RNTI: identification used for sidelink communication scheduling;
- Random value for contention resolution: during some transient states, the UE is temporarily identified with a random value used for contention resolution purposes.

In DC, two C-RNTIs are independently allocated to the UE: one for MCG, and one for SCG.

8.2 Network entity related Identities

The following identities are used in E-UTRAN for identifying a specific network entity TS 36.413 [25]:

- Globally Unique MME Identity (GUMMEI): used to identify MME globally. The GUMMEI is constructed from the PLMN identity the MME belongs to, the group identity of the MME group the MME belongs to and the MME code (MMEC) of the MME within the MME group.

NOTE: GUMMEI or S-TMSI containing the MMEC is provided by the UE to the eNB according to TS 23.401 [17], TS 24.301 [20] and TS 36.331 [16].

- E-UTRAN Cell Global Identifier (ECGI): used to identify cells globally. The ECGI is constructed from the PLMN identity the cell belongs to and the Cell Identity (CI) of the cell. The included PLMN is the one given by the first PLMN entry in SIB1, according to TS 36.331 [16].
- eNB Identifier (eNB ID): used to identify eNBs within a PLMN. The eNB ID is contained within the CI of its cells.
- Global eNB ID: used to identify eNBs globally. The Global eNB ID is constructed from the PLMN identity the eNB belongs to and the eNB ID. The MCC and MNC are the same as included in the E-UTRAN Cell Global Identifier (ECGI).
  - The Global eNB ID of RN is the same as its serving DeNB.
- Tracking Area identity (TAI): used to identify tracking areas. The TAI is constructed from the PLMN identity the tracking area belongs to and the TAC (Tracking Area Code) of the Tracking Area.
- CSG identity (CSG ID): used to identify a CSG within a PLMN.
- EPS Bearer ID / E-RAB ID:

- The value of the E-RAB ID used at S1 and X2 interfaces to identify an E-RAB allocated to the UE is the same as the EPS Bearer ID value used at the Uu interface to identify the associated EPS Bearer (and also used at the NAS layer as defined in TS 36.413 [25]).

The following identities are broadcast in every E-UTRAN cell (SIB1): CI, TAC, CSG ID (if any) and one or more PLMN identities.

8.3 Sidelink communication related identities

The following identities are used for sidelink communication:

- Source Layer-2 ID: Identifies the sender of the data in sidelink communication. The Source Layer-2 ID is 24 bits long and is used together with Destination Layer-2 ID and LCID for identification of the RLC UM entity and PDCP entity in the receiver;
- Destination Layer-2 ID: Identifies the target of the data in sidelink communication. The Destination Layer-2 ID is 24 bits long and is split in the MAC layer into two bit strings:
  - One bit string is the LSB part (8 bits) of Destination Layer-2 ID and forwarded to physical layer as Group Destination ID. This identifies the target of the intended data in sidelink control information and is used for filtering of packets at the physical layer.
  - Second bit string is the MSB part (16 bits) of the Destination Layer-2 ID and is carried within the MAC header. This is used for filtering of packets at the MAC layer.

No Access Stratum signalling is required for group formation and to configure Source Layer-2 ID, Destination Layer-2 ID and Group Destination ID in the UE. These identities are either provided by higher layer or derived from identities provided by higher layer. In case of groupcast and broadcast, the ProSe UE ID [62] provided by higher layer is used directly as the Source Layer-2 ID and the ProSe Layer-2 Group ID [62] provided by higher layer is used directly as the Destination Layer-2 ID in the MAC layer.

9 ARQ and HARQ

E-UTRAN provides ARQ and HARQ functionalities. The ARQ functionality provides error correction by retransmissions in acknowledged mode at Layer 2. The HARQ functionality ensures delivery between peer entities at Layer 1.

9.1 HARQ principles

The HARQ within the MAC sublayer has the following characteristics:

- HARQ transmits and retransmits transport blocks;
- In the downlink:
  - N-process Stop-And-Wait;
  - Asynchronous adaptive HARQ;
  - Uplink ACK/NAKs in response to downlink (re)transmissions are sent on PUCCH or PUSCH;
  - PDCCH signals the HARQ process number and if it is a transmission or retransmission;
  - Retransmissions are always scheduled through PDCCH.
- In the uplink:
  - N-process Stop-And-Wait;
  - Synchronous HARQ;
  - Maximum number of retransmissions configured per UE (as opposed to per radio bearer);
  - Downlink ACK/NAKs in response to uplink (re)transmissions are sent on PHICH;

- HARQ operation in uplink is governed by the following principles (summarized in Table 9.1-1):

  1) Regardless of the content of the HARQ feedback (ACK or NACK), when a PDCCH for the UE is correctly received, the UE follows what the PDCCH asks the UE to do i.e. perform a transmission or a retransmission (referred to as adaptive retransmission);

  2) When no PDCCH addressed to the C-RNTI of the UE is detected, the HARQ feedback dictates how the UE performs retransmissions:

     - NACK: the UE performs a non-adaptive retransmission i.e. a retransmission on the same uplink resource as previously used by the same process;

     - ACK: the UE does not perform any UL (re)transmission and keeps the data in the HARQ buffer. A PDCCH is then required to perform a retransmission i.e. a non-adaptive retransmission cannot follow.

- In the sidelink:

  - No HARQ feedback;

  - Retransmissions are always performed in a pre-defined/ configured number.

- Measurement gaps are of higher priority than HARQ retransmissions: whenever an HARQ retransmission collides with a measurement gap, the HARQ retransmission does not take place.

Table 9.1-1: UL HARQ Operation

HARQ feedback seen by the UE	PDCCH seen by the UE	UE behaviour
ACK or NACK	New Transmission	New transmission according to PDCCH
ACK or NACK	Retransmission	Retransmission according to PDCCH (adaptive retransmission)
ACK	None	No (re)transmission, keep data in HARQ buffer and a PDDCH is required to resume retransmissions
NACK	None	Non-adaptive retransmission

9.2 ARQ principles

The ARQ within the RLC sublayer has the following characteristics:

- ARQ retransmits RLC PDUs or RLC PDU segments based on RLC status reports;
- Polling for RLC status report is used when needed by RLC;
- RLC receiver can also trigger RLC status report after detecting a missing RLC PDU or RLC PDU segment.

9.3 Void

10 Mobility

Load balancing is achieved in E-UTRAN with handover, redirection mechanisms upon RRC release, DC and through the usage of inter-frequency and inter-RAT absolute priorities and inter-frequency Qoffset parameters.

Measurements to be performed by a UE for mobility are classified in at least four measurement types:

- Intra-frequency E-UTRAN measurements;
- Inter-frequency E-UTRAN measurements;
- Inter-RAT measurements for UTRAN and GERAN;
- Inter-RAT measurements of CDMA2000 HRPD or 1xRTT frequencies.

For each measurement type one or several measurement objects can be defined (a measurement object defines e.g. the carrier frequency to be monitored).

For each measurement object one or several reporting configurations can be defined (a reporting configuration defines the reporting criteria). Three reporting criteria are used: event triggered reporting, periodic reporting and event triggered periodic reporting.

The association between a measurement object and a reporting configuration is created by a measurement identity (a measurement identity links together one measurement object and one reporting configuration of same RAT). By using several measurement identities (one for each measurement object, reporting configuration pair) it is possible:

- To associate several reporting configurations to one measurement object and;
- To associate one reporting configuration to several measurement objects.

The measurements identity is as well used when reporting results of the measurements.

Measurement quantities are considered separately for each RAT.

Measurement commands are used by E-UTRAN to order the UE to start measurements, modify measurements or stop measurements.

10.1 Intra E-UTRAN

In E-UTRAN RRC_CONNECTED state, network-controlled UE-assisted handovers and DC specific activities are performed and various DRX cycles are supported.

In E-UTRAN RRC_IDLE state, cell reselections are performed and DRX is supported.

10.1.1 Mobility Management in ECM-IDLE

10.1.1.1 Cell selection

The principles of PLMN selection in E-UTRA are based on the 3GPP PLMN selection principles. Cell selection is required on transition from EMM_DETACHED to EMM-REGISTERED and from ECM-IDLE or ECM-CONNECTED.

Cell selection:

- The UE NAS layer identifies a selected PLMN and equivalent PLMNs;
- The UE searches the E-UTRA frequency bands and for each carrier frequency identifies the strongest cell. It reads cell system information broadcast to identify its PLMN(s):
  - The UE may search each carrier in turn ("initial cell selection") or make use of stored information to shorten the search ("stored information cell selection").
- The UE seeks to identify a suitable cell; if it is not able to identify a suitable cell it seeks to identify an acceptable cell. When a suitable cell is found or if only an acceptable cell is found it camps on that cell and commence the cell reselection procedure:
  - A suitable cell is one for which the measured cell attributes satisfy the cell selection criteria; the cell PLMN is the selected PLMN, registered or an equivalent PLMN; the cell is not barred or reserved and the cell is not part of a tracking area which is in the list of "forbidden tracking areas for roaming";
  - An acceptable cell is one for which the measured cell attributes satisfy the cell selection criteria and the cell is not barred.

Transition to RRC_IDLE:

On transition from RRC_CONNECTED to RRC_IDLE, a UE should camp on the last cell for which it was in RRC_CONNECTED or a cell/any cell of set of cells or frequency be assigned by RRC in the state transition message.

Recovery from out of coverage:

The UE should attempt to find a suitable cell in the manner described for stored information or initial cell selection above. If no suitable cell is found on any frequency or RAT the UE should attempt to find an acceptable cell.

10.1.1.2 Cell reselection

A UE in RRC_IDLE performs cell reselection. The principles of the procedure are the following:

- The UE makes measurements of attributes of the serving and neighbour cells to enable the reselection process:
  - There is no need to indicate neighbouring cells in the serving cell system information to enable the UE to search and measure a cell i.e. E-UTRAN relies on the UE to detect the neighbouring cells;
  - For the search and measurement of inter-frequency neighbouring cells, only the carrier frequencies need to be indicated;
  - Measurements may be omitted if the serving cell attribute fulfils particular search or measurement criteria.
- Cell reselection identifies the cell that the UE should camp on. It is based on cell reselection criteria which involves measurements of the serving and neighbour cells:
  - Intra-frequency reselection is based on ranking of cells;
  - Inter-frequency reselection is based on absolute priorities where a UE tries to camp on the highest priority frequency available. Absolute priorities for reselection are provided only by the RPLMN and are valid only within the RPLMN; priorities are given by the system information and are valid for all UEs in a cell, specific priorities per UE can be signalled in the RRC Connection Release message. A validity time can be associated with UE specific priorities.
  - For inter-frequency neighbouring cells, it is possible to indicate layer-specific cell reselection parameters (e.g., layer specific offset). These parameters are common to all neighbouring cells on a frequency;
  - An NCL can be provided by the serving cell to handle specific cases for intra- and inter-frequency neighbouring cells. This NCL contains cell specific cell reselection parameters (e.g., cell specific offset) for specific neighbouring cells;
  - Black lists can be provided to prevent the UE from reselecting to specific intra- and inter-frequency neighbouring cells;
  - Cell reselection can be speed dependent (speed detection based on UTRAN solution);
  - Cell reselection parameters are applicable for all UEs in a cell, but it is possible to configure specific reselection parameters per UE group or per UE.

Cell access restrictions apply as for UTRAN, which consist of access class (AC) barring and cell reservation (e.g. for cells "reserved for operator use") applicable for mobiles in RRC_IDLE mode.

10.1.1.3 Void

10.1.1.4 Void

10.1.1.5 Void

10.1.2 Mobility Management in ECM-CONNECTED

The Intra-E-UTRAN-Access Mobility Support for UEs in ECM-CONNECTED handles all necessary steps for

- Handover procedures, like processes that precede the final HO decision on the source network side (control and evaluation of UE and eNB measurements taking into account certain UE specific roaming and access restrictions), preparation of resources on the target network side, commanding the UE to the new radio resources and finally releasing resources on the (old) source network side. It contains mechanisms to transfer context data between evolved nodes, and to update node relations on C-plane and U-plane.
- DC specific procedures, like processes that precede the final decision for a certain configuration of a SeNB (control and evaluation of UE and network side measurements), preparation of respective resources on the

network side of a SeNB, commanding the UE to the new radio resources configuration for a second connection and, if applicable, finally releasing resources of a SeNB. It contains mechanisms to transfer UE- and bearer-context data between involved nodes, and to update node relations on C-plane and U-plane.

In E-UTRAN RRC_CONNECTED state, network-controlled UE-assisted handovers and DC specific activities are performed and various DRX cycles are supported.

The UE makes measurements of attributes of the serving and neighbour cells to enable the process:

- There is no need to indicate neighbouring cells to enable the UE to search and measure a cell i.e. E-UTRAN relies on the UE to detect the neighbouring cells;
- For the search and measurement of inter-frequency neighbouring cells, at least the carrier frequencies need to be indicated;
- The E-UTRAN signals reporting criteria for event-triggered and periodical reporting;
- An NCL can be provided by the serving cell by RRC dedicated signalling to handle specific cases for intra- and inter-frequency neighbouring cells. This NCL contains cell specific measurement parameters (e.g. cell specific offset) for specific neighbouring cells;
- Black lists can be provided to prevent the UE from measuring specific neighbouring cells.

For the UE measuring discovery signals (i.e. CRS and/or CSI-RS) of the serving and neighbour cells, the E-UTRAN indicates the measurement configuration to the UE, including the measurement timing configuration of the discovery signals.

Depending on whether the UE needs transmission/reception gaps to perform the relevant measurements, measurements are classified as gap assisted or non-gap assisted. A non-gap assisted measurement is a measurement on a cell that does not require transmission/reception gaps to allow the measurement to be performed. A gap assisted measurement is a measurement on a cell that does require transmission/reception gaps to allow the measurement to be performed. Gap patterns (as opposed to individual gaps) are configured and activated by RRC.

10.1.2.1 Handover

The intra E-UTRAN HO of a UE in RRC_CONNECTED state is a UE-assisted network-controlled HO, with HO preparation signalling in E-UTRAN:

- Part of the HO command comes from the target eNB and is transparently forwarded to the UE by the source eNB;
- To prepare the HO, the source eNB passes all necessary information to the target eNB (e.g. E-RAB attributes and RRC context):
  - When CA is configured and to enable SCell selection in the target eNB, the source eNB can provide in decreasing order of radio quality a list of the best cells and optionally measurement result of the cells.
  - When DC is configured, the source MeNB provides the SCG configuration (in addition to the MCG configuration) to the target MeNB.
- Both the source eNB and UE keep some context (e.g. C-RNTI) to enable the return of the UE in case of HO failure;
- UE accesses the target cell via RACH following a contention-free procedure using a dedicated RACH preamble or following a contention-based procedure if dedicated RACH preambles are not available:
  - the UE uses the dedicated preamble until the handover procedure is finished (successfully or unsuccessfully);
- If the RACH procedure towards the target cell is not successful within a certain time, the UE initiates radio link failure recovery using a suitable cell;
- No ROHC context is transferred at handover;
- ROHC context can be kept at handover within the same eNB.

10.1.2.1.1 C-plane handling

The preparation and execution phase of the HO procedure is performed without EPC involvement, i.e. preparation messages are directly exchanged between the eNBs. The release of the resources at the source side during the HO completion phase is triggered by the eNB. In case an RN is involved, its DeNB relays the appropriate S1 messages between the RN and the MME (S1-based handover) and X2 messages between the RN and target eNB (X2-based handover); the DeNB is explicitly aware of a UE attached to the RN due to the S1 proxy and X2 proxy functionality (see section 4.7.6.6). The figure below depicts the basic handover scenario where neither MME nor Serving Gateway changes:

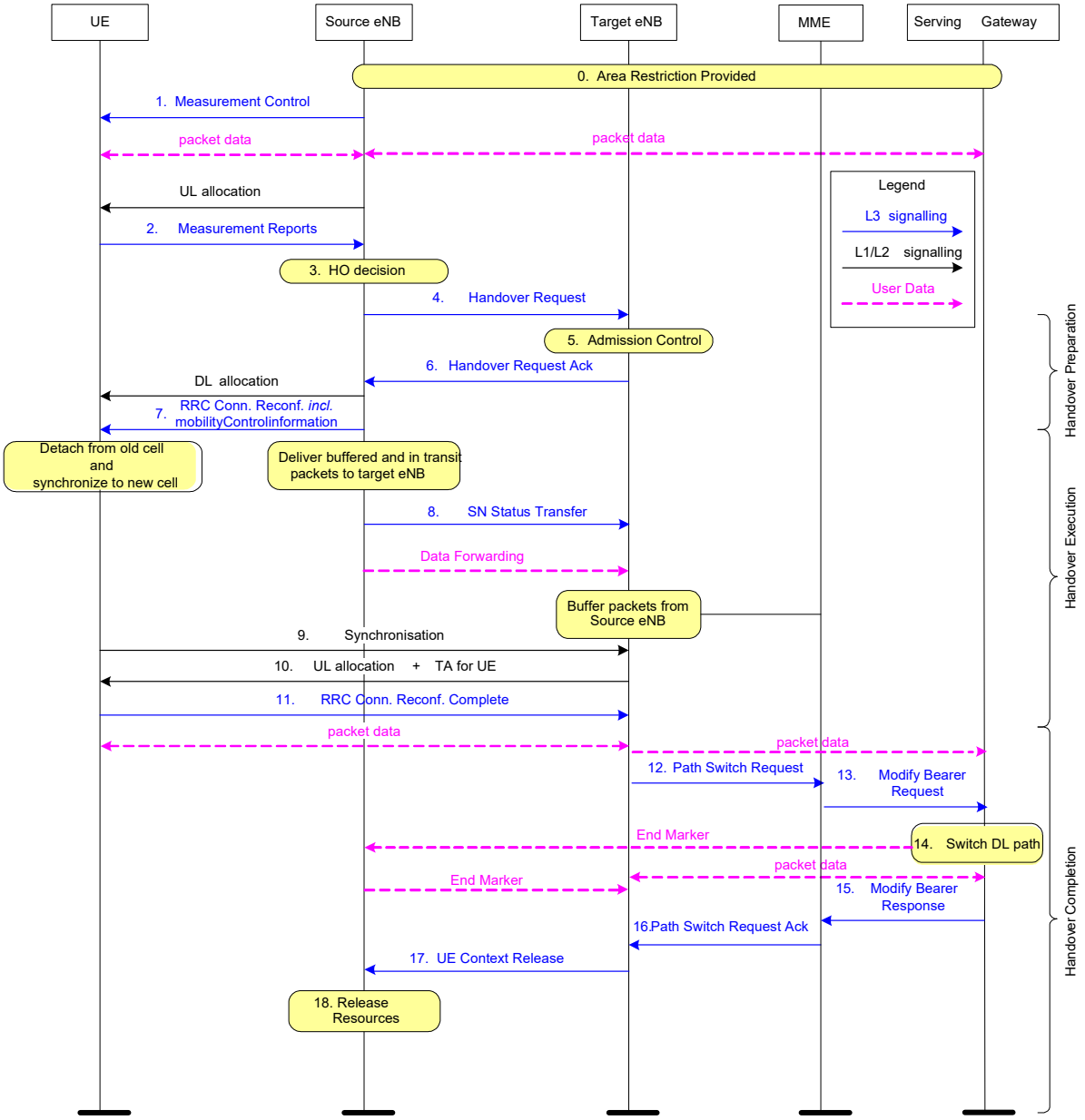


Figure 10.1.2.1.1-1: Intra-MME/Serving Gateway HO

Below is a more detailed description of the intra-MME/Serving Gateway HO procedure:

0 The UE context within the source eNB contains information regarding roaming and access restrictions which were provided either at connection establishment or at the last TA update.

1 The source eNB configures the UE measurement procedures according to the roaming and access restriction information and e.g. the available multiple frequency band information. Measurements provided by the source eNB may assist the function controlling the UE's connection mobility.

2 A MEASUREMENT REPORT is triggered and sent to the eNB.

3 The source eNB makes decision based on MEASUREMENT REPORT and RRM information to hand off the UE.

4 The source eNB issues a HANDOVER REQUEST message to the target eNB passing necessary information to prepare the HO at the target side (UE X2 signalling context reference at source eNB, UE S1 EPC signalling context reference, target cell ID, K_{eNB*}, RRC context including the C-RNTI of the UE in the source eNB, AS-configuration, E-RAB context and physical layer ID of the source cell + short MAC-I for possible RLF recovery). UE X2 / UE S1 signalling references enable the target eNB to address the source eNB and the EPC. The E-RAB context includes necessary RNL and TNL addressing information, and QoS profiles of the E-RABs.

5 Admission Control may be performed by the target eNB dependent on the received E-RAB QoS information to increase the likelihood of a successful HO, if the resources can be granted by target eNB. The target eNB configures the required resources according to the received E-RAB QoS information and reserves a C-RNTI and optionally a RACH preamble. The AS-configuration to be used in the target cell can either be specified independently (i.e. an "establishment") or as a delta compared to the AS-configuration used in the source cell (i.e. a "reconfiguration").

6 The target eNB prepares HO with L1/L2 and sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. The HANDOVER REQUEST ACKNOWLEDGE message includes a transparent container to be sent to the UE as an RRC message to perform the handover. The container includes a new C-RNTI, target eNB security algorithm identifiers for the selected security algorithms, may include a dedicated RACH preamble, and possibly some other parameters i.e. access parameters, SIBs, etc. The HANDOVER REQUEST ACKNOWLEDGE message may also include RNL/TNL information for the forwarding tunnels, if necessary.

NOTE: As soon as the source eNB receives the HANDOVER REQUEST ACKNOWLEDGE, or as soon as the transmission of the handover command is initiated in the downlink, data forwarding may be initiated.

Steps 7 to 16 provide means to avoid data loss during HO and are further detailed in 10.1.2.1.2 and 10.1.2.3.

7 The target eNB generates the RRC message to perform the handover, i.e. *RRCConnectionReconfiguration* message including the *mobilityControlInformation*, to be sent by the source eNB towards the UE. The source eNB performs the necessary integrity protection and ciphering of the message. The UE receives the *RRCConnectionReconfiguration* message with necessary parameters (i.e. new C-RNTI, target eNB security algorithm identifiers, and optionally dedicated RACH preamble, target eNB SIBs, etc.) and is commanded by the source eNB to perform the HO. The UE does not need to delay the handover execution for delivering the HARQ/ARQ responses to source eNB.

8 The source eNB sends the SN STATUS TRANSFER message to the target eNB to convey the uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs for which PDCP status preservation applies (i.e. for RLC AM). The uplink PDCP SN receiver status includes at least the PDCP SN of the first missing UL SDU and may include a bit map of the receive status of the out of sequence UL SDUs that the UE needs to retransmit in the target cell, if there are any such SDUs. The downlink PDCP SN transmitter status indicates the next PDCP SN that the target eNB shall assign to new SDUs, not having a PDCP SN yet. The source eNB may omit sending this message if none of the E-RABs of the UE shall be treated with PDCP status preservation.

9 After receiving the *RRCConnectionReconfiguration* message including the *mobilityControlInformation* , UE performs synchronisation to target eNB and accesses the target cell via RACH, following a contention-free procedure if a dedicated RACH preamble was indicated in the *mobilityControlInformation*, or following a contention-based procedure if no dedicated preamble was indicated. UE derives target eNB specific keys and configures the selected security algorithms to be used in the target cell.

10 The target eNB responds with UL allocation and timing advance.

11 When the UE has successfully accessed the target cell, the UE sends the *RRCConnectionReconfigurationComplete* message (C-RNTI) to confirm the handover, along with an uplink Buffer Status Report, whenever possible, to the target eNB to indicate that the handover procedure is completed for the UE. The target eNB verifies the C-RNTI sent in the *RRCConnectionReconfigurationComplete* message. The target eNB can now begin sending data to the UE.

12 The target eNB sends a PATH SWITCH REQUEST message to MME to inform that the UE has changed cell.

13 The MME sends a MODIFY BEARER REQUEST message to the Serving Gateway.

14 The Serving Gateway switches the downlink data path to the target side. The Serving gateway sends one or more "end marker" packets on the old path to the source eNB and then can release any U-plane/TNL resources towards the source eNB.

15 The Serving Gateway sends a MODIFY BEARER RESPONSE message to MME.

16 The MME confirms the PATH SWITCH REQUEST message with the PATH SWITCH REQUEST ACKNOWLEDGE message.

17 By sending the UE CONTEXT RELEASE message, the target eNB informs success of HO to source eNB and triggers the release of resources by the source eNB. The target eNB sends this message after the PATH SWITCH REQUEST ACKNOWLEDGE message is received from the MME.

18 Upon reception of the UE CONTEXT RELEASE message, the source eNB can release radio and C-plane related resources associated to the UE context. Any ongoing data forwarding may continue.

When an X2 handover is used involving HeNBs and when the source HeNB is connected to a HeNB GW, a UE CONTEXT RELEASE REQUEST message including an explicit GW Context Release Indication is sent by the source HeNB, in order to indicate that the HeNB GW may release of all the resources related to the UE context.

10.1.2.1.2 U-plane handling

The U-plane handling during the Intra-E-UTRAN-Access mobility activity for UEs in ECM-CONNECTED takes the following principles into account to avoid data loss during HO:

- During HO preparation U-plane tunnels can be established between the source eNB and the target eNB. There is one tunnel established for uplink data forwarding and another one for downlink data forwarding for each E-RAB for which data forwarding is applied. In the case of a UE under an RN performing handover, forwarding tunnels can be established between the RN and the target eNB via the DeNB.

- During HO execution, user data can be forwarded from the source eNB to the target eNB. The forwarding may take place in a service and deployment dependent and implementation specific way.

  - Forwarding of downlink user data from the source to the target eNB should take place in order as long as packets are received at the source eNB from the EPC or the source eNB buffer has not been emptied.

- During HO completion:

  - The target eNB sends a PATH SWITCH message to MME to inform that the UE has gained access and MME sends a MODIFY BEARER REQUEST message to the Serving Gateway, the U-plane path is switched by the Serving Gateway from the source eNB to the target eNB.

  - The source eNB should continue forwarding of U-plane data as long as packets are received at the source eNB from the Serving Gateway or the source eNB buffer has not been emptied.

For **RLC-AM bearers**:

- During normal HO not involving Full Configuration:

  - For in-sequence delivery and duplication avoidance, PDCP SN is maintained on a bearer basis and the source eNB informs the target eNB about the next DL PDCP SN to allocate to a packet which does not have a PDCP sequence number yet (either from source eNB or from the Serving Gateway).

  - For security synchronisation, HFN is also maintained and the source eNB provides to the target one reference HFN for the UL and one for the DL i.e. HFN and corresponding SN.

- In both the UE and the target eNB, a window-based mechanism is needed for duplication detection.
- The occurrence of duplicates over the air interface in the target eNB is minimised by means of PDCP SN based reporting at the target eNB by the UE. In uplink, the reporting is optionally configured on a bearer basis by the eNB and the UE should first start by transmitting those reports when granted resources in the target eNB. In downlink, the eNB is free to decide when and for which bearers a report is sent and the UE does not wait for the report to resume uplink transmission.
- The target eNB re-transmits and prioritizes all downlink PDCP SDUs forwarded by the source eNB (i.e. the target eNB should send data with PDCP SNs from X2 before sending data from S1), with the exception of PDCP SDUs of which the reception was acknowledged through PDCP SN based reporting by the UE.
- The UE re-transmits in the target eNB all uplink PDCP SDUs starting from the first PDCP SDU following the last consecutively confirmed PDCP SDU i.e. the oldest PDCP SDU that has not been acknowledged at RLC in the source, excluding the PDCP SDUs of which the reception was acknowledged through PDCP SN based reporting by the target.

- During HO involving Full Configuration:
  - The following description below for RLC-UM bearers also applies for RLC-AM bearers. Data loss may happen.

For **RLC-UM bearers**:

- The PDCP SN and HFN are reset in the target eNB.
- No PDCP SDUs are retransmitted in the target eNB.
- The target eNB prioritizes all downlink PDCP SDUs forwarded by the source eNB if any (i.e. the target eNB should send data with PDCP SNs from X2 before sending data from S1).
- The UE PDCP entity does not attempt to retransmit any PDCP SDU in the target cell for which transmission had been completed in the source cell. Instead UE PDCP entity starts the transmission with other PDCP SDUs.

10.1.2.2 Path Switch

10.1.2.2.1 Path Switch upon handover

After the downlink path is switched at the Serving GW downlink packets on the forwarding path and on the new direct path may arrive interchanged at the target eNB. The target eNodeB should first deliver all forwarded packets to the UE before delivering any of the packets received on the new direct path. The method employed in the target eNB to enforce the correct delivery order of packets is outside the scope of the standard.

In order to assist the reordering function in the target eNB, the Serving GW shall send one or more "end marker" packets on the old path immediately after switching the path for each E-RAB of the UE. The "end marker" packet shall not contain user data. The "end marker" is indicated in the GTP header. After completing the sending of the tagged packets the GW shall not send any further user data packets via the old path.

Upon receiving the "end marker" packets, the source eNB shall, if forwarding is activated for that bearer, forward the packet toward the target eNB.

On detection of an "end marker" the target eNB shall discard the end marker packet and initiate any necessary processing to maintain in sequence delivery of user data forwarded over X2 interface and user data received from the serving GW over S1 as a result of the path switch.

On detection of the "end marker", the target eNB may also initiate the release of the data forwarding resource. However, the release of the data forwarding resource is implementation dependent and could also be based on other mechanisms (e.g. timer-based mechanism).

EPC may change the uplink end-point of the tunnels with Path Switch procedure. However, the EPC should keep the old GTP tunnel end-point(s) sufficiently long time in order to minimise the probability of packet losses and avoid unintentional release of respective E-RAB(s).

10.1.2.2.2 Path Update upon Dual Connectivity specific activities

Upon DC specific activities which involve the transfer of bearer contexts from one eNB to another, if one of the eNBs involved in DC provides radio resources to the UE for one or several E-RABs configured with the SCG bearer option, the update of the downlink path towards the EPC for the relevant E-RABs needs to be communicated by the MeNB to the MME. The functions specified for the path switch for handover as specified in section 10.1.2.2.1 are applicable for the path update for DC with SCG bearer option as well except that:

- The role of involved eNBs are different: in DC, the "source eNB" as specified for handover, is the eNB from which the bearer context is transferred and the "target eNB" is the eNB to which the bearer context is transferred.

- The EPC does not change the uplink end-point of the tunnels with the Path Update procedure in a way that this would change the Serving GW.

10.1.2.3 Data forwarding

10.1.2.3.1 For RLC-AM DRBs

Upon handover, the source eNB may forward in order to the target eNB all downlink PDCP SDUs with their SN that have not been acknowledged by the UE. In addition, the source eNB may also forward without a PDCP SN fresh data arriving over S1 to the target eNB.

NOTE: The target eNB does not have to wait for the completion of forwarding from the source eNB before it begins transmitting packets to the UE.

The source eNB discards any remaining downlink RLC PDUs. Correspondingly, the source eNB does not forward the downlink RLC context to the target eNB.

NOTE: The source eNB does not need to abort ongoing RLC transmissions with the UE as it starts data forwarding to the target eNB.

Upon handover, the source eNB forwards to the Serving Gateway the uplink PDCP SDUs successfully received in-sequence until the sending of the Status Transfer message to the target eNB. Then at that point of time the source eNB stops delivering uplink PDCP SDUs to the S-GW and shall discard any remaining uplink RLC PDUs. Correspondingly, the source eNB does not forward the uplink RLC context to the target eNB.

Then the source eNB shall either:

- discard the uplink PDCP SDUs received out of sequence if the source eNB has not accepted the request from the target eNB for uplink forwarding or if the target eNB has not requested uplink forwarding for the bearer during the Handover Preparation procedure,

- forward to the target eNB the uplink PDCP SDUs received out of sequence if the source eNB has accepted the request from the target eNB for uplink forwarding for the bearer during the Handover Preparation procedure.

The PDCP SN of forwarded SDUs is carried in the "PDCP PDU number" field of the GTP-U extension header. The target eNB shall use the PDCP SN if it is available in the forwarded GTP-U packet.

For normal HO in-sequence delivery of upper layer PDUs during handover is based on a continuous PDCP SN and is provided by the "in-order delivery and duplicate elimination" function at the PDCP layer:

- in the downlink, the "in-order delivery and duplicate elimination" function at the UE PDCP layer guarantees in-sequence delivery of downlink PDCP SDUs;

- in the uplink, the "in-order delivery and duplicate elimination" function at the target eNB PDCP layer guarantees in-sequence delivery of uplink PDCP SDUs.

After a normal handover, when the UE receives a PDCP SDU from the target eNB, it can deliver it to higher layer together with all PDCP SDUs with lower SNs regardless of possible gaps.

For handovers involving Full Configuration, the source eNB behaviour is unchanged from the description above. The target eNB may not send PDCP SDUs for which delivery was attempted by the source eNB. The target eNB identifies these by the presence of the PDCP SN in the forwarded GTP-U packet and discards them.

After a Full Configuration handover, the UE delivers received PDCP SDU from the source cell to the higher layer regardless of possible gaps. UE discards uplink PDCP SDUs for which transmission was attempted and retransmission of these over the target cell is not possible.

10.1.2.3.2 For RLC-UM DRBs

Upon handover, the source eNB does not forward to the target eNB downlink PDCP SDUs for which transmission had been completed in the source cell. PDCP SDUs that have not been transmitted may be forwarded. In addition, the source eNB may forward fresh downlink data arriving over S1 to the target eNB. The source eNB discards any remaining downlink RLC PDUs. Correspondingly, the source eNB does not forward the downlink RLC context to the target eNB.

Upon handover, the source eNB forwards all uplink PDCP SDUs successfully received to the Serving Gateway (i.e. including the ones received out of sequence) and discards any remaining uplink RLC PDUs. Correspondingly, the source eNB does not forward the uplink RLC context to the target eNB.

10.1.2.3.3 SRB handling

With respect to SRBs, the following principles apply at HO:

- No forwarding or retransmissions of RRC messages in the target;
- The PDCP SN and HFN are reset in the target.

10.1.2.3.4 User data forwarding for Dual Connectivity

Upon DC specific activities user data forwarding may be performed for E-RABs configured with the SCG bearer option or with the split bearer option. The behaviour of the eNB from which data is forwarded is the same as specified for the "source eNB" for handover, the behaviour of the eNB to which data is forwarded is the same as specified for the "target eNB" for handover. If data forwarding for split bearer option is applied, the PDCP PDUs which are not acknowledged by the UE are forwarded from the SeNB to the MeNB in the course of procedures involving the release of the SCG part of the split bearer (e.g., SeNB Modification, SeNB Release, Change of SeNB).

10.1.2.4 Void

10.1.2.5 Void

10.1.2.6 Void

10.1.2.7 Timing Advance

In RRC_CONNECTED, the eNB is responsible for maintaining the timing advance. Serving cells having UL to which the same timing advance applies (typically corresponding to the serving cells hosted by the same receiver) and using the same timing reference cell are grouped in a timing advance group (TAG). Each TAG contains at least one serving cell with configured uplink, and the mapping of each serving cell to a TAG is configured by RRC. In case of DC, a TAG only includes cells that are associated to the same CG and the maximum number of TAG is 8.

For the pTAG the UE uses the PCell in MCG and the PSCell in SCG as timing reference. In a sTAG, the UE may use any of the activated SCells of this TAG as a timing reference cell, but should not change it unless necessary.

In some cases (e.g. during DRX), the timing advance is not necessarily always maintained and the MAC sublayer knows if the L1 is synchronised and which procedure to use to start transmitting in the uplink:

- as long as the L1 is non-synchronised, uplink transmission can only take place on PRACH.

For a TAG, cases where the UL synchronisation status moves from "synchronised" to "non-synchronised" include:

- Expiration of a timer specific to the TAG;
- Non-synchronised handover.

The synchronisation status of the UE follows the synchronisation status of the pTAG of MCG. The synchronisation status of the UE w.r.t. SCG follows the synchronisation status of the pTAG of SCG. When the timer associated with

pTAG is not running, the timer associated with an sTAG in that CG shall not be running. Expiry of the timers associated with one CG does not affect the operation of the other CG.

The value of the timer associated to the pTAG of MCG is either UE specific and managed through dedicated signalling between the UE and the eNB, or cell specific and indicated via broadcast information. In both cases, the timer is normally restarted whenever a new timing advance is given by the eNB for the pTAG:

- restarted to a UE specific value if any; or
- restarted to a cell specific value otherwise.

The value of the timer associated to a pTAG of SCG and the value of a timer associated to an sTAG of an MCG or an sTAG of SCG are managed through dedicated signalling between the UE and the eNB, and the timers associated to these TAGs can be configured with different values. The timers of these TAGs are normally restarted whenever a new timing advance is given by the eNB for the corresponding TAG.

Upon DL data arrival or for positioning purpose, a dedicated signature on PRACH can be allocated by the eNB to the UE. When a dedicated signature on PRACH is allocated, the UE shall perform the corresponding random access procedure regardless of its L1 synchronisation status.

Timing advance updates are signalled by the eNB to the UE in MAC PDUs.

10.1.2.8 Dual Connectivity operation

10.1.2.8.1 SeNB Addition

The SeNB Addition procedure is initiated by the MeNB and is used to establish a UE context at the SeNB in order to provide radio resources from the SeNB to the UE. This procedure is used to add at least the first cell (PSCell) of the SCG. Figure 10.1.2.8.1-1 shows the SeNB Addition procedure.

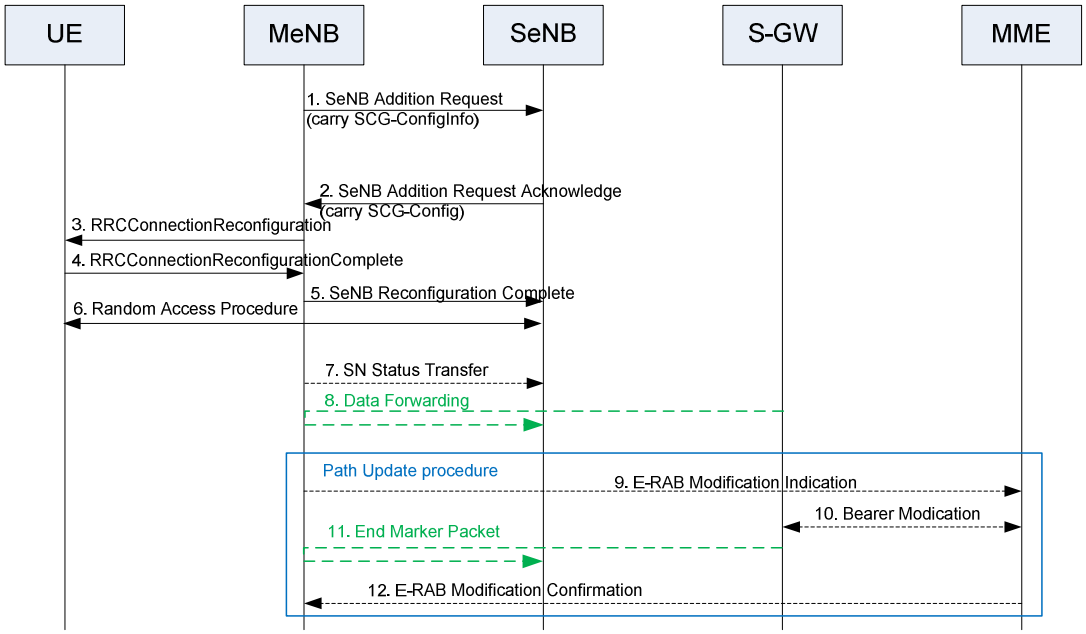


Figure 10.1.2.8.1-1: SeNB Addition procedure

1. The MeNB decides to request the SeNB to allocate radio resources for a specific E-RAB, indicating E-RAB characteristics (E-RAB parameters, TNL address information corresponding to bearer type). In addition, MeNB indicates within *SCG-ConfigInfo* the MCG configuration and the entire UE capabilities for UE capability coordination to be used as basis for the reconfiguration by the SeNB, but does not include SCG configuration. The MeNB can provide the latest measurement results for the SCG cell(s) requested to be added. The SeNB may reject the request.

NOTE: In contrast to SCG bearer, for the split bearer option the MeNB may either decide to request resources from the SeNB of such an amount, that the QoS for the respective E-RAB is guaranteed by the exact sum of resources provided by the MeNB and the SeNB together, or even more. The MeNBs decision may be reflected in step 1 by the E-RAB parameters signalled to the SeNB, which may differ from E-RAB parameters received over S1.

NOTE: For a specific E-RAB, the MeNB may request the direct establishment of an SCG or a Split bearer, i.e., without first having to establish an MCG bearer.

2. If the RRM entity in the SeNB is able to admit the resource request, it allocates respective radio resources and, dependent on the bearer option, respective transport network resources. The SeNB triggers Random Access so that synchronisation of the SeNB radio resource configuration can be performed. The SeNB provides the new radio resource of SCG in *SCG-Config* to the MeNB. For SCG bearers, the SeNB provides the new radio resource of the SCG together with S1 DL TNL address information for the respective E-RAB and security algorithm, for split bearers together with X2 DL TNL address information.

NOTE: In case of split bearers, transmission of user plane data may take place after step 2.

NOTE: In case of SCG bearers, data forwarding and the SN Status Transfer may take place after step 2.

3. If the MeNB endorses the new configuration, the MeNB sends the *RRCConnectionReconfiguration* message to the UE including the new radio resource configuration of SCG according to the *SCG-Config*.

4. The UE applies the new configuration and replies with *RRCConnectionReconfigurationComplete* message. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

5. The MeNB informs the SeNB that the UE has completed the reconfiguration procedure successfully.

6. The UE performs synchronisation towards the PSCell of the SeNB. The order the UE sends the *RRCConnectionReconfigurationComplete* message and performs the Random Access procedure towards the SCG is not defined. The successful RA procedure towards the SCG is not required for a successful completion of the RRC Connection Reconfiguration procedure.

7./8. In case of SCG bearers, and dependent on the bearer characteristics of the respective E-RAB, the MeNB may take actions to minimise service interruption due to activation of dual connectivity (Data forwarding, SN Status Transfer).

9.-12. For SCG bearers, the update of the UP path towards the EPC is performed.

10.1.2.8.2 SeNB Modification

The SeNB Modification procedure may be initiated either by the MeNB or by the SeNB and be used to modify, establish or release bearer contexts, to transfer bearer contexts to and from the SeNB or to modify other properties of the UE context within the same SeNB.

The SeNB modification procedure does not necessarily need to involve signalling towards the UE.

MeNB initiated SeNB Modification

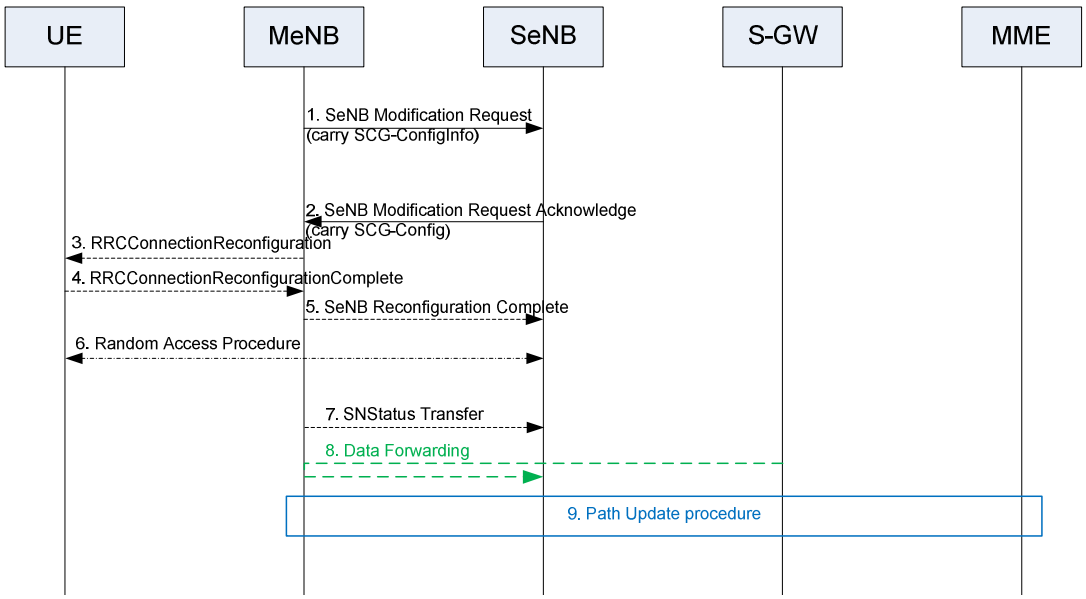


Figure 10.1.2.8.2-1: SeNB Modification procedure - MeNB initiated

The MeNB uses the procedure to initiate configuration changes of the SCG within the same SeNB, e.g. the addition or release of SCG SCells, the addition, modification or release of SCG bearer(s) and the SCG part of split bearer(s) and to trigger PSCell change involving PSCell release. The SeNB may reject the request, except if it concerns the release of SCG cells, of SCG bearer(s) or the SCG part of split bearer(s). Figure 10.1.2.8.2-1 shows an example signalling flow for a MeNB initiated SeNB Modification procedure.

1. The MeNB sends the SeNB Modification Request message, which may contain bearer context related or other UE context related information, data forwarding address information (if applicable) and *SCG-ConfigInfo* which contains the MCG configuration and the entire UE capabilities for UE capability coordination to be used as basis for the reconfiguration by the SeNB. In case of SCG SCell addition request, the MeNB can provide the latest measurement results for the SCG cell(s) requested to be added and SCG serving cell(s). In case of SCG Change, SCG Change Indication is included.

NOTE: MeNB may request the establishment or release of SCG or Split bearer while not reconfiguration to MCG bearer, which can be performed without SCG change.

2. The SeNB responds with the SeNB Modification Request Acknowledge message, which may contain radio configuration information within *SCG-Config* message and data forwarding address information (if applicable). In this step, the SeNB does not initiate an SCG change i.e. the *SCG-Config* message indicates an SCG Change only if the MeNB included the SCG Change Indication in the SeNB Modification Request message (as an SCG change initiated by the SeNB would subsequently require an SCG counter from the MeNB). In case of SCG Change, for E-RABs configured with the split bearer option for which no bearer type change is performed, the SeNB provides a new DL GTP TEID to the MeNB. The MeNB shall continue sending DL PDCP PDUs to the SeNB with the previous DL GTP TEID until it performs PDCP re-establishment or PDCP data recovery, and use the new DL GTP TEID starting with the PDCP re-establishment or data recovery.

¾. The MeNB initiates the RRC connection reconfiguration procedure. The UE applies the new configuration and replies with *RRCConnectionReconfigurationComplete*. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

5. Upon successful completion of the reconfiguration, the success of the procedure is indicated in the SeNB Reconfiguration Complete message.

6. If instructed, the UE performs synchronisation towards the PSCell of the SeNB as described in SeNB addition procedure. Otherwise, the UE may perform UL transmission after having applied the new configuration.

7/8. If applicable, data forwarding between MeNB and the SeNB takes place (Figure 10.1.2.8.2-1 depicts the case where a bearer context is transferred from the MeNB to the SeNB).

9. If applicable, a path update is performed.

SeNB initiated SeNB Modification

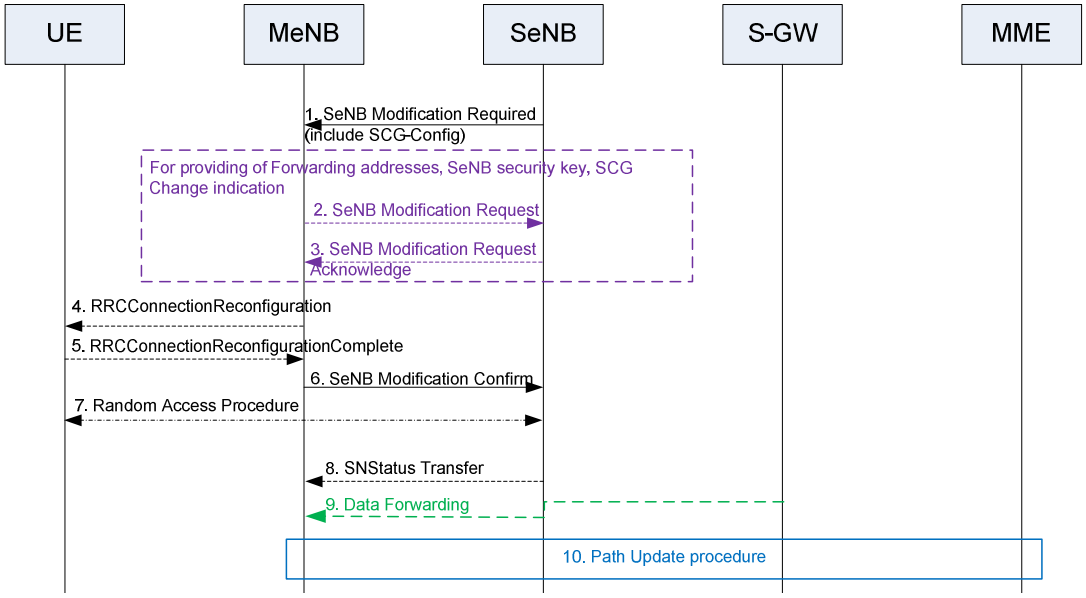


Figure 10.1.2.8.2-2: SeNB Modification procedure - SeNB initiated

The SeNB uses the procedure to perform configuration changes of the SCG within the same SeNB, e.g. to trigger the release of SCG SCell(s) (other than PSCell), SCG bearer(s) and the SCG part of split bearer(s) (upon which the MeNB may release the bearer or reconfigure it to an MCG bearer), and to trigger PSCell change. The MeNB cannot reject the release request of SCG SCells (other than PSCell), SCG bearer and the SCG part of split bearer. The SeNB cannot initiate an SCG SCell addition except for the case of SI update of an SCG SCell. Figure 10.1.2.8.2-2 shows an example signalling flow for an SeNB initiated SeNB Modification procedure.

1. The SeNB sends the SeNB Modification Required message, which may contain bearer context related, other UE context related information and *SCG-Config* which contains the new radio resource configuration of SCG. For bearer release or modification a corresponding E-RAB list is included in the SeNB Modification Required message. In case of SCG Change, SCG Change Indication together with *SCG-Config* are included. In case of release of bearer served by SeNB, *SCG-Config* is not included.

   The SeNB can decide whether the Random Access procedure is required, i.e. SCG change.

2./3. If data forwarding and/or SeNB security key change needs to be applied, the MeNB triggers the preparation of the MeNB initiated SeNB Modification procedure and provides forwarding address and/or a new SeNB security key information within the SeNB Modification Request message, respectively. If the SeNB requested to release a bearer in step 1, and the MeNB decides to reconfigure it to an MCG bearer, the MeNB provides the SCG Change Indication within the SeNB Modification Request message and the SeNB provides respective RRC information in the *SCG-Configuration* within the SeNB Modification Request Acknowledgement message.

NOTE: When the SeNB Modification Required message contains *SCG-Config* in step 1, the following MeNB initiated SeNB Modification procedure triggered by the MeNB in step 2 cannot be used for anything that would require a new SCG configuration (as *SCG-Config* cannot be subsequently signalled by the SeNB).

NOTE: If only SeNB security key (i.e. without SCG Change Indication) is provided in step 2, the MeNB does not need to wait for the reception of step 3 to initiate the RRC connection reconfiguration procedure.

4. If MeNB accepts the SeNB request, the MeNB sends the *RRCConnectionReconfiguration* message to the UE including the new radio resource configuration of SCG according to the *SCG-Config*.

5. The UE applies the new configuration and replies the *RRCConnectionReconfigurationComplete* message. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

6. Upon successful completion of the reconfiguration, the success of the procedure related to *SCG-Config* is indicated in the SeNB Modification Confirm message.

7. If instructed, the UE performs synchronisation towards the PSCell of the SeNB as described in SeNB addition procedure. Otherwise, the UE may perform UL transmission after having applied the new configuration.

8/9. If applicable, data forwarding between MeNB and the SeNB takes place (Figure 10.1.2.8.2-2 depicts the case where a bearer context is transferred from the SeNB to the MeNB).

10. If applicable, a path update is performed.

10.1.2.8.2.1 Intra-MeNB handover involving SCG change

This procedure is used to perform handover within the same MeNB while keeping the SCG in the same SeNB.

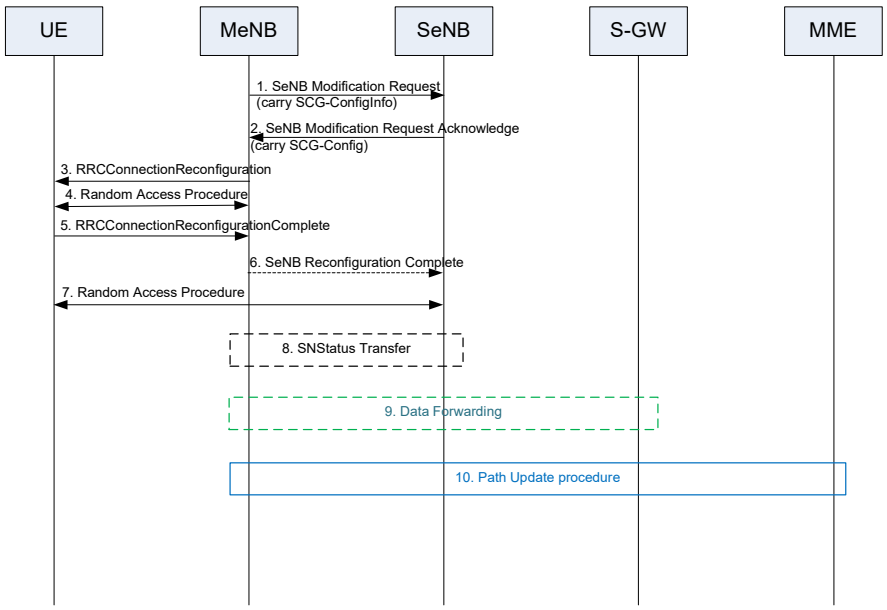


Figure 10.1.2.8.2.1-1: Intra-MeNB handover procedure with SeNB configuration

1. The MeNB sends the SeNB Modification Request message, which may contain bearer context related or other UE context related information, data forwarding address information (if applicable) and *SCG-ConfigInfo* which contains the MCG configuration and the entire UE capabilities for UE capability coordination to be used as basis for the reconfiguration by the SeNB. In case of SCG SCell addition request, the MeNB can provide the latest measurement results for the SCG cell(s) requested to be added and SCG serving cell(s). For E-RABs configured with the split bearer option for which no bearer type change is performed during the SCG Change procedure the MeNB provides a new UL GTP TEID to the SeNB. The SeNB shall continue sending UL PDCP PDUs to the MeNB with the previous UL GTP TEID until it re-establishes the RLC and use the new UL GTP TEID after RLC re-establishment.

2. The SeNB responds with the SeNB Modification Request Acknowledge message, which may contain radio configuration information within *SCG-Config* message and data forwarding address information (if applicable).

3. The MeNB triggers the UE to apply the new configuration including SCG configuration.

4/5. The UE synchronizes to the MeNB.

6. Upon successful completion of the reconfiguration, the success of the procedure is indicated in the SeNB Reconfiguration Complete message.

7. The UE performs synchronisation towards the PSCell of the SeNB as described in SeNB addition procedure.

8/9. Data forwarding between MeNB and the SeNB may take place.

10. If applicable, a path update is performed.

10.1.2.8.3 SeNB Release

The SeNB Release procedure may be initiated either by the MeNB or by the SeNB and is used to initiate the release of the UE context at the SeNB. The recipient node of this request cannot reject.

It does not necessarily need to involve signalling towards the UE, e.g., RRC connection re-establishment due to Radio Link Failure in MeNB.

MeNB initiated SeNB Release

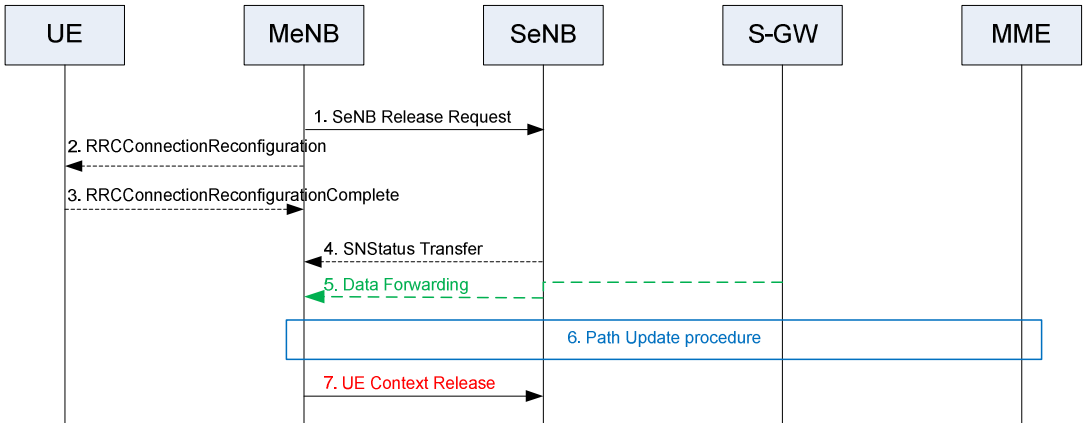


Figure 10.1.2.8.3-1: SeNB Release procedure – MeNB initiated

Figure 10.1.2.8.3-1 shows an example signalling flow for the MeNB initiated SeNB Release procedure.

1. The MeNB initiates the procedure by sending the SeNB Release Request message. If data forwarding is requested, the MeNB provides data forwarding addresses to the SeNB.

2/3. If required, the MeNB indicates in the *RRCConnectionReconfiguration* message towards the UE that the UE shall release the entire SCG configuration. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

NOTE: If data forwarding is applied, timely coordination between steps 1 and 2 may minimize gaps in service provision, this is however regarded to be an implementation matter.

4/5. Data forwarding from the SeNB to the MeNB takes place.

6. If applicable, the path update procedure is initiated.

7. Upon reception of the UE Context Release message, the SeNB can release radio and C-plane related resource associated to the UE context. Any ongoing data forwarding may continue.

SeNB initiated SeNB Release

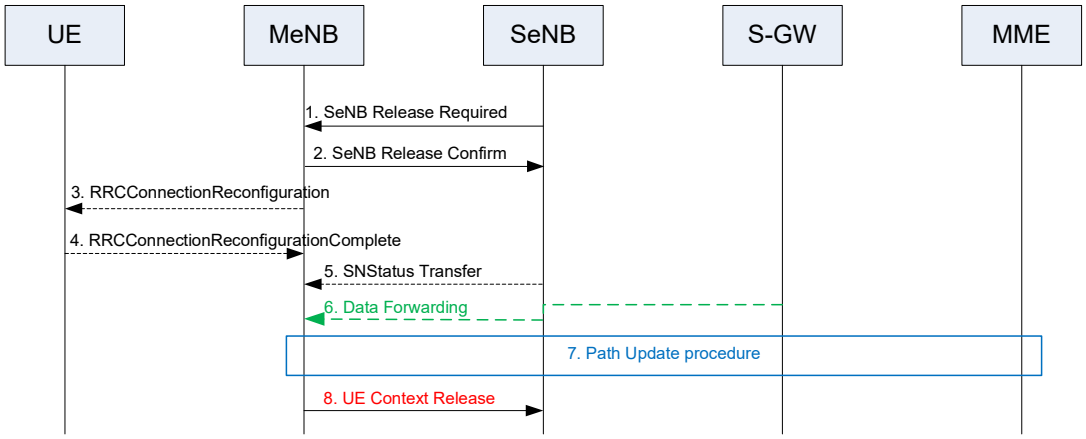


Figure 10.1.2.8.3-2: SeNB Release procedure – SeNB initiated

Figure 10.1.2.8.3-2 shows an example signalling flow for the SeNB initiated SeNB Release procedure.

1. The SeNB initiates the procedure by sending the SeNB Release Required message which does not contain inter-node message.

2. If data forwarding is requested, the MeNB provides data forwarding addresses to the SeNB in the SeNB Release Confirm message. The SeNB may start data forwarding and stop providing user data to the UE as early as it receives the SeNB Release Confirm message.

¾. If required, the MeNB indicates in the *RRCConnectionReconfiguration* message towards the UE that the UE shall release the entire SCG configuration. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

NOTE: If data forwarding is applied, timely coordination between steps 2 and 3 may minimize gaps in service provision. This is however regarded to be an implementation matter.

5/6. Data forwarding from the SeNB to the MeNB takes place.

7. If applicable, the path update procedure is initiated.

8. Upon reception of the UE Context Release message, the SeNB can release radio and C-plane related resource associated to the UE context. Any ongoing data forwarding may continue.

10.1.2.8.4 Change of SeNB

The change of SeNB procedure is initiated by MeNB and used to transfer a UE context from a source SeNB to a target SeNB and to change the SCG configuration in UE from one SeNB to another.

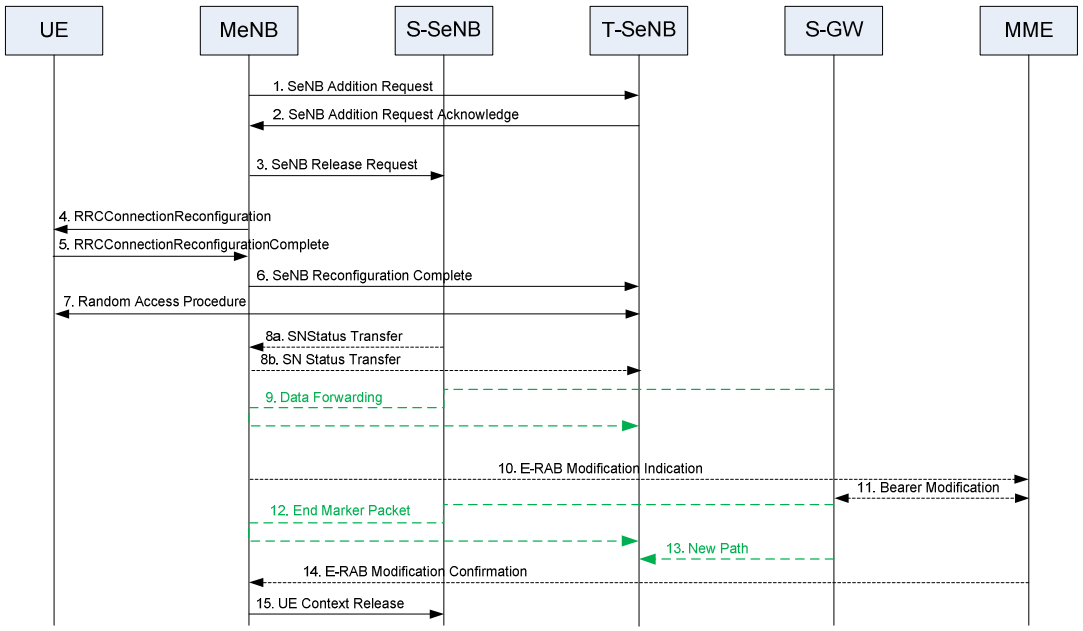


Figure 10.1.2.8.4-1: Change of SeNB

Figure 10.1.2.8.4-1 shows an example signalling flow for the Change of SeNB:

½. The MeNB initiates the change of SeNB by requesting the target SeNB to allocate resources for the UE by means of the SeNB Addition Preparation procedure. MeNB includes the SCG configuration of the old SeNB in the SeNB Addition Request. If forwarding is needed, the target SeNB provides forwarding addresses to the MeNB.

3. If the allocation of target SeNB resources was successful, the MeNB initiates the release of the source SeNB resources towards the UE and the source SeNB. If data forwarding is needed the MeNB provides data forwarding addresses to the source SeNB. Either direct data forwarding or indirect data forwarding is used for SCG bearer. Only indirect data forwarding is used for Split bearer. Reception of the SeNB Release Request message triggers the source SeNB to stop providing user data to the UE and, if applicable, to start data forwarding.

4/5. The MeNB triggers the UE to apply the new configuration. The MeNB indicates the new configuration in the *RRCConnectionReconfiguration* message towards the UE. In case the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message, it performs the reconfiguration failure procedure.

6. If the RRC connection reconfiguration procedure was successful, the MeNB informs the target SeNB.

7. The UE synchronizes to the target SeNB.

8/9. If applicable, data forwarding from the source SeNB takes place. It may be initiated as early as the source SeNB receives the SeNB Release Request message from the MeNB.

10-14. If one of the bearer contexts was configured with the SCG bearer option at the source SeNB, path update is triggered by the MeNB.

15. Upon reception of the UE Context Release message, the source SeNB can release radio and C-plane related resource associated to the UE context. Any ongoing data forwarding may continue.

10.1.2.8.5 MeNB to eNB Change

The MeNB to eNB Change procedure is used to transfer context data from a source MeNB/SeNB to a target eNB.

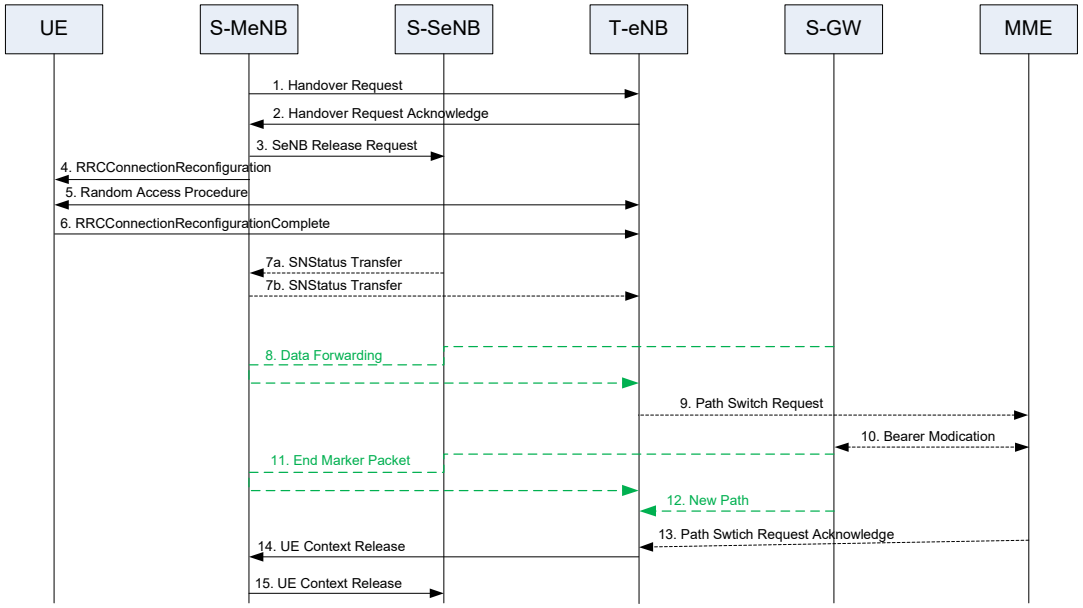


Figure 10.1.2.8.5-1: MeNB to eNB Change procedure

Figure 10.1.2.8.5-1 shows an example signalling flow for the MeNB to eNB Change procedure:

1. The source MeNB starts the MeNB to eNB Change procedure by initiating the X2 Handover Preparation procedure. The source MeNB includes the SCG configuration in the *HandoverPreparationInformation*.

2. The target eNB includes the field in HO command which releases SCG configuration, and may also provide forwarding addresses to the source MeNB. The addition of an SeNB can be initiated only after completing HO.

3. If the allocation of target eNB resources was successful, the MeNB initiates the release of the source SeNB resources towards the source SeNB. If data forwarding is needed, the MeNB provides data forwarding addresses to the source SeNB. Either direct data forwarding or indirect data forwarding is used for SCG bearer. Only indirect data forwarding is used for Split bearer. Reception of the SeNB Release Request message triggers the source SeNB to stop providing user data to the UE and, if applicable, to start data forwarding.

4. The MeNB triggers the UE to apply the new configuration. Upon receiving the new configuration, the UE releases the entire SCG configuration.

5/6. The UE synchronizes to the target eNB.

7/8. If applicable, data forwarding from the source SeNB takes place. It may start as early as the source SeNB receives the SeNB Release Request message from the MeNB.

9-13. The target eNB initiates the S1 Path Switch procedure.

14. The target eNB initiates the UE Context Release procedure towards the source MeNB.

15. Upon reception of the UE CONTEXT RELEASE message, the S-SeNB can release radio and C-plane related resource associated to the UE context. Any ongoing data forwarding may continue.

10.1.2.8.6 SCG change

"SCG change" refers to a synchronous SCG reconfiguration procedure towards the UE involving random access on PSCell. This procedure is used to establish SCG, and can be used to reconfigure the SCG configuration. During SCG change, MAC configured for SCG is reset and RLC configured for SCG is re-established regardless of the bearer type(s) established on SCG. For SCG bearer, PDCP configured for SCG is re-established. In case of reconfiguration from split to MCG bearer, RLC configured for SCG is released. During SCG change, S-K_{eNB} key is refreshed. To perform SCG change within the same SeNB, the SeNB Modification procedure as described in section 10.1.2.8.2 is used and in this case, the path switch and data forwarding for DRB on SCG may be suppressed. To perform SCG change between different SeNBs, the change of SeNB as described in section 10.1.2.8.4 is used.

10.1.3 Measurements

Measurements to be performed by a UE for intra/inter-frequency mobility can be controlled by E-UTRAN, using broadcast or dedicated control. In RRC_IDLE state, a UE shall follow the measurement parameters defined for cell reselection specified by the E-UTRAN broadcast. The use of dedicated measurement control for RRC_IDLE state is possible through the provision of UE specific priorities (see sub-clause 10.2.4). In RRC_CONNECTED state, a UE shall follow the measurement configurations specified by RRC directed from the E-UTRAN (e.g. as in UTRAN MEASUREMENT_CONTROL).

In RRC_IDLE and RRC_CONNECTED the UE may be configured to monitor some UTRA or E-UTRA carriers according to reduced performance requirements as specified in 36.133 [21].

For CSI-RS based discovery signals measurements, "cell" should be interpreted as "transmission point of the concerned cell" in the following descriptions.

Intra-frequency neighbour (cell) measurements and inter-frequency neighbour (cell) measurements are defined as follows:

- Intra-frequency neighbour (cell) measurements: Neighbour cell measurements performed by the UE are intra-frequency measurements when the current and target cell operates on the same carrier frequency. The UE shall be able to carry out such measurements without measurement gaps.

- Inter-frequency neighbour (cell) measurements: Neighbour cell measurements performed by the UE are inter-frequency measurements when the neighbour cell operates on a different carrier frequency, compared to the current cell. The UE should not be assumed to be able to carry out such measurements without measurement gaps.

Whether a measurement is non gap assisted or gap assisted depends on the UE's capability and the current operating frequency. The UE determines whether a particular cell measurement needs to be performed in a transmission/reception gap and the scheduler needs to know whether gaps are needed:

- Same carrier frequency and cell bandwidths (Scenario A): an intra-frequency scenario; not measurement gap assisted.

- Same carrier frequency, bandwidth of the target cell smaller than the bandwidth of the current cell (Scenario B): an intra-frequency scenario; not measurement gap assisted.

- Same carrier frequency, bandwidth of the target cell larger than the bandwidth of the current cell (Scenario C): an intra-frequency scenario; not measurement gap assisted.

- Different carrier frequencies, bandwidth of the target cell smaller than the bandwidth of the current cell and bandwidth of the target cell within bandwidth of the current cell (Scenario D): an inter-frequency scenario; measurement gap-assisted scenario.

- Different carrier frequencies, bandwidth of the target cell larger than the bandwidth of the current cell and bandwidth of the current cell within bandwidth of the target cell (Scenario E): an inter-frequency scenario; measurement gap-assisted scenario.

- Different carrier frequencies and non-overlapping bandwidth, (Scenario F): an inter-frequency scenario; measurement gap-assisted scenario.

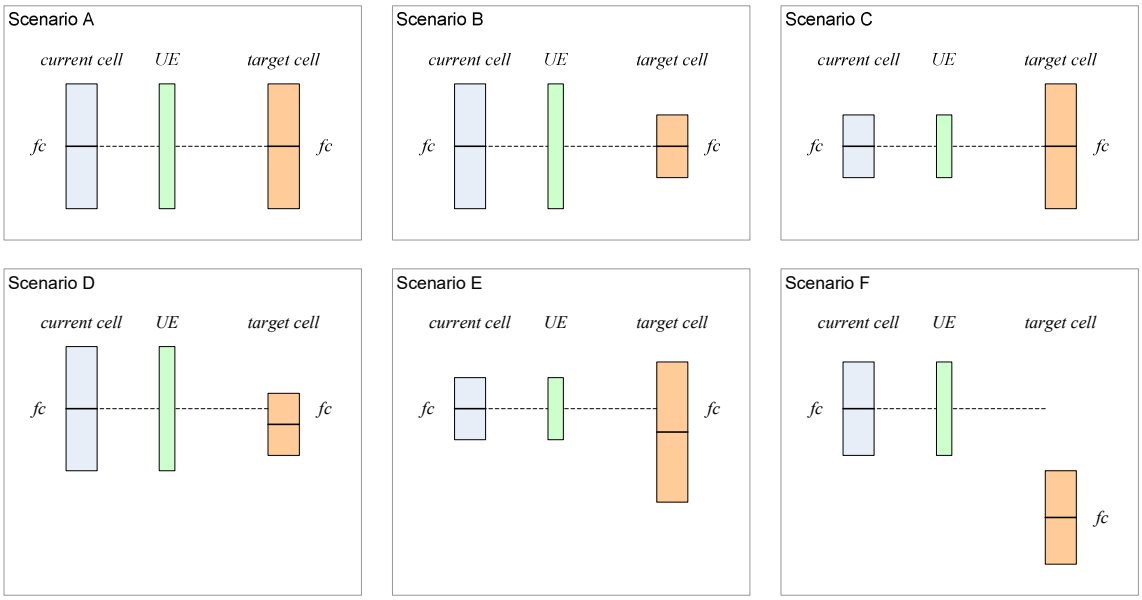


Figure 10.1.3-1: Inter and Intra-frequency measurements scenarios

Measurement gaps patterns are configured and activated by RRC.

When CA is configured, the "current cell" above refers to any serving cell of the configured set of serving cells. For instance, for the definition of intra and inter frequency measurements, this means:

- Intra-frequency neighbour (cell) measurements: Neighbour cell measurements performed by the UE are intra-frequency measurements when one of the serving cells of the configured set and the target cell operates on the same carrier frequency. The UE shall be able to carry out such measurements without measurement gaps.
- Inter-frequency neighbour (cell) measurements: Neighbour cell measurements performed by the UE are inter-frequency measurements when the neighbour cell operates on a different carrier frequency than any serving cell of the configured set. The UE should not be assumed to be able to carry out such measurements without measurement gaps.

When DC is configured, the following principles are applied:

- The configured set of serving cells includes all the cells from MCG and SCG as for CA;
- The measurement procedure of serving cells belonging to the SeNB shall not be impacted due to RLF of SeNB;
- Common gap for the MeNB and the SeNB is applied;
  - There is only a single measurement gap configuration for the UE which is controlled and informed by the MeNB.
- UE determines the starting point of the measurement gap based on the SFN, subframe number and subframe boundaries of the MCG serving cells.

10.1.3.1 Intra-frequency neighbour (cell) measurements

In a system with frequency reuse = 1, mobility within the same frequency layer (i.e. between cells with the same carrier frequency) is predominant. Good neighbour cell measurements are needed for cells that have the same carrier frequency as the serving cell in order to ensure good mobility support and easy network deployment. Search for neighbour cells with the same carrier frequency as the serving cell, and measurements of the relevant quantities for identified cells are needed.

NOTE: To avoid UE activity outside the DRX cycle, the reporting criteria for neighbour cell measurements should match the used DRX cycle.

10.1.3.2 Inter-frequency neighbour (cell) measurements

Regarding mobility between different frequency layers (i.e. between cells with a different carrier frequency), UE may need to perform neighbour cell measurements during DL/UL idle periods that are provided by DRX or packet scheduling (i.e. gap assisted measurements).

10.1.4 Paging and C-plane establishment

Paging groups (where multiple UEs can be addressed) are used on PDCCH:

- Precise UE identity is found on PCH;
- DRX configurable via BCCH and NAS;
- Only one subframe allocated per paging interval per UE;
- The network may divide UEs to different paging occasions in time;
- There is no grouping within paging occasion;
- One paging RNTI for PCH.

10.1.5 Random Access Procedure

The random access procedure is characterized by:

- Common procedure for FDD and TDD;
- One procedure irrespective of cell size and the number of serving cells when CA is configured;

The random access procedure is performed for the following events related to the PCell:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- Handover;
- DL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised".
- UL data arrival during RRC_CONNECTED requiring random access procedure:
  - E.g. when UL synchronisation status is "non-synchronised" or there are no PUCCH resources for SR available.
- For positioning purpose during RRC_CONNECTED requiring random access procedure;
  - E.g. when timing advance is needed for UE positioning.

The random access procedure is also performed on a SCell to establish time alignment for the corresponding sTAG.

In DC, the random access procedure is also performed on at least PSCell upon SCG addition/modification, if instructed, or upon DL/UL data arrival during RRC_CONNECTED requiring random access procedure. The UE initiated random access procedure is performed only on PSCell for SCG.

Furthermore, the random access procedure takes two distinct forms:

- Contention based (applicable to first five events);
- Non-contention based (applicable to only handover, DL data arrival, positioning and obtaining timing advance alignment for a sTAG).

Normal DL/UL transmission can take place after the random access procedure.

An RN supports both contention-based and non-contention-based random access. When an RN performs the random access procedure, it suspends any current RN subframe configuration, meaning it temporarily disregards the RN subframe configuration. The RN subframe configuration is resumed at successful random access procedure completion.

10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

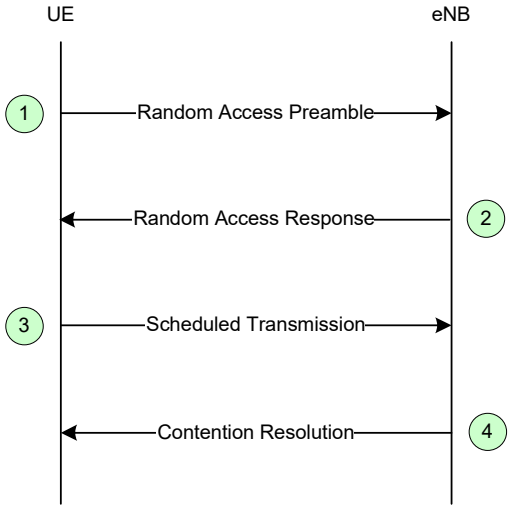


Figure 10.1.5.1-1: Contention based Random Access Procedure

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:
   - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.
2) Random Access Response generated by MAC on DL-SCH:
   - Semi-synchronous (within a flexible window of which the size is one or more TTI) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least RA-preamble identifier, Timing Alignment information for the pTAG, initial UL grant and assignment of Temporary C-RNTI (which may or may not be made permanent upon Contention Resolution);
   - Intended for a variable number of UEs in one DL-SCH message.
3) First scheduled UL transmission on UL-SCH:
   - Uses HARQ;
   - Size of the transport blocks depends on the UL grant conveyed in step 2.
   - For initial access:
     - Conveys the RRC Connection Request generated by the RRC layer and transmitted via CCCH;
     - Conveys at least NAS UE identifier but no NAS message;
     - RLC TM: no segmentation.
   - For RRC Connection Re-establishment procedure:

- Conveys the RRC Connection Re-establishment Request generated by the RRC layer and transmitted via CCCH;
- RLC TM: no segmentation;
- Does not contain any NAS message.

- After handover, in the target cell:
  - Conveys the ciphered and integrity protected RRC Handover Confirm generated by the RRC layer and transmitted via DCCH;
  - Conveys the C-RNTI of the UE (which was allocated via the Handover Command);
  - Includes an uplink Buffer Status Report when possible.
- For other events:
  - Conveys at least the C-RNTI of the UE.

4) Contention Resolution on DL:
   - Early contention resolution shall be used i.e. eNB does not wait for NAS reply before resolving contention;
   - Not synchronised with message 3;
   - HARQ is supported;
   - Addressed to:
     - The Temporary C-RNTI on PDCCH for initial access and after radio link failure;
     - The C-RNTI on PDCCH for UE in RRC_CONNECTED.
   - HARQ feedback is transmitted only by the UE which detects its own UE identity, as provided in message 3, echoed in the Contention Resolution message;
   - For initial access and RRC Connection Re-establishment procedure, no segmentation is used (RLC-TM).

The Temporary C-RNTI is promoted to C-RNTI for a UE which detects RA success and does not already have a C-RNTI; it is dropped by others. A UE which detects RA success and already has a C-RNTI, resumes using its C-RNTI.

When CA is configured, the first three steps of the contention based random access procedures occur on the PCell while contention resolution (step 4) can be cross-scheduled by the PCell.

When DC is configured, the first three steps of the contention based random access procedures occur on the PCell in MCG and PSCell in SCG. When CA is configured in SCG, the first three steps of the contention based random access procedures occur on the PSCell while contention resolution (step 4) can be cross-scheduled by the PSCell.

10.1.5.2 Non-contention based random access procedure

The non-contention based random access procedure is outlined on Figure 10.1.5.2-1 below:

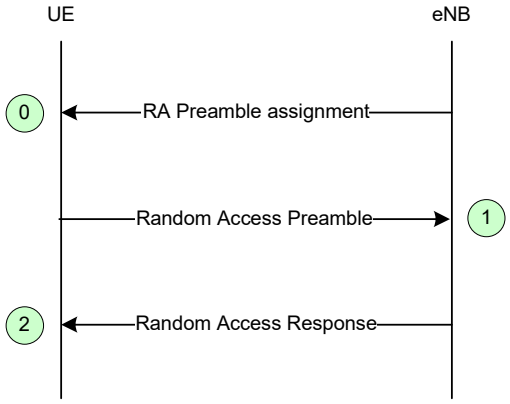


Figure 10.1.5.2-1: Non-contention based Random Access Procedure

The three steps of the non-contention based random access procedures are:

0) Random Access Preamble assignment via dedicated signalling in DL:
   - eNB assigns to UE a non-contention Random Access Preamble (a Random Access Preamble not within the set sent in broadcast signalling).
   - Signalled via:
     - HO command generated by target eNB and sent via source eNB for handover;
     - PDCCH in case of DL data arrival or positioning;
     - PDCCH for initial UL time alignment for a sTAG.
1) Random Access Preamble on RACH in uplink:
   - UE transmits the assigned non-contention Random Access Preamble.
2) Random Access Response on DL-SCH:
   - Semi-synchronous (within a flexible window of which the size is two or more TTIs) with message 1;
   - No HARQ;
   - Addressed to RA-RNTI on PDCCH;
   - Conveys at least:
     - Timing Alignment information and initial UL grant for handover;
     - Timing Alignment information for DL data arrival;
     - RA-preamble identifier;
     - Intended for one or multiple UEs in one DL-SCH message.

When performing non-contention based random access on the PCell while CA is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the PCell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the sTAG. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell.

When performing non-contention based random access on the PCell or PSCell while DC is configured, the Random Access Preamble assignment via PDCCH of step 0, step 1 and 2 of the non-contention based random access procedure occur on the corresponding cell. In order to establish timing advance for a sTAG, the eNB may initiate a non-contention based random access procedure with a PDCCH order (step 0) that is sent on a scheduling cell of activated SCell of the

sTAG not including PSCell. Preamble transmission (step 1) is on the indicated SCell and Random Access Response (step 2) takes place on PCell for MCG and PSCell for SCG.

10.1.5.3 Interaction model between L1 and L2/3 for Random Access Procedure

Random access procedure described above is modelled in Figure 10.1.5.3-1 below from L1 and L2/3 interaction point of view. L2/L3 receives indication from L1 whether ACK is received or DTX is detected after indication of Random Access Preamble transmission to L1. L2/3 indicates L1 to transmit first scheduled UL transmission (RRC Connection Request in case of initial access) if necessary or Random Access Preamble based on the indication from L1.

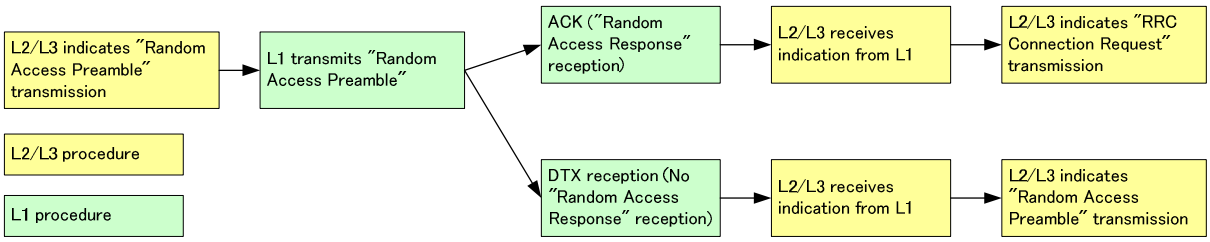


Figure 10.1.5.3-1: Interaction model between L1 and L2/3 for Random Access Procedure

10.1.6 Radio Link Failure

Two phases govern the behaviour associated to radio link failure as shown on Figure 10.1.6-1:

- First phase:
  - started upon radio problem detection;
  - leads to radio link failure detection;
  - no UE-based mobility;
  - based on timer or other (e.g. counting) criteria (T_1).
- Second Phase:
  - started upon radio link failure detection or handover failure;
  - leads to RRC_IDLE;
  - UE-based mobility;
  - Timer based (T_2).

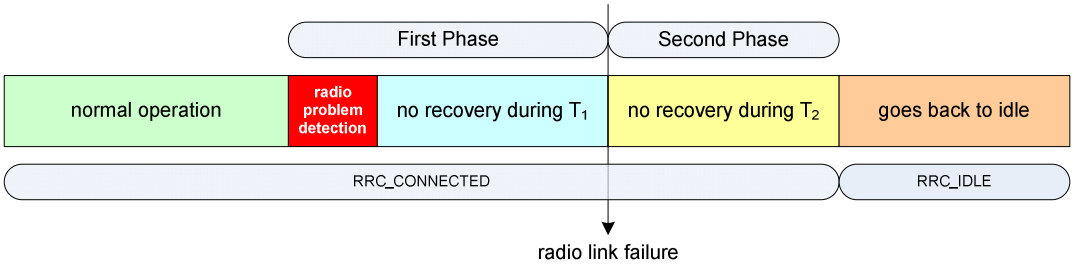


Figure 10.1.6-1: Radio Link Failure

Table 10.1.6-1 below describes how mobility is handled with respect to radio link failure:

Table 10.1.6-1: Mobility and Radio Link Failure

Cases	First Phase	Second Phase	T2 expired
UE returns to the same cell	Continue as if no radio problems occurred	Activity is resumed by means of explicit signalling between UE and eNB	Go via RRC_IDLE
UE selects a different cell from the same eNB	N/A	Activity is resumed by means of explicit signalling between UE and eNB	Go via RRC_IDLE
UE selects a cell of a prepared eNB (NOTE)	N/A	Activity is resumed by means of explicit signalling between UE and eNB	Go via RRC_IDLE
UE selects a cell of a different eNB that is not prepared (NOTE)	N/A	Go via RRC_IDLE	Go via RRC_IDLE
NOTE: a prepared eNB is an eNB which has admitted the UE during an earlier executed HO preparation phase, or obtains the UE context during the Second Phase.			

In the Second Phase, in order to resume activity and avoid going via RRC_IDLE when the UE returns to the same cell or when the UE selects a different cell from the same eNB, or when the UE selects a cell from a different eNB, the following procedure applies:

- The UE stays in RRC_CONNECTED;
- The UE accesses the cell through the random access procedure;
- The UE identifier used in the random access procedure for contention resolution (i.e. C-RNTI of the UE in the cell where the RLF occurred + physical layer identity of that cell + short MAC-I based on the keys of that cell) is used by the selected eNB to authenticate the UE and check whether it has a context stored for that UE:
  - If the eNB finds a context that matches the identity of the UE, or obtains this context from the previously serving eNB, it indicates to the UE that its connection can be resumed;
  - If the context is not found, RRC connection is released and UE initiates procedure to establish new RRC connection. In this case UE is required to go via RRC_IDLE.

The radio link failure procedure applies also for RNs, with the exception that the RN is limited to select a cell from its DeNB cell list. Upon detecting radio link failure, the RN discards any current RN subframe configuration (for communication with its DeNB), enabling the RN to perform normal contention-based RACH as part of the re-establishment. Upon successful re-establishment, an RN subframe configuration can be configured again using the RN reconfiguration procedure.

For DC, PCell supports above phases. In addition, the first phase of the radio link failure procedure is supported for PSCell. However, upon detecting RLF on the PSCell, the re-establishment procedure is not triggered at the end of the first phase. Instead, UE shall inform the radio link failure of PSCell to the MeNB.

NOTE: If the recovery attempt in the second phase fails, the details of the RN behaviour in RRC_IDLE to recover an RRC connection are up to the RN implementation.

10.1.7 Radio Access Network Sharing

E-UTRAN shall support radio access network sharing based on support for multi-to-multi relationship between E-UTRAN nodes and EPC nodes (S1-flex).

If the E-UTRAN is shared by multiple operators, the system information broadcasted in each shared cell contains the PLMN-id of each operator (up to 6) and a single tracking area code (TAC) valid within all the PLMNs sharing the radio access network resources.

The UE shall be able to read up to 6 PLMN-ids, to select one of the PLMN-ids at initial attachment and to indicate this PLMN-id to the E-UTRAN in subsequent instances of the Random Access procedures (e.g. as defined in subclause 10.1.5). The E-UTRAN shall select an appropriate MME for the PLMN indicated by the UE. Once attached to an MME, the UE shall be able to indicate the allocated MME in subsequent instances of the Random Access procedures. The indication of the allocated MMEC is contained in the temporary UE identity.

Handling of roaming and access restrictions for UE in ECM-CONNECTED shall follow the principles specified in sub-clause 10.4a.

10.1.8 Handling of Roaming and Area Restrictions for UEs in ECM-CONNECTED

NOTE: The term Roaming and Area Restrictions is not used in Rel-11 and onwards. It has been replaced by the term Roaming and Access Restrictions, see section 10.1.8a.

10.1.8a Handling of Roaming and Access Restrictions for UEs in ECM-CONNECTED

Handling of roaming and access restrictions and handling of subscription specific preferences in ECM-CONNECTED is performed in the eNB based on information provided by the EPC over the S1 interface.

10.2 Inter RAT

Service-based redirection between GERAN / UTRAN and E-UTRAN is supported in both directions. This should not require inter-RAT reporting in RRC CONNECTION REQUEST.

10.2.1 Cell reselection

A UE in RRC_IDLE performs cell reselection. The principles of this procedure are as follows:

- The UE makes **measurements** of attributes of the serving and neighbour cells to enable the reselection process:
  - For a UE to search and measure neighbouring GERAN cells, the ARFCNs of the BCCH carriers need to be indicated in the serving cell system information (i.e., an NCL). The NCL does not contain BSICs or cell specific offsets and Qrxlevmin is given per frequency band.
  - For a UE to search and measure neighbouring UTRAN cells, the serving cell can indicate an NCL containing a list of carrier frequencies and scrambling codes.
  - Measurements may be omitted if the serving cell attribute fulfils particular search or measurement criteria.
- **Cell reselection** identifies the cell that the UE should camp on. It is based on cell reselection criteria which involves measurements of the serving and neighbour cells:
  - Inter-RAT reselection is based on absolute priorities where UE tries to camp on highest priority RAT available. Absolute priorities for inter-RAT reselection are provided only by the RPLMN and valid only within the RPLMN; priorities are given by the system information and valid for all UEs in a cell, specific priorities per UE can be signalled in the RRC Connection Release message. A validity time can be associated with UE specific priorities.
  - It should be possible to prevent the UE from reselecting to specific detected neighbouring cells;
  - The UE is allowed to "leave" the source E-UTRAN cell to read the target GERAN cell broadcast, in order to determine its "suitability", prior to completing the cell reselection;
  - Cell reselection can be speed dependent (speed detection based on UTRAN solution);

Cell access restrictions apply as for UTRAN, which consist of access class (AC) barring and cell reservation (e.g. for cells "reserved for operator use") applicable for mobiles in RRC_IDLE mode.

When performing cell reselection while the UE is camped on another RAT, the principles of this procedure are as follows:

- The UE measures attributes of the E-UTRA neighbouring cells:
  - Only the carrier frequencies need to be indicated to enable the UE to search and measure E-UTRA neighbouring cells;
- Cell reselection identifies the cell that the UE should camp on. It is based on cell reselection criteria which involves measurements of the serving and neighbour cells:

  - For E-UTRA neighbouring cells, there is no need to indicate cell-specific cell reselection parameters i.e. these parameters are common to all neighbouring cells on an E-UTRA frequency;

- Cell reselection parameters are applicable to all UEs in a cell, but it is possible to configure specific reselection parameters per UE group or per UE.

- It should be possible to prevent the UE from reselecting to specific detected neighbouring cells.

10.2.2 Handover

Inter RAT HO is designed so that changes to GERAN and UTRAN are minimised. This can be done by following the principles specified for GERAN to/from UTRAN intersystem HO. In particular the following principles are applied to E-UTRAN Inter RAT HO design:

1. Inter RAT HO is network controlled through source access system. The source access system decides about starting the preparation and provides the necessary information to the target system in the format required by the target system. That is, the source system adapts to the target system. The actual handover execution is decided in the source system.

2. Inter RAT HO is backwards handover, i.e. radio resources are prepared in the target 3GPP access system before the UE is commanded by the source 3GPP access system to change to the target 3GPP access system.

3. To enable backwards handover, and while RAN level interfaces are not available, a control interface exists in CN level. In Inter RAT HO involving E-UTRAN access, this interface is between 2G/3G SGSN and corresponding MME/Serving Gateway.

4. The target access system will be responsible for giving exact guidance for the UE on how to make the radio access there (this includes radio resource configuration, target cell system information etc.). This information is given during the handover preparation and should be transported completely transparently through the source access system to the UE.

5. Mechanisms for avoiding or mitigating the loss of user data (i.e. forwarding) can be used until the 3GPP Anchor determines that it can send DL U-plane data directly to the target system.

6. The handover procedure should not require any UE to CN signalling in order for data to start to flow in the target system. This requires that the security context, UE capability context and QoS context is transferred (or translated) within the network between source and target system.

7. Similar handover procedure should apply for handovers of both real time and non-real time services.

8. Similar handover procedure should apply for both Inter RAT Handover and intra-LTE Handover with EPC node change.

9. Network controlled mobility is supported even if no prior UE measurements have been performed on the target cell and/or frequency i.e. "blind HO" is supported.

10.2.2a Inter-RAT cell change order to GERAN with NACC

For interworking towards GERAN, inter-RAT cell change order with NACC is supported even if no prior UE measurements have been performed on the system i.e. "blind NACC" is supported.

10.2.2b Inter-RAT handovers from E-UTRAN

10.2.2b.1 Data forwarding

10.2.2b.1.1 For RLC-AM bearers

Upon handover, the eNB may forward all downlink PDCP SDUs that have not been acknowledged by the UE, or all downlink PDCP SDUs that have not been transmitted to the UE, to the target node. In addition, the eNB may forward fresh data arriving over S1 to the target node.

NOTE: Any assigned PDCP SNs are not forwarded because of PDCP reset.

NOTE: Target node does not have to wait for the completion of forwarding from the eNB before it begins transmitting packets to the UE.

The eNB discards any remaining downlink RLC PDUs.

Upon handover, all successfully received PDCP SDUs are delivered to the upper layers in the UE.

NOTE: eNB does not need to abort ongoing RLC transmissions with the UE as it starts data forwarding to the target node.

Upon handover, the eNB may forward uplink PDCP SDUs successfully received to the Serving Gateway and shall discard any remaining uplink RLC PDUs.

Correspondingly, the eNB does not forward the downlink and uplink RLC context.

For the uplink, the UE transmits over the target RAT from the first PDCP SDU for which transmission has not been attempted in the source cell.

In-sequence delivery of upper layer PDUs during handover is not guaranteed.

10.2.2b.1.2 For RLC-UM bearers

Upon handover, the eNB does not forward to the target node downlink PDCP SDUs for which transmission had been completed in the source cell. PDCP SDUs that have not been transmitted may be forwarded. In addition, the eNB may forward fresh data arriving over S1 to the target node. The eNB discards any remaining downlink RLC PDUs.

Upon handover, all successfully received PDCP SDUs are delivered to the upper layers in the UE.

Upon handover, the eNB may forward all uplink PDCP SDUs successfully received to the Serving Gateway and discards any remaining uplink RLC PDUs.

For the uplink, the UE transmits over the target RAT from the first PDCP SDU for which transmission has not been attempted in the source cell.

Correspondingly, the eNB does not forward the downlink and uplink RLC context.

10.2.3 Measurements

10.2.3.1 Inter-RAT handovers from E-UTRAN

Measurements to be performed by a UE for inter-RAT mobility can be controlled by E-UTRAN, using broadcast or dedicated control. In RRC_CONNECTED state, a UE shall follow the measurement parameters specified by RRC directed from the E-UTRAN (e.g. as in UTRAN MEASUREMENT_CONTROL).

UE performs inter-RAT neighbour cell measurements during DL/UL idle periods that are provided by the network through suitable DRX/DTX period or packet scheduling if necessary.

10.2.3.2 Inter-RAT handovers to E-UTRAN

From UTRAN, UE performs E-UTRAN measurements by using idle periods created by compressed mode (CELL_DCH) or DRX (other states) or measurement occasions (CELL_FACH).

From GERAN, E-UTRAN measurements are performed in the same way as WCDMA measurements for handover to UTRAN: E-UTRAN measurements are performed in GSM idle frames in a time multiplexed manner.

10.2.3.3 Inter-RAT cell reselection from E-UTRAN

In RRC_IDLE state, a UE shall follow the measurement parameters specified by the E-UTRAN broadcast (as in UTRAN SIB). The use of dedicated measurement control is possible through the provision of UE specific priorities (see sub-clause 10.2.4).

10.2.3.4 Limiting measurement load at UE

Introduction of E-UTRA implies co-existence of various UE capabilities. Each UE may support different combinations of RATs, e.g., E-UTRA, UTRA, GSM, and non-3GPP RATs, and different combinations of frequency bands, e.g., 800 MHz, 1.7 GHz, 2 GHZ, etc. Despite such heterogeneous environment, the measurement load at UE should be minimised. To limit the measurement load and the associated control load:

- E-UTRAN can configure the RATs to be measured by UE;

- The number of measurement criteria (event and periodic reporting criteria) should be limited (as in TS 25.133 subclause 8.3.2 [7]);
- E-UTRAN should be aware of the UE capabilities for efficient measurement control, to prevent unnecessary waking up of the measurement entity;
- Blind HO (i.e., HO without measurement reports from UE) is possible.

10.2.4 Network Aspects

Inter-frequency/inter-RAT UE based mobility relies on a "priority based scheme", where the network configures a list of RATs/frequencies to be taken as basis for UE's inter-frequency/inter-RAT cell reselection decisions in priority order. E-UTRAN cells can enable inter-frequency/inter-RAT cell reselection by broadcasting a common priority valid for all UEs in a given cell in addition to other inter-frequency/inter-RAT information.

NOTE: The same principles apply in UTRAN.

These common priorities can be overwritten by E-UTRAN through dedicated signalling to individual UEs at RRC_CONNECTED to RRC_IDLE transition.

NOTE: In order to have consistent inter-RAT operation, the same principles apply to inter-RAT reselection to E-UTRAN. For UTRAN this includes also the transitions within RRC_CONNECTED state from CELL_DCH to CELL_PCH and URA_PCH.

Setting dedicated priorities by E-UTRAN can be based on subscription related information provided by the MME.

10.2.5 CS fallback

CS fallback can be performed via different options. The following table summarize the various CS fallback options per RAT, necessary UE capabilities and FGI index which should be set to '1'. The meaning of FGI index is specified in [16, Annex B]

Table 10.2.5-1: CS fallback options

Target RAT	Solutions	Release	UE Capability	FGI Index
CS fallback to UMTS	RRC Connection Release with Redirection without Sys Info	Rel-8	(NOTE 1) Mandatory for UEs supporting CS fallback to UMTS	
	RRC Connection Release with Redirection with Sys Info	Rel-9	(NOTE 1) e-RedirectionUTRA	
	PS handover with DRB(s)	Rel-8	(NOTE 1) Mandatory for UEs supporting CS fallback to UMTS	FGI8, FGI22
CS fallback to GSM	RRC Connection Release with Redirection without Sys Info	Rel-8	(NOTE 2) Mandatory for UEs supporting CS fallback to GSM	
	RRC Connection Release with Redirection with Sys Info	Rel-9	(NOTE 2) Mandatory for UEs supporting CS fallback to GSM	
	Cell change order without NACC	Rel-8	(NOTE 2) Mandatory for UEs supporting CS fallback to GSM	FGI10
	Cell change order with NACC	Rel-8	(NOTE 2) Mandatory for UEs supporting CS fallback to GSM	FGI10
	PS handover	Rel-8	(NOTE 2) interRAT-PS-HO-ToGERAN	
NOTE 1: All CS fallback to UMTS capable UE shall indicate that it supports UTRA FDD or TDD and supported band list in the UE capability. NOTE 2: All CS fallback to GSM capable UE shall indicate that it supports GERAN and supported band list in the UE capability. NOTE 3: The measurement may be performed before any of the above CS fallback solution is triggered to select the target cell or frequency layer more accurately based on eNB decision. eNB may trigger any of above CS fallback solutions blindly.				

10.3 Mobility between E-UTRAN and Non-3GPP radio technologies

10.3.1 UE Capability Configuration

A UE shall be able to communicate with the E-UTRAN about its radio access capability, such as the system (including the release and frequency band) it supports and its receive and transmit capabilities (single/dual radio, dual receiver). UE shall transfer its capability about other radio technologies over E-UTRAN using the same procedure used to carry its E-UTRAN radio capability.

10.3.2 Mobility between E-UTRAN and cdma2000 network

This section describes the E-UTRAN mechanisms to support idle and active mode mobility between E-UTRAN and cdma2000 HRPD or 1xRTT. The overall system is described in [17].

10.3.2.1 Tunnelling of cdma2000 Messages over E-UTRAN between UE and cdma2000 Access Nodes

In order to efficiently support handover procedures when on E-UTRAN with a cdma2000 target system, cdma2000 messages are sent transparently to the target system over the E-UTRAN, with the eNB and MME acting as relay points.

To support the MME in its selection of the correct target system node to which it should route an Uplink tunnelled message and to provide the target system with information that is needed to resolve technology-specific measurement information (RouteUpdate and pilot strength measurements) that are delivered to the cdma2000 system, each eNB cell is associated with a cdma2000 HRPD SectorID and/or with a cdma2000 1xRTT SectorID (generically referred to as cdma2000 reference cellid). This cdma2000 reference cellid is provided by the eNB to the MME using the cdma2000 message transfer capability over S1-AP and forwarded to the target system via the S101 interface and corresponding interface to the cdma2000 1xRTT system.

Tunnelling is achieved over the E-UTRAN radio interface by encapsulating tunnelled cdma2000 messages in the UL Information Transfer (for pre-registration signalling) or UL Handover Preparation transfer (for handover signalling) and DL Information Transfer RRC messages (e.g., similar to UMTS Uplink/Downlink Direct Transfer). The reason for using different UL transfer messages is so that the UL Handover Preparation transfer messages can use a higher priority signalling radio bearer. For the UL/DL Information Transfer messages a specific IE in these RRC messages is used to identify the type of information contained in the message (e.g., NAS, TunneledMsg). Additionally if the message is carrying a tunnelled message, an additional IE is included to carry cdma2000 specific RRC Tunnelling Procedure Information (e.g. RAT type).

AS level security will be applied for these UL Information Transfer / UL Handover Preparation Transfer and DL Information Transfer RRC messages as normal but there is no NAS level security for these tunnelled cdma2000 messages.

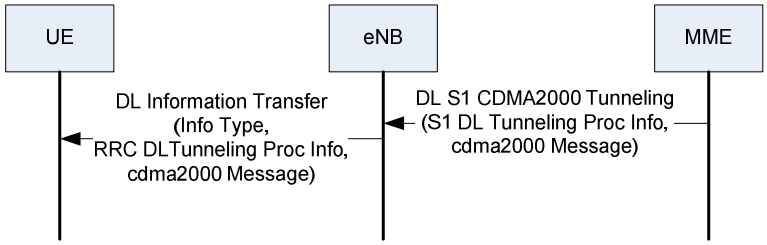


Figure 10.3.2.1-1: Downlink Direct Transfer

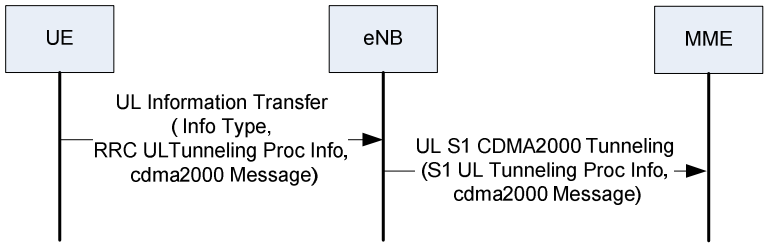


Figure 10.3.2.1-2: Uplink Direct Transfer

Tunnelling to the MME is achieved over the S1-MME interface by encapsulating the tunnelled cdma2000 message in a new S1 CDMA tunnelling messages. These S1 messages carry in addition to the tunnelled message some additional cdma2000 specific IEs (e.g. cdma2000 Reference Cell Id, RAT type, cdma2000 message type).

10.3.2.2 Mobility between E-UTRAN and HRPD

10.3.2.2.1 Mobility from E-UTRAN to HRPD

10.3.2.2.1.1 HRPD System Information Transmission in E-UTRAN

The HRPD system information block (SIB) shall be sent on the E-UTRAN BCCH. The UE shall monitor the E-UTRAN BCCH during the RRC_IDLE and RRC_CONNECTED modes to retrieve the HRPD system information for the preparation of cell reselection or handover from the E-UTRAN to HRPD system. HRPD system information may also be provided to the UE by means of dedicated signalling. The HRPD system information contains HRPD neighbouring cell information, cdma timing information, as well as information controlling the HRPD pre-registration.

10.3.2.2.1.2 Measuring HRPD from E-UTRAN

Measurement events and parameters for HRPD measurements are to be aligned with those defined in section 10.2.3.

10.3.2.2.1.2.1 Idle Mode Measurement Control

UE shall be able to make measurements on the HRPD cells in RRC_IDLE mode to perform cell re-selection.

The intra-3GPP inter-RAT idle mode measurement control is re-used to control the idle mode measurements on HRPD. The UE performs measurement on HRPD when the signal quality from E-UTRAN serving cell falls below a given threshold.

10.3.2.2.1.2.2 Active Mode Measurement Control

In RRC_CONNECTED mode, the UE shall perform radio measurements on the HRPD network when directed by the E-UTRAN network. The network provides the required HRPD neighbour cell list information and measurement controls to the UE through dedicated RRC signalling. When needed the eNB is responsible for configuring and activating the HRPD measurements on the UE via the dedicated RRC signalling message. Periodic and event-triggered measurements are supported.

For single-radio terminals, measurement gaps are needed to allow the UE to switch into the HRPD network and do radio measurements. These measurement gaps are network-controlled. The eNB is responsible for configuring the gap pattern and providing it to the UE through RRC dedicated signalling. Terminals with a dual receiver perform measurements on HRPD neighbour cells without tuning away from the E-UTRAN network. No DL gap patterns will be required for UEs which are capable of simultaneous reception on the involved frequency bands. No UL gap patterns will be required for UEs which are capable simultaneous transmission in one access and measuring on another access.

10.3.2.2.1.2.3 Active Mode Measurement

In RRC_CONNECTED mode, the UE measures the strengths of each of the HRPD neighbour cells and reports them in an RRC message.

10.3.2.2.1.3 Pre-registration to HRPD Procedure

Pre-registration allows a UE to establish a presence with an HRPD system in advance of a cell re-selection or handover. E-UTRAN network instructs the UE whether the pre-registration is needed over broadcast channel and in a dedicated RRC message.

The signalling procedure is transparent to E-UTRAN network. In the pre-registration to HRPD, messages shall be tunnelled inside RRC and S1-AP messages between the UE and MME and in a generic "transfer" message between source MME and target access network.

The UE is responsible for maintaining the HRPD context e.g. by performing periodic re-registrations if needed. The UE will use pre-registration zone information (including the current HRPD Pre-registration Zone and a list of HRPD Secondary Pre-registration Zone ID) to decide whether a re-registration shall be performed. A dual-receiver UE can ignore the parameter. E-UTRAN will provide the pre-registration zone information on the E-UTRAN system information broadcast channel or dedicated RRC signalling (unless it is determined that the UE will read the E-UTRAN system information broadcast channel in RRC_CONNECTED). Re-registrations are only allowed in areas where pre-registration is requested.

The managing of pre-registration and re-registration is handled by HRPD upper layer. The UE should indicate if it is pre-registered when sending measurement reports on cdma2000 cells.

10.3.2.2.1.4 E-UTRAN to HRPD Cell Re-selection

For the "Optimized Idle-mode Mobility" in [19], the pre-condition for cell re-selection from E-UTRAN to HRPD is that the UE has previously established a presence in the target HRPD network, either through the pre-registration procedure or previous HRPD attachment.

For the "Non-optimized Handover" in [19], the above pre-condition does not apply.

The UE performs Cell re-selection to HRPD while in RRC_IDLE.

Cell reselection from E-UTRAN to HRPD should be aligned with 3GPP inter RAT cell reselection mechanism.

10.3.2.2.1.5 E-UTRAN to HRPD Handover

The pre-condition for the E-UTRAN to HRPD Handover procedure is that the UE is attached in the E-UTRAN network in E-UTRAN_ACTIVE state and has pre-registered with the HRPD network. Based on measurement reports received from the UE the eNB initiates a handover by sending an RRC HANDOVER FROM E-UTRA PREPARATION

REQUEST message to the UE to indicate to the UE that it should begin the handover procedure. This message shall include the specified target RAT type and any cdma2000 specific HRPD parameters needed by the UE to create the appropriate HRPD messages needed to request a connection. Upon reception of this message the UE should begin handover signalling towards the HRPD access. The HRPD handover signalling is tunnelled through E-UTRAN between the UE and HRPD network. These HRPD parameters and HRPD messages are transparent to E-UTRAN. The set of the required HRPD parameters are out of scope of this specification.

The messages are transferred inside RRC transfer messages and S1 CDMA2000 tunnelling messages. The MME will, based on indication provided by the HRPD network, get information about if the handover succeeded or failed making it possible for the MME set the handover status in the S1 CDMA2000 tunnelling messages (e.g. handover success, handover failure). In case the handover succeeded E-UTRAN will include the tunnelled "CDMA2000 handover command", which will be sent to the UE, inside the RRC MOBILITY FROM E-UTRA COMMAND message.

The UE can continue to send and receive data on the E-UTRAN radio until it receives the RRC MOBILITY FROM E-UTRA COMMAND message including a tunnelled "CDMA2000 handover command". After this message is received by the UE, the UE shall leave the E-UTRAN radio and start acquiring the HRPD traffic channel. The HRPD handover signalling is tunnelled between the UE and HRPD network.

10.3.2.2.2 Mobility from HRPD to E-UTRAN

Mobility from HRPD to E-UTRAN has no impact on the E-UTRAN.

10.3.2.3 Mobility between E-UTRAN and cdma2000 1xRTT

10.3.2.3.1 Mobility from E-UTRAN to cdma2000 1xRTT

10.3.2.3.1.1 cdma2000 1xRTT System Information Transmission in E-UTRAN

The cdma2000 1xRTT system information block (SIB) shall be sent on E-UTRAN BCCH. The UE shall monitor the E-UTRAN BCCH during the RRC_IDLE and RRC_CONNECTED modes to retrieve the 1xRTT system information for the preparation of handover from the E-UTRAN to cdma2000 1xRTT system. 1xRTT system information may also be provided to the UE by means of dedicated signalling. The 1xRTT system information contains 1xRTT neighbouring cell information, cdma timing information, and 1xRTT CS Fallback information.

10.3.2.3.1.2 Measuring cdma2000 1xRTT from E-UTRAN

Measurement events and parameters for 1xRTT measurements are to be aligned with those defined in section 10.2.3.

10.3.2.3.1.2.1 Idle Mode Measurement Control

UE shall be able to make measurements on the 1xRTT system cells in LTE_IDLE mode to perform cell re-selection. UE shall perform cdma2000 1xRTT neighbour cell measurements during DRX periods, between paging occasions.

The intra-3GPP inter-RAT idle mode measurement control is re-used to control the idle mode measurements on cdma2000 1xRTT. The UE performs measurement on cdma2000 1xRTT when the signal quality from E-UTRAN serving cell falls below a given threshold.

10.3.2.3.1.2.2 Active Mode Measurement Control

In the E-UTRAN network, in RRC_CONNECTED mode, the UE shall perform radio measurements on the cdma2000 1xRTT network when directed by the E-UTRAN network. The network provides the required cdma2000 1xRTT neighbour cell list information and measurement controls to the UE through dedicated RRC signalling. When needed the eNB is responsible for configuring and activating the cdma2000 1xRTT measurements on the UE via the dedicated RRC signalling message. As for intra-3GPP inter-RAT measurement reporting, periodic and event-triggered measurements are supported.

For single-radio terminals, measurement gaps are needed to allow the UE to switch into the cdma2000 1xRTT network and do radio measurements. These Measurement gaps are network-controlled. The eNB is responsible for configuring the gap pattern and providing it to the UE through RRC dedicated signalling. Terminals with a dual receiver perform measurements on cdma2000 1xRTT neighbour cells without tuning away from the E-UTRAN network. No DL gap patterns will be required for UEs which are capable of simultaneous reception on the involved frequency bands. No UL gap patterns will be required for UEs which are capable simultaneous transmission in one access and measuring on another access.

10.3.2.3.1.2.3 Active Mode Measurement

In RRC_CONNECTED mode, the UE measures the strengths of each of the cdma2000 1xRTT neighbour cells and reports them in an RRC Message.

10.3.2.3.1.3 E-UTRAN to cdma2000 1xRTT Cell Re-selection

UE performs Cell re-selection to cdma2000 1xRTT while in RRC_IDLE.

Cell reselection from E-UTRAN to 1xRTT should be aligned with 3GPP inter RAT cell reselection mechanism.

10.3.2.3.1.4 E-UTRAN to cdma2000 1xRTT Handover

In the high level procedure for handover from E-UTRAN to cdma2000 1xRTT except 1xRTT CS Fallback, registration and handover is performed directly after the handover decision has been made. Based on measurement reports received from the UE the eNB initiates a handover by sending a RRC HANDOVER FROM E-UTRA PREPARATION REQUEST message to the UE to indicate to the UE that it should begin the handover procedure. This message shall include the specified target RAT type and any cdma2000 specific 1xRTT access parameters needed by the UE to create the appropriate 1xRTT Origination Request message. The 1xRTT handover signalling is tunnelled between the UE and 1xRTT network. The 1xRTT access parameters and 1xRTT messages are transparent to E-UTRAN. The set of the required 1xRTT access parameters are out of scope of this specification.

The messages are transferred inside RRC transfer messages and S1 CDMA2000 tunnelling messages. The MME will, based on indication provided by the 1xRTT network, get information about if the handover succeeded or failed making it possible for the MME set the handover status in the S1 CDMA2000 tunnelling messages (e.g. handover success, handover failure). In case the handover succeeded E-UTRAN will include the tunnelled "CDMA2000 handover command", which will be sent to the UE, inside the RRC MOBILITY FROM E-UTRA COMMAND message.

The UE can continue to send and receive data on the E-UTRAN radio until it receives the RRC MOBILITY FROM E-UTRA COMMAND message including a tunnelled "CDMA2000 handover command". After this message is received by the UE, the UE shall leave the E-UTRAN radio and start acquiring the 1xRTT traffic channel.

10.3.2.3.2 Mobility from cdma2000 1xRTT to E-UTRAN

Mobility from cdma2000 1xRTT has no impact on E-UTRAN.

10.3.2.3.3 1xRTT CS Fallback

CS fallback to 1xRTT enables the delivery of CS-domain services when a UE is being served by the E-UTRAN [23].

The UE initiates 1xCSFB (e.g. to perform a 1xCS call origination or accept a 1xCS call termination) by using NAS signalling to send a CSFB indication to the MME. The MME then indicates to the eNB that 1xCSFB is required, which triggers the eNB to execute one of the following 1xCSFB procedures depending on network support and UE capability:

- Rel-8 1xCSFB, characterized by RRC connection release with redirection to 1xRTT;
- enhanced 1xCSFB, characterized by 1xRTT handover signalling tunnelled between the UE and 1xRTT network;
- dual receiver 1xCSFB, characterized by RRC connection release without redirection information; or
- dual receiver/transmitter enhanced 1xCSFB, characterized by either 1xRTT handover signalling tunnelled between the UE and 1xRTT network, or redirection of the UE's second radio to 1xRTT.

The network advertises its support for Rel-8 1xCSFB by broadcasting 1xRTT pre-registration parameters in system information (SIB8). The Rel-8 1xCSFB procedure is the default procedure, when no other 1xCSFB procedure can be performed. If Rel-8 1xCSFB is to be performed, the eNB optionally solicits 1xRTT measurements from the UE, and then sends an RRC Connection Release message with redirection to 1xRTT. The UE then performs the normal 1xCS call origination or termination procedure in the 1xRTT access network.

A network which advertises support for Rel-8 1xCSFB may also support enhanced 1xCSFB, in which case the eNB determines to perform enhanced 1xCSFB based on UE capability. If enhanced 1xCSFB is to be performed, the eNB optionally solicits 1xRTT measurements from the UE, and then sends it a Handover From EUTRA Preparation Request message. This triggers the UE to send the UL Handover Preparation Transfer message containing 1xRTT dedicated information. The 1xRTT information is contained inside RRC and S1-AP messages between the UE and MME and in a generic "transfer" message between MME and 1xRTT network. The response from the 1xRTT network triggers the eNB to send a Mobility From EUTRA Command message which includes a 1xRTT channel assignment message that causes the UE to acquire a traffic channel in the 1xRTT access network. In addition to enhanced 1xCSFB, the eNB may

determine to perform concurrent mobility to HRPD based on UE capability; if so, then two separate UL Handover Preparation Transfer messages are triggered from the UE containing 1xRTT and HRPD dedicated information, respectively. The concurrent HRPD handover procedure is handled independently from the e1xCSFB procedure, except that responses from the 1xRTT and HRPD networks shall be combined by the eNB into a single Mobility From EUTRA Command message.

The network advertises support for dual receiver 1xCSFB by broadcasting the dual receiver 1xCSFB support indicator in system information (SIB8). The eNB determines to perform dual receiver 1xCSFB if the UE has a dual Rx configuration according to UE capability, and enhanced 1xCSFB cannot be performed (i.e. because enhanced 1xCSFB is not supported by both network and UE). If dual receiver 1xCSFB is to be performed, the eNB sends an RRC Connection Release message without including redirection information. The UE then performs the normal 1xCS call origination or termination procedure in the 1xRTT access network. A UE with dual Rx configuration may initiate 1xCSFB to a network broadcasting 1xRTT pre-registration parameters but not broadcasting the dual receiver 1xCSFB support indicator; in this case, the UE may receive an RRC Connection Release message with redirection to 1xRTT.

The network advertises support for dual receiver/transmitter enhanced 1xCSFB (dual Rx/Tx e1xCSFB) by broadcasting the dual Rx/Tx e1xCSFB support indicator in system information (SIB8). The eNB determines to perform dual Rx/Tx e1xCSFB if the UE supports dual Rx/Tx e1xCSFB according to UE capability. If the network does not advertise support for dual Rx/Tx e1xCSFB, UE which have dual Rx/Tx configuration may decide to keep the 1xRTT receiver/transmitter turned on in order to continuously operate in both 1xRTT and E-UTRAN. If dual Rx/Tx e1xCSFB is to be performed, the eNB optionally solicits 1xRTT measurements from the UE, and then sends a Handover From EUTRA Preparation Request message. This triggers the UE to perform one of the following:

- send the UL Handover Preparation Transfer message containing 1xRTT dedicated information. The 1xRTT information is contained inside RRC and S1-AP messages between the UE and MME and in a generic "transfer" message between MME and 1xRTT network. The response from the 1xRTT network triggers the eNB to send a DL Information Transfer message which includes a 1xRTT channel assignment message that causes the UE to acquire a traffic channel in the 1xRTT access network while continuing to be served by the E-UTRAN (for PS-domain services).

- direct its second radio to 1xRTT, where it performs the 1xCS call origination or termination procedure in the 1xRTT access network while continuing to be served by the E-UTRAN (for PS-domain services).

The following table summarizes the various CS fallback options for 1xRTT, necessary UE capabilities and FGI index which should be set to '1'. The meaning of FGI index is specified in [16, Annex B].

Table 10.3.2.3.3-1: CS fallback options

Target RAT	Solutions	Release	UE Capability	FGI Index
CS fallback to 1xRTT	RRC Connection Release with Redirection	Rel-8	(NOTE 1) Mandatory for UEs supporting CS fallback to 1xRTT	
	enhanced 1xCSFB	Rel-9	(NOTE 1) e-CSFB-1XRTT	
	enhanced 1xCSFB with concurrent HRPD handover	Rel-9	(NOTE 1) e-CSFB-ConcPS-Mob1XRTT, Support of HRPD, supportedBandListHRPD	FGI12, FGI26
	dual receiver 1xCSFB (RRC Connection Release without Redirection)	Rel-9	(NOTE 1) rx-Config1XRTT (set to 'dual')	
	dual receiver/transmitter enhanced 1xCSFB	Rel-10	(NOTE 1) e-CSFB-dual-1XRTT	
NOTE 1: All CS fallback to 1xRTT capable UE shall indicate that it supports 1xRTT and supported band list in the UE capability. NOTE 2: The measurement may be performed before any of the above CS fallback solution is triggered to select the target cell or frequency layer more accurately based on eNB decision. eNB may trigger any of above CS fallback solutions blindly.				

10.3.2.3.3.1 Pre-registration Procedure for 1xRTT CSFB

A 1xCSFB capable terminal may pre-register in the 1xRTT network via the E-UTRAN in order to establish CS services (e.g. originating and terminating voice calls) in the 1xRTT network. Pre-registration applies only to Rel-8 1xCSFB, enhanced 1xCSFB and dual receiver/transmitter enhanced 1xCSFB. It does not apply to dual receiver 1xCSFB, since the UE registers directly in the 1xRTT network using the normal 1xCS registration procedure.

The UE determines whether pre-registration is needed based on 1xRTT pre-registration parameters broadcast in system information (SIB8). Before performing a 1xRTT pre-registration, the UE requests from the eNB the necessary information to perform the 1xRTT pre-registration using the CDMA2000 CSFB Parameters Request message. The eNB provides the necessary parameters in the CDMA2000 CSFB Parameters Response message. These necessary parameters are pre-configured in the eNB and are transparent to E-UTRAN.

The UE is responsible for maintaining the 1xRTT context, e.g. by performing re-registrations if needed. The UE will use the 1xRTT pre-registration information to decide whether a re-registration shall be performed. A dual receiver UE which registers directly in the 1xRTT network can ignore these parameters. Re-registrations are only allowed in areas where pre-registration is allowed.

The management of the pre-registration and re-registration is handled by the 1xRTT upper layer in the UE.

10.3.3 CDMA2000 interworking in LTE shared networks

LTE system information (SIB8) can contain parameters for multiple CDMA2000 networks to allow the different PLMNs to inter-work with different CDMA2000 networks. There is a one to one mapping between PLMN and CDMA2000 network in that each LTE PLMN in SIB1 can inter-work with only one CDMA2000 network. Thus the UE, eNB and MME implicitly knows the CDMA2000 network from the UE's RPLMN. All UEs not supporting the per-PLMN signalling inter-work with the same CDMA2000 network independent of their RPLMN.

10.4 Area Restrictions

NOTE: The term Area Restrictions is not used in Rel-11 and onwards. It has been replaced by the term Roaming and Access Restrictions, see section 10.4a.

10.4a Roaming and Access Restrictions

The roaming and access restriction information for a UE includes information on restrictions to be applied for subsequent mobility action during ECM-CONNECTED state. It includes the Serving PLMN and may include a list of equivalent PLMNs and other information. It may be provided by the MME at context setup over the S1 interface, and may be updated by the MME during S1 Handover, and when sending NAS Downlink messages.

NOTE: In case of GWCN network sharing scenario, the roaming and access restriction information should always be provided by the MME to the eNBs.

Upon receiving the roaming and access restriction information for a UE, the eNB shall store it and thereafter it should use it to determine whether to apply restriction handling for subsequent mobility action for which the eNB provides information about the target of the mobility action towards the UE, e.g., handover and CCO, if applicable [17] [23]. If the roaming and access restriction information is not available at the eNB, the eNB shall consider that there is no restriction for subsequent mobility actions.

Only if received via S1 signalling or X2 signalling, the roaming and access restriction information for a UE shall be propagated by the source eNB over X2 at intra E-UTRAN handover. For the case when the X2 handover results in a change of serving PLMN (to an equivalent PLMN), the source eNB shall replace the Serving PLMN with the identity of the target PLMN and move the Serving PLMN to the equivalent PLMN list, before propagating the roaming and access restriction information.

SCG selection for DC at the MeNB is based upon roaming and access restriction information. If the roaming and access restriction information is not available at the MeNB, the MeNB shall consider that there is no restriction for the SCG selection. In case of RAN sharing scenarios, the MeNB selects the serving PLMN ID of the SCG and provides it to the SeNB.

10.5 Mobility to and from CSG and Hybrid cells

10.5.0 Principles for idle-mode mobility with CSG cells

10.5.0.1 Intra-frequency mobility

Intra-frequency mobility in idle mode in the presence of CSG member cells is based on cell ranking and reselection using the "best cell principle": For cell ranking and reselection, the UE may ignore all CSG cells that are known by the UE not to be CSG member cells.

10.5.0.2 Inter-frequency mobility

For cell ranking and reselection, the UE should prioritize CSG member cells irrespective of normal network configured frequency priorities.

10.5.0.3 Inter-RAT Mobility

Inter-RAT inbound mobility to E-UTRAN CSG cells is also supported by a UE autonomous search when the UE is camped on a RAT other than E-UTRAN. The UE requirements are defined in the specifications of the concerned RAT.

10.5.1 Inbound mobility to CSG cells

10.5.1.1 RRC_IDLE

Cell selection/reselection to CSG cells is based on a UE autonomous search function. The search function determines itself when/where to search, and need not be assisted by the network with information about frequencies which are dedicated to CSG cells.

To assist the search function on mixed carriers, all CSG cells on mixed carriers broadcast in system information a range of PCI values reserved by the network for use by CSG cells. Optionally also non-CSG cells on the mixed carrier can send this information in system information. The reserved PCI range is only applicable to the frequency of the PLMN where the UE received this information. The UE considers the last received reserved range of PCI values for CSG cells to be valid for a maximum of 24 hours within the entire PLMN. UE's use of the received PCI split information is UE implementation dependent.

NOTE: In shared NW scenario, aligned PCI ranges are beneficial in the shared carrier frequency across the involved PLMNs. Furthermore, in deployments where cells broadcast different primary PLMN (with or without multiple PLMN IDs), it is beneficial that CSG and non-CSG cells will broadcast same PCI ranges.

UE checks the suitability of CSG cells (identified by the 1 bit indicator) based on the CSG whitelist in the UE (provided by upper layers). Only CSG member cells are considered suitable.

The automated searching for the CSG cells by the UE shall be disabled by the search function, if the CSG whitelist configured in the UE is empty.

In addition, manual selection of CSG cells is supported.

Cell selection/reselection to CSG cells does not require the network to provide neighbour cell information to the UE. The neighbour cell information can be provided to help the UE in specific cases, e.g. where the network wishes to trigger the UE to search for CSG cells.

Cell Reselection between CSG member cells is based on normal cell reselection procedure.

10.5.1.2 RRC_CONNECTED

While the UE is in RRC_CONNECTED state, the UE performs normal measurement and mobility procedures based on configuration provided by the network.

The UE is not required to support manual selection of CSG IDs while in RRC_CONNECTED state.

Handover to a HNB/HeNB follows the framework of UE assisted network controlled handover as described in 10.1.2.1. Handover to a HNB/HeNB is different from the normal handover procedure in four aspects:

1. **Proximity Estimation**: in case the UE is able to determine, using autonomous search procedures, that it is near a CSG member cell, the UE may provide to the source eNB an indication of proximity. The proximity indication may be used as follows:

   - If a measurement configuration is not present for the concerned frequency/RAT, the source eNB may configure the UE to perform measurements and reporting for the concerned frequency/RAT.

   - The source eNB may determine whether to perform other actions related to handover to HNB/HeNBs based on having received a proximity indication (for example, the source eNB may not configure the UE to acquire system information of the HNB/HeNB unless it has received a proximity indication).

2. **PSC/PCI Confusion:** due to the typical cell size of HNB/HeNBs being much smaller than macro cells, there can be multiple HNBs/HeNBs within the coverage of the source eNB that have the same PSC/PCI. This leads to a condition referred to as PSC/PCI confusion, wherein the source eNB is unable to determine the correct target cell for handover from the PSC/PCI included in the measurement reports from the UE. PSC/PCI confusion is solved by the UE reporting the global cell identity of the target HNB/HeNB.

3. **Access Control:** if the target cell is a hybrid cell, prioritization of allocated resources may be performed based on the UE's membership status. Access control is done by a two step process, where first the UE reports whether the target cell is a CSG member cell based on the UE's CSG whitelist, and then the network verifies the reported status. When the UE has an emergency call the MME allows inbound mobility to CSG cells even if the access control fails as specified in TS 23.401[17].

4. **PLMN Selection:** If the target cell is a shared CSG/hybrid cell, the UE reports the subset of the broadcasted PLMN identities passing PLMN ID check and the CSG whitelist of the UE includes an entry comprising of the concerned PLMN identity and the CSG ID broadcast by the target cell. The source eNB performs PLMN ID check for the PLMNs reported by the UE and selects one if multiple pass the PLMN ID check. Finally the MME verifies the CSG membership according to the received CSG ID, the selected PLMN ID and stored subscription CSG information of the UE.

Mobility from eNB/HeNB to a HeNB's CSG/hybrid cell may take place with the S1 Handover procedure. In the following call flow the source cell can be an eNB or a HeNB.

The current version of the specification also supports mobility involving HeNBs by using X2 handover in some cases (see section 4.6.1). If membership verification is required for X2 mobility, the procedure described in Section 10.1.2.1 applies, with the following additions to the steps described in Section 10.1.2.1.1:

- In Step 4, the source eNB/HeNB includes the CSG membership status reported by the UE handed over in the X2AP HANDOVER REQUEST message to the target HeNB; the target HeNB performs admission control based on the CSG membership status reported by the UE;

- In Step 12, the target HeNB includes the CSG membership status of the UE handed over in the PATH SWITCH REQUEST message to the MME;

- In Step 16, after the MME has performed membership verification for the UE handed over, the MME includes its verified CSG membership status in the PATH SWITCH REQUEST ACKNOWLEDGE message to the target HeNB; the target HeNB updates its membership information if needed.

The procedure below applies to any scenario where the CSG ID is provided by the UE or provided by the source eNB.

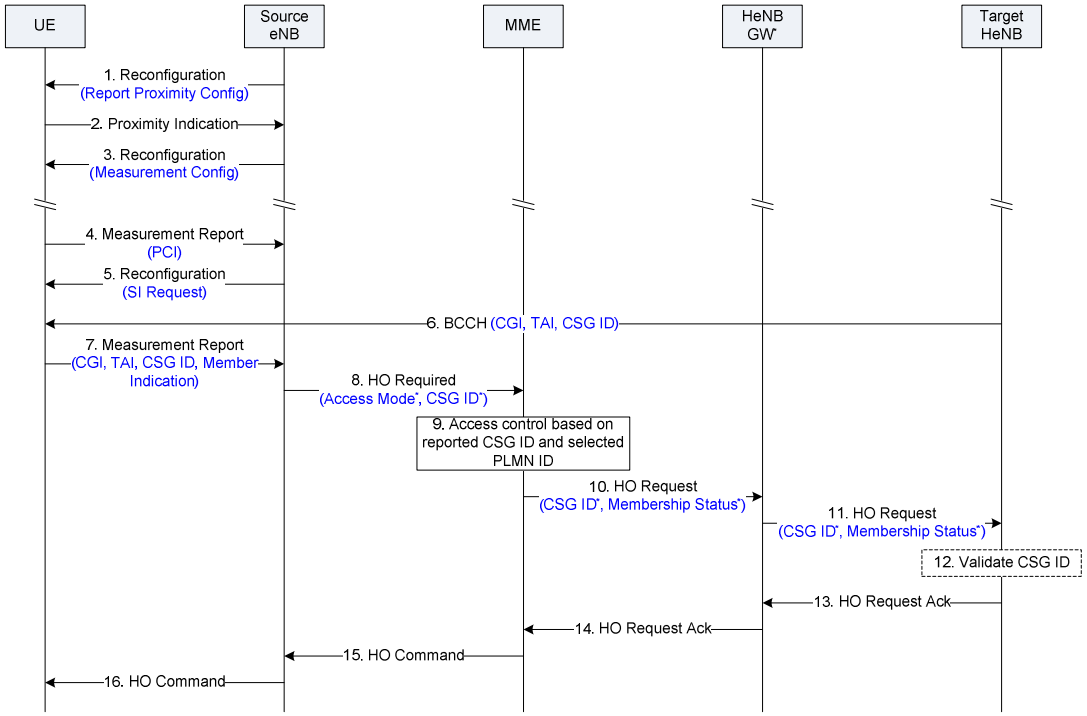


Figure 10.5.1.2-1: Mobility to HeNB's CSG and hybrid cells.

1) The source eNB configures the UE with proximity indication control.

2) The UE sends an "entering" proximity indication when it determines it may be near a CSG member cell (based on autonomous search procedures). The proximity indication includes the RAT and frequency of the cell.

3) If a measurement configuration is not present for the concerned frequency/RAT the source eNB configures the UE with relevant measurement configuration including measurement gaps as needed, so that the UE can perform measurements on the reported RAT and frequency. The network may also use the proximity indication to minimize the requesting of handover preparation information of CSG/hybrid cells by avoiding requesting such information when the UE is not in the geographical area where its CSG member cells are located.

4) The UE sends a measurement report including the PCI (e.g., due to triggered event A3).

5) The source eNB configures the UE to perform SI acquisition and reporting of a particular PCI.

6) The UE performs SI acquisition using autonomous gaps, i.e., the UE may suspend reception and transmission with the source eNB within the limits defined in [TS 36.133] to acquire the relevant system information from the target HeNB.

7) The UE sends a measurement report including (E-)CGI, TAI, CSG ID and "member/non-member" indication. If the target cell is a shared CSG/hybrid cell, the measurement report also includes the subset of the broadcast PLMN identities that pass PLMN ID check and for which the CSG whitelist of the UE includes an entry comprising the cell's CSG ID and the respective PLMN identity.

8) The source eNB includes the target E-CGI and the CSG ID in the Handover Required message sent to the MME. If the target is a hybrid cell the Cell Access Mode of the target is included.

9) The MME performs UE access control to the CSG cell based on the CSG ID and the selected target PLMN received in the Handover Required message and the stored CSG subscription data for the UE (see 3GPP TS 23.401 [17]). If the access control procedure fails, the MME ends the handover procedure by replying with the Handover Preparation Failure message. If the Cell Access Mode is present, the MME determines the CSG Membership Status of the UE handing over to the hybrid cell and includes it in the Handover Request message.

10-11) The MME sends the Handover Request message to the target HeNB including the target CSG ID received in the Handover Required message. If the target is a hybrid cell the CSG Membership Status will be included in the Handover Request message.

12) The target HeNB verifies that the CSG ID received in the Handover Request message matches the CSG ID broadcast in the target cell and if such validation is successful it allocates appropriate resources. UE prioritisation may also be applied if the CSG Membership Status indicates that the UE is a member.

13-14) The target HeNB sends the Handover Request Acknowledge message to the MME via the HeNB GW if present.

15) The MME sends the Handover Command message to the source eNB.

16) The source eNB transmits the Handover Command (RRC Connection Reconfiguration message including mobility control information) to the UE.

NOTE: Steps 1-9, 15 and 16 also apply to inter-RAT mobility from LTE to HNB.

After sending an "entering" proximity indication (step 2), if the UE determines that it is no longer near a CSG member cell, the UE sends a "leaving" proximity indication to the source eNB. Upon reception of this indication, the source eNB may reconfigure the UE to stop measurements on the reported RAT and frequency.

In the above procedure, steps 2 and 3 may not be performed in case the UE has not previously visited the HeNB, e.g., when the UE first visits a hybrid cell.

The PCI confusion is resolved by steps 5, 6 and 7. The source eNB can request SI acquisition and reporting for any PCI, not limited to PSCs/PCIs of CSG or hybrid cells.

10.5.2 Outbound mobility from CSG cells

10.5.2.1 RRC_IDLE

For a UE leaving a CSG cell in idle mode normal cell reselection based on configuration from the BCCH of the CSG cell applies.

10.5.2.2 RRC_CONNECTED

For a UE leaving a CSG cell in active mode normal network controlled mobility applies.

10.6 Measurement Model

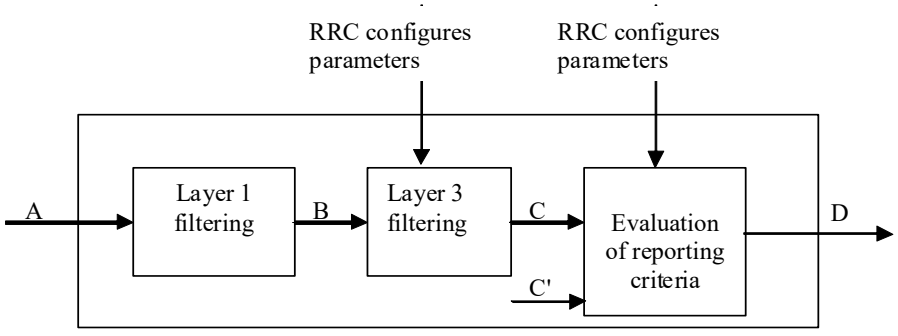


Figure 10.6-1: Measurement model

- **A:** measurements (samples) internal to the physical layer.
- **Layer 1 filtering:** internal layer 1 filtering of the inputs measured at point A. Exact filtering is implementation dependant. How the measurements are actually executed in the physical layer by an implementation (inputs A and Layer 1 filtering) in not constrained by the standard.
- **B:** A measurement reported by layer 1 to layer 3 after layer 1 filtering.

- **Layer 3 filtering:** Filtering performed on the measurements provided at point B. The behaviour of the Layer 3 filters are standardised and the configuration of the layer 3 filters is provided by RRC signalling. Filtering reporting period at C equals one measurement period at B.

- **C:** A measurement after processing in the layer 3 filter. The reporting rate is identical to the reporting rate at point B. This measurement is used as input for one or more evaluation of reporting criteria.

- **Evaluation of reporting criteria:** This checks whether actual measurement reporting is necessary at point D. The evaluation can be based on more than one flow of measurements at reference point C e.g. to compare between different measurements. This is illustrated by input C and C'. The UE shall evaluate the reporting criteria at least every time a new measurement result is reported at point C, C'. The reporting criteria are standardised and the configuration is provided by RRC signalling (UE measurements).

- **D:** Measurement report information (message) sent on the radio interface.

Layer 1 filtering will introduce a certain level of measurement averaging. How and when the UE exactly performs the required measurements will be implementation specific to the point that the output at B fulfils the performance requirements set in [21]. Layer 3 filtering and parameters used is specified in [16] and does not introduce any delay in the sample availability between B and C. Measurement at point C, C' is the input used in the event evaluation.

10.7 Hybrid Cells

Hybrid Cells have a CSG Indication bit set to FALSE but broadcast a CSG Identity and the PCI values for hybrid cells are not contained within the reserved PCI range for CSG cells. Similar to CSG cells, the network can reserve a PCI list for hybrid cells.

The network shall distinguish whether it is a hybrid cell, e.g. by reserving a PCI list for hybrid cells.

10.7.1 RRC_IDLE

When the CSG ID and associated PLMN ID of the hybrid cell belong to the CSG whitelist of the UE, the hybrid cell is considered by the UE as a CSG cell in idle mode cell selection/reselection procedures.

NOTE: The autonomous search for hybrid cells does not imply that a UE needs to constantly check the CSG ID and associated PLMN ID of all cells it sees.

For all other UEs, normal cell selection/reselection procedures apply with hybrid cells (as for non CSG cells).

Manual selection of CSG IDs of hybrid cells is also supported in the same way as for CSG cells.

10.7.2 RRC_CONNECTED

10.7.2.1 Inbound Mobility

Inbound mobility to hybrid cells is described in Section 10.5.1.2.

10.7.2.2 Outbound Mobility

Procedure for outbound mobility from CSG cells applies (See section 10.5.2.2).

11 Scheduling and Rate Control

In order to utilise the SCH resources efficiently, a scheduling function is used in MAC. In this subclause, an overview of the scheduler is given in terms of scheduler operation, signalling of scheduler decisions, and measurements to support scheduler operation.

11.1 Basic Scheduler Operation

MAC in eNB includes dynamic resource schedulers that allocate physical layer resources for the DL-SCH, UL-SCH and SL-SCH transport channels. Different schedulers operate for the DL-SCH, UL-SCH and SL-SCH.

The scheduler should take account of the traffic volume and the QoS requirements of each UE and associated radio bearers, when sharing resources between UEs. Only "per UE" grants are used to grant the right to transmit on the UL-SCH and SL-SCH (i.e. there are no "per UE per RB" grants).

Schedulers may assign resources taking account the radio conditions at the UE identified through measurements made at the eNB and/or reported by the UE.

Radio resource allocations can be valid for one or multiple TTIs.

Resource assignment consists of physical resource blocks (PRB) and MCS. Allocations for time periods longer than one TTI might also require additional information (allocation time, allocation repetition factor…).

When CA is configured, a UE may be scheduled over multiple serving cells simultaneously but at most one random access procedure shall be ongoing at any time. Cross-carrier scheduling with the Carrier Indicator Field (CIF) allows the PDCCH of a serving cell to schedule resources on another serving cell but with the following restrictions:

- Cross-carrier scheduling does not apply to PCell i.e. PCell is always scheduled via its PDCCH;
- When the PDCCH of an SCell is configured, cross-carrier scheduling does not apply to this SCell i.e. it is always scheduled via its PDCCH;
- When the PDCCH of an SCell is not configured, cross-carrier scheduling applies and this SCell is always scheduled via the PDCCH of one other serving cell.

A linking between UL and DL allows identifying the serving cell for which the DL assignment or UL grant applies when the CIF is not present:

- DL assignment received on PCell corresponds to downlink transmission on PCell;
- UL grant received on PCell corresponds to uplink transmission on PCell;
- DL assignment received on $SCell_n$ corresponds to downlink transmission on $SCell_n$;
- UL grant received on $SCell_n$ corresponds to uplink transmission on $SCell_n$. If $SCell_n$ is not configured for uplink usage by the UE, the grant is ignored by the UE.

When DC is configured, cross-carrier scheduling can only be used across serving cells within the same CG. Within a CG, neither PCell of MCG nor PSCell of SCG can be cross-carrier scheduled

11.1.1 Downlink Scheduling

In the downlink, E-UTRAN can dynamically allocate resources (PRBs and MCS) to UEs at each TTI via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible allocation when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

In addition, E-UTRAN can allocate semi-persistent downlink resources for the first HARQ transmissions to UEs:

- RRC defines the periodicity of the semi-persistent downlink grant;
- PDCCH indicates whether the downlink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

When required, retransmissions are explicitly signalled via the PDCCH(s). In the sub-frames where the UE has semi-persistent downlink resource, if the UE cannot find its C-RNTI on the PDCCH(s), a downlink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI is assumed. Otherwise, in the sub-frames where the UE has semi-persistent downlink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the semi-persistent allocation for that TTI and the UE does not decode the semi-persistent resources.

When CA is configured, semi-persistent downlink resources can only be configured for the PCell and only PDCCH allocations for the PCell can override the semi-persistent allocation. When DC is configured, semi-persistent downlink resources can only be configured for the PCell or PSCell. Only PDCCH allocations for the PCell can override the semi-persistent allocation for PCell and only PDCCH allocations for the PSCell can override the semi-persistent allocation for PSCell.

11.1.2 Uplink Scheduling

In the uplink, E-UTRAN can dynamically allocate resources (PRBs and MCS) to UEs at each TTI via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible allocation for uplink transmission when its downlink reception is enabled (activity governed by DRX when configured). When CA is configured, the same C-RNTI applies to all serving cells.

In addition, E-UTRAN can allocate a semi-persistent uplink resource for the first HARQ transmissions and potentially retransmissions to UEs:

- RRC defines the periodicity of the semi-persistent uplink grant;
- PDCCH indicates whether the uplink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

In the sub-frames where the UE has semi-persistent uplink resource, if the UE cannot find its C-RNTI on the PDCCH(s), an uplink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI can be made. The network performs decoding of the pre-defined PRBs according to the pre-defined MCS. Otherwise, in the sub-frames where the UE has semi-persistent uplink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the persistent allocation for that TTI and the UE's transmission follows the PDCCH allocation, not the semi-persistent allocation. Retransmissions are either implicitly allocated in which case the UE uses the semi-persistent uplink allocation, or explicitly allocated via PDCCH(s) in which case the UE does not follow the semi-persistent allocation.

NOTE: there is no blind decoding in uplink and when the UE does not have enough data to fill the allocated resource, padding is used.

When the UE is provided with valid uplink grants in several serving cells in one TTI, the order in which the grants are processed during logical channel prioritisation and whether joint or serial processing is applied are left up to UE implementation.

Similarly as for the downlink, semi-persistent uplink resources can only be configured for the PCell and only PDCCH allocations for the PCell can override the semi-persistent allocation. When DC is configured, semi-persistent uplink resources can only be configured for the PCell or PSCell. Only PDCCH allocations for the PCell can override the semi-persistent allocation for PCell and only PDCCH allocations for the PSCell can override the semi-persistent allocation for PSCell.

11.2 Activation/Deactivation Mechanism

To enable reasonable UE battery consumption when CA is configured, an activation/deactivation mechanism of SCells is supported (i.e. activation/deactivation does not apply to PCell). When an SCell is deactivated, the UE does not need to receive the corresponding PDCCH or PDSCH, cannot transmit in the corresponding uplink, nor is it required to perform CQI measurements. Conversely, when an SCell is active, the UE shall receive PDSCH and PDCCH (if the UE is configured to monitor PDCCH from this SCell), and is expected to be able to perform CQI measurements.

The activation/deactivation mechanism is based on the combination of a MAC control element and deactivation timers. The MAC control element carries a bitmap for the activation and deactivation of SCells: a bit set to 1 denotes activation of the corresponding SCell, while a bit set to 0 denotes deactivation. With the bitmap, SCells can be activated and deactivated individually, and a single activation/deactivation command can activate/deactivate a subset of the SCells. One deactivation timer is maintained per SCell but one common value is configured per UE by RRC.

At reconfiguration without mobility control information:

- SCells added to the set of serving cells are initially "deactivated";
- SCells which remain in the set of serving cells (either unchanged or reconfigured) do not change their activation status ("activated" or "deactivated").

At reconfiguration with mobility control information (i.e. handover):

- SCells are "deactivated".

In DC, the serving cells of the MCG other than the PCell can only be activated/deactivated by the MAC Control Element received on MCG, and the serving cells of the SCG other than PSCell can only be activated/ deactivated by the

MAC Control Element received on SCG. The MAC entity applies the bitmap for the associated cells of either MCG or SCG. PSCell in SCG is always activated like the PCell (i.e. deactivation timer is not applied to PSCell). One deactivation timer is maintained per SCell but one common value is configured per CG by RRC.

11.3 Measurements to Support Scheduler Operation

Measurement reports are required to enable the scheduler to operate in both uplink and downlink. These include transport volume and measurements of a UEs radio environment.

Uplink buffer status reports (BSR) are needed to provide support for QoS-aware packet scheduling. In E-UTRAN uplink buffer status reports refer to the data that is buffered in for a group of logical channel (LCG) in the UE. Four LCGs and two formats are used for reporting in uplink:

- A short format for which only one BSR (of one LCG) is reported;
- A long format for which all four BSRs (of all four LCGs) are reported.

Uplink buffer status reports are transmitted using MAC signalling.

In DC, LCG is configured per CG.

In DC, BSR configuration, triggering and reporting are independently performed per CG. For split bearers, the PDCP data is considered in BSR only in one CG that is configured by RRC.

11.4 Rate Control of GBR, MBR and UE-AMBR

11.4.1 Downlink

The eNB guarantees the downlink GBR associated with a GBR bearer, enforces the downlink MBR associated with a GBR bearer and enforces the downlink AMBR associated with a group of Non-GBR bearers.

11.4.2 Uplink

The UE has an uplink rate control function which manages the sharing of uplink resources between radio bearers. RRC controls the uplink rate control function by giving each bearer a priority and a prioritised bit rate (PBR). The values signalled may not be related to the ones signalled via S1 to the eNB.

The uplink rate control function ensures that the UE serves its radio bearer(s) in the following sequence:

1. All the radio bearer(s) in decreasing priority order up to their PBR;
2. All the radio bearer(s) in decreasing priority order for the remaining resources assigned by the grant.

NOTE1: In case the PBRs are all set to zero, the first step is skipped and the radio bearer(s) are served in strict priority order: the UE maximises the transmission of higher priority data.

NOTE2: By limiting the total grant to the UE, the eNB can ensure that the UE-AMBR plus the sum of MBRs is not exceeded.

NOTE3: Provided the higher layers are responsive to congestion indications, the eNB can enforce the MBR of an uplink radio bearer by triggering congestion indications towards higher layers and by shaping the data rate towards the S1 interface.

If more than one radio bearer has the same priority, the UE shall serve these radio bearers equally.

11.4.3 UE-AMBR for Dual Connectivity

In DC, the MeNB ensures that the UE-AMBR is not exceeded by:

1) limiting the resources it allocates to the UE in MCG; and
2) indicating to the SeNB a limit so that the SeNB can also in turn guarantee that this limit is not exceeded.

For split bearers the SeNB ignores the indicated downlink UE-AMBR. If the SeNB is not configured to serve the uplink for split bearers, the SeNB ignores the indicated uplink UE-AMBR.

11.5 CQI reporting for Scheduling

The time and frequency resources used by the UE to report CQI are under the control of the eNB. CQI reporting can be either periodic or aperiodic. A UE can be configured to have both periodic and aperiodic reporting at the same time. In case both periodic and aperiodic reporting occurs in the same subframe for a particular CG, only the aperiodic report is transmitted in that subframe.

For efficient support of localized, distributed and MIMO transmissions, E-UTRA supports three types of CQI reporting:

- Wideband type: providing channel quality information of entire system bandwidth of the cell;
- Multi-band type: providing channel quality information of some subset(s) of system bandwidth of the cell;
- MIMO type: open loop or closed loop operation (with or without PMI feedback).

Periodic CQI reporting is defined by the following characteristics:

- When the UE is allocated PUSCH resources in a subframe where a periodic CQI report is configured to be sent, the periodic CQI report is transmitted together with uplink data on the PUSCH. Otherwise, the periodic CQI reports are sent on the PUCCH.

Aperiodic CQI reporting is defined by the following characteristics:

- The report is scheduled by the eNB via the PDCCH;
- Transmitted together with uplink data on PUSCH.

When a CQI report is transmitted together with uplink data on PUSCH, it is multiplexed with the transport block by L1 (i.e. the CQI report is not part of the uplink the transport block).

The eNB configures a set of sizes and formats of the reports. Size and format of the report depends on whether it is transmitted over PUCCH or PUSCH and whether it is a periodic or aperiodic CQI report.

11.6 Explicit Congestion Notification

The eNB and the UE support of the Explicit Congestion Notification (ECN) is specified in Section 5 of [35] (i.e., the normative part of [35] that applies to the end-to-end flow of IP packets), and below. This enables the eNB to control the initial codec rate selection and/or to trigger a codec rate reduction. Thereby the eNB can increase capacity (e.g., in terms of number of accepted VoIP calls), and improve coverage (e.g. for high bit rate video sessions).

The eNB should set the Congestion Experienced (CE) codepoint (‘11’) in PDCP SDUs in the downlink direction to indicate downlink (radio) congestion if those PDCP SDUs have one of the two ECN-Capable Transport (ECT) codepoints set. The eNB should set the Congestion Experienced (CE) codepoint (‘11’) in PDCP SDUs in the uplink direction to indicate uplink (radio) congestion if those PDCP SDUs have one of the two ECN-Capable Transport (ECT) codepoints set.

12 DRX in RRC_CONNECTED

In order to enable reasonable UE battery consumption, DRX in E-UTRAN is characterised by the following:

- Per UE mechanism (as opposed to per radio bearer);
- No RRC or MAC substate to distinguish between different levels of DRX;
- Available DRX values are controlled by the network and start from non-DRX up to *x* seconds. Value *x* may be as long as the paging DRX used in ECM-IDLE;
- Measurement requirement and reporting criteria can differ according to the length of the DRX interval i.e. long DRX intervals may experience more relaxed requirements;
- Irrespective of DRX, UE may use first available RACH opportunity to send an UL measurement report;

- HARQ operation related to data transmission is independent of DRX operation and the UE wakes up to read the PDCCH for possible retransmissions and/or ACK/NAK signalling regardless of DRX In the downlink, a timer is used to limit the time the UE stays awake awaiting for a retransmission;

- When DRX is configured, the UE may be further configured with an "on-duration" timer during which time the UE monitors the PDCCHs for possible allocations;

- When DRX is configured, periodic CQI reports can only be sent by the UE during the "active-time". RRC can further restrict periodic CQI reports so that they are only sent during the on-duration;

- A timer per TAG in the UE is used to detect need for obtaining timing advance for each TAG.

The following definitions apply to DRX in E-UTRAN:

- **on-duration**: duration in downlink subframes that the UE waits for, after waking up from DRX, to receive PDCCHs. If the UE successfully decodes a PDCCH, the UE stays awake and starts the inactivity timer;

- **inactivity-timer**: duration in downlink subframes that the UE waits to successfully decode a PDCCH, from the last successful decoding of a PDCCH, failing which it re-enters DRX. The UE shall restart the inactivity timer following a single successful decoding of a PDCCH for a first transmission only (i.e. not for retransmissions).

- **active-time**: total duration that the UE is awake. This includes the "on-duration" of the DRX cycle, the time UE is performing continuous reception while the inactivity timer has not expired and the time UE is performing continuous reception while waiting for a DL retransmission after one HARQ RTT. Based on the above the minimum active time is of length equal to on-duration, and the maximum is undefined (infinite);

Of the above parameters the on-duration and inactivity-timer are of fixed lengths, while the active-time is of varying lengths based on scheduling decision and UE decoding success. Only on-duration and inactivity-timer duration are signalled to the UE by the eNB:

- There is only one DRX configuration applied in the UE at any time;

- UE shall apply an on-duration on wake-up from DRX sleep;

NOTE: this is also applicable for the case where the UE has only one service (e.g. Real Time) that is being handled through the allocation of predefined resources; this allows for other signalling such as RRC to be sent during the remaining portion of the active time.

- New transmissions can only take place during the active-time (so that when the UE is waiting for one retransmission only, it does not have to be "awake" during the RTT).

- If PDCCH has not been successfully decoded during the on-duration, the UE shall follow the DRX configuration (i.e. the UE can enter DRX sleep if allowed by the DRX configuration):

  - This applies also for the sub-frames where the UE has been allocated predefined resources.

- If it successfully decodes a PDCCH for a first transmission, the UE shall stay awake and start the inactivity timer (even if a PDCCH is successfully decoded in the sub-frames where the UE has also been allocated predefined resources) until a MAC control message tells the UE to re-enter DRX, or until the inactivity timer expires. In both cases, the DRX cycle that the UE follows after re-entering DRX is given by the following rules:

  - If a short DRX cycle is configured; the UE first follows the short DRX cycle and after a longer period of inactivity the UE follows the long DRX cycle;

  - Else the UE follows the long DRX cycle directly.

NOTE: When DRX is configured, the network should detect whether UE remains in EUTRAN coverage by requesting UE to send periodic signals to the network.

In CA, whenever a UE is configured with only one serving cell (i.e. PCell) Rel-8/9 DRX applies. In other cases, the same DRX operation applies to all configured and activated serving cells (i.e. identical active time for PDCCH monitoring).

In DC, separate DRX configurations can be applied to MCG and SCG, and the CG specific DRX operation applies to all configured and activated serving cells in the same CG (i.e. identical active time for PDCCH monitoring).

13 QoS

An EPS bearer/E-RAB is the level of granularity for bearer level QoS control in the EPC/E-UTRAN. That is, SDFs mapped to the same EPS bearer receive the same bearer level packet forwarding treatment (e.g. scheduling policy, queue management policy, rate shaping policy, RLC configuration, etc.) [17].

One EPS bearer/E-RAB is established when the UE connects to a PDN, and that remains established throughout the lifetime of the PDN connection to provide the UE with always-on IP connectivity to that PDN. That bearer is referred to as the *default* bearer. Any additional EPS bearer/E-RAB that is established to the same PDN is referred to as a *dedicated* bearer. The initial bearer level QoS parameter values of the default bearer are assigned by the network, based on subscription data. The decision to establish or modify a dedicated bearer can only be taken by the EPC, and the bearer level QoS parameter values are always assigned by the EPC.

An EPS bearer/E-RAB is referred to as a GBR bearer if dedicated network resources related to a Guaranteed Bit Rate (GBR) value that is associated with the EPS bearer/E-RAB are permanently allocated (e.g. by an admission control function in the eNodeB) at bearer establishment/modification. Otherwise, an EPS bearer/E-RAB is referred to as a Non-GBR bearer. A dedicated bearer can either be a GBR or a Non-GBR bearer while a default bearer shall be a Non-GBR bearer.

13.1 Bearer service architecture

The EPS bearer service layered architecture is depicted in Figure 13.1-1 below, where:

- An UL TFT in the UE binds an SDF to an EPS bearer in the uplink direction. Multiple SDFs can be multiplexed onto the same EPS bearer by including multiple uplink packet filters in the UL TFT.
- A DL TFT in the PDN GW binds an SDF to an EPS bearer in the downlink direction. Multiple SDFs can be multiplexed onto the same EPS bearer by including multiple downlink packet filters in the DL TFT.
- An E-RAB transports the packets of an EPS bearer between the UE and the EPC. When an E-RAB exists, there is a one-to-one mapping between this E-RAB and an EPS bearer.
- A data radio bearer transports the packets of an EPS bearer between a UE and one or more eNB(s). When a data radio bearer exists, there is a one-to-one mapping between this data radio bearer and the EPS bearer/E-RAB.
- An S1 bearer transports the packets of an E-RAB between an eNodeB and a Serving GW.
- An S5/S8 bearer transports the packets of an EPS bearer between a Serving GW and a PDN GW.
- A UE stores a mapping between an uplink packet filter and a data radio bearer to create the binding between an SDF and a data radio bearer in the uplink.
- A PDN GW stores a mapping between a downlink packet filter and an S5/S8a bearer to create the binding between an SDF and an S5/S8a bearer in the downlink.
- An eNB stores a one-to-one mapping between a data radio bearer and an S1 bearer to create the binding between a data radio bearer and an S1 bearer in both the uplink and downlink.
- A Serving GW stores a one-to-one mapping between an S1 bearer and an S5/S8a bearer to create the binding between an S1 bearer and an S5/S8a bearer in both the uplink and downlink.

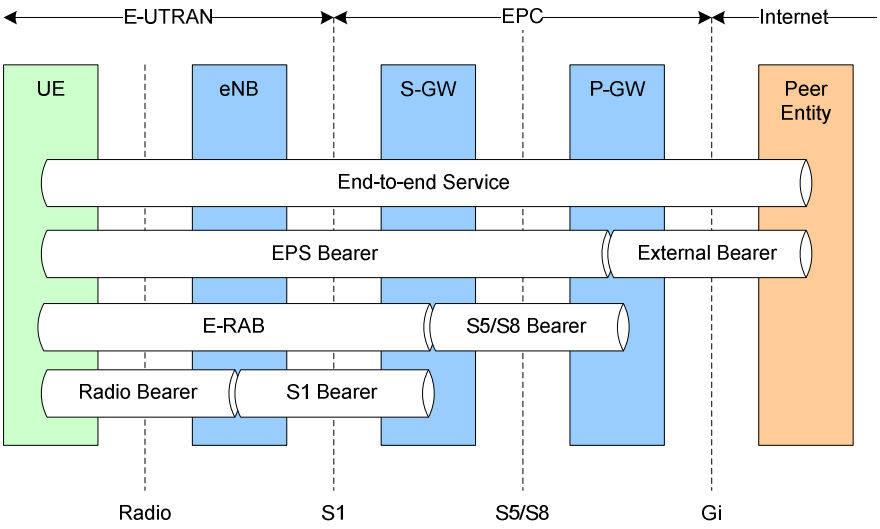


Figure 13.1-1: EPS Bearer Service Architecture

13.2 QoS parameters

The bearer level (i.e. per bearer or per bearer aggregate) QoS parameters are QCI, ARP, GBR, and AMBR [17]. Each EPS bearer/E-RAB (GBR and Non-GBR) is associated with the following bearer level QoS parameters:

- QoS Class Identifier (QCI): scalar that is used as a reference to access node-specific parameters that control bearer level packet forwarding treatment (e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration, etc.), and that have been pre-configured by the operator owning the eNodeB. A one-to-one mapping of standardized QCI values to standardized characteristics is captured in [17].

- Allocation and Retention Priority (ARP): the primary purpose of ARP is to decide whether a bearer establishment / modification request can be accepted or needs to be rejected in case of resource limitations. In addition, the ARP can be used by the eNodeB to decide which bearer(s) to drop during exceptional resource limitations (e.g. at handover).

Each GBR bearer is additionally associated with the following bearer level QoS parameter:

- Guaranteed Bit Rate (GBR): the bit rate that can be expected to be provided by a GBR bearer;

- Maximum Bit Rate (MBR): the maximum bit rate that can be expected to be provided by a GBR bearer. MBR can be greater or equal to the GBR.

Each APN access, by a UE, is associated with the following QoS parameter:

- per APN Aggregate Maximum Bit Rate (APN-AMBR).

Each UE in state EMM-REGISTERED is associated with the following bearer aggregate level QoS parameter:

- per UE Aggregate Maximum Bit Rate (UE-AMBR).

The definitions of APN AMBR and UE-AMBR are captured in [17].

The GBR and MBR denotes bit rate of traffic per bearer while UE-AMBR/APN-AMBR denote bit rate of traffic per group of bearers. Each of those QoS parameters has an uplink and a downlink component.

13.3 QoS support in Hybrid Cells

The following principles apply to serving non CSG members and CSG members of a Hybrid Cell:

Note: The term "eNB" in this section applies to HeNBs (as described in §4.6.1), as well as eNBs (as denoted in the basic E-UTRAN architecture in Figure 4-1).

- When the UE connects to a Hybrid Cell, the MME shall inform the eNB serving this Hybrid Cell whether the UE is a member or not of the CSG associated with this Hybrid Cell;
- Based on CSG membership, the offered QoS for UEs served by this Hybrid Cell may be modified as follows:
  - The eNB serving this Hybrid Cell may distinguish between a CSG member and non-member when determining whether to handover a UE, which GBR bearers to admit and which GBR bearers to deactivate;
  - The eNB serving this Hybrid Cell may distinguish between a CSG member and non-member for handover and packet scheduling on Uu interface (including reduced QoS) of non-GBR bearers.

14 Security

14.1 Overview and Principles

The following principles apply to E-UTRAN security:

- The keys used for NAS and AS protection shall be dependent on the algorithm with which they are used.
- The eNB keys are cryptographically separated from the EPC keys used for NAS protection (making it impossible to use the eNB key to figure out an EPC key).
- For SCG bearers in DC, the SeNB keys are cryptographically separated from the eNB keys.
- The AS (RRC and UP) and NAS keys are derived in the EPC/UE from key material that was generated by a NAS (EPC/UE) level AKA procedure (K_{ASME}) and identified with a key identifier (KSI_{ASME}).
- For SCG bearers in DC, the AS (UP) keys are derived in the SeNB/UE from key material that was generated in the MeNB/UE.
- The eNB key (K_{eNB}) is sent from the EPC to the eNB when the UE is entering ECM-CONNECTED state (i.e. during RRC connection or S1 context setup).
- For SCG bearers in DC, the SeNB key ($S\text{-}K_{eNB}$) is sent from the MeNB to the SeNB when adding an SCG.
- Separate AS and NAS level security mode command procedures are used. AS level security mode command procedure configures AS security (RRC and user plane) and NAS level security mode command procedure configures NAS security. Both integrity protection and ciphering for RRC are activated within the same AS SMC procedure. User plane ciphering is activated at the same time as RRC ciphering.
- Keys stored inside eNBs shall never leave a secure environment within the eNB (except when done in accordance with this or other 3GPP specifications), and user plane data ciphering/deciphering shall take place inside the secure environment where the related keys are stored.
- Key material for the eNB keys is sent between the eNBs during ECM-CONNECTED intra-E-UTRAN mobility and from the MeNB to the SeNB in DC for SCG bearer during SCG addition and SCG change.
- A sequence number (COUNT) is used as input to the ciphering and integrity protection. A given sequence number must only be used once for a given eNB key (except for identical re-transmission) on the same radio bearer in the same direction. The same sequence number can be used for both ciphering and integrity protection.
- A hyper frame number (HFN) (i.e. an overflow counter mechanism) is used in the eNB and UE in order to limit the actual number of sequence number bits that is needed to be sent over the radio. The HFN needs to be synchronized between the UE and eNB.
- No integrity protection initialisation number (FRESH).
- Since SIM access is not granted in E-UTRAN TS 33.401 [22] except for making IMS Emergency calls, idle mode UE not equipped with USIM shall not attempt to reselect to E-UTRAN unless it is originating an IMS Emergency call. The RNC may try to prevent handover to E-UTRAN for example by identifying a SIM based UE from the security keys provided by the CN.

A simplified key derivation is depicted on Figure 14.1-1 below, where:

- **K_{NASint}** is a key, which shall only be used for the protection of NAS traffic with a particular integrity algorithm This key is derived by UE and MME from K_{ASME}, as well as an identifier for the integrity algorithm.
- **K_{NASenc}** is a key, which shall only be used for the protection of NAS traffic with a particular encryption algorithm. This key is derived by UE and MME from K_{ASME}, as well as an identifier for the encryption algorithm.
- **K_{eNB}** is a key derived by UE and MME from K_{ASME}. K_{eNB} may also be derived by the target eNB from NH at handover. K_{eNB} shall be used for the derivation of K_{RRCint}, K_{RRCenc} and K_{UPenc}, and for the derivation of K_{eNB*} upon handover.
- **K_{eNB*}** is a key derived by UE and source eNB from either K_{eNB} or from a fresh NH. K_{eNB*} shall be used by UE and target eNB as a new K_{eNB} for RRC and UP traffic.
- **K_{UPenc}** is a key, which shall only be used for the protection of UP traffic with a particular encryption algorithm. This key is derived by UE and eNB from K_{eNB}, as well as an identifier for the encryption algorithm.
- **K_{RRCint}** is a key, which shall only be used for the protection of RRC traffic with a particular integrity algorithm. K_{RRCint} is derived by UE and eNB from K_{eNB}, as well as an identifier for the integrity algorithm.
- **K_{RRCenc}** is a key, which shall only be used for the protection of RRC traffic with a particular encryption algorithm. K_{RRCenc} is derived by UE and eNB from K_{eNB} as well as an identifier for the encryption algorithm.
- Next Hop (**NH**) is used by UE and eNB in the derivation of K_{eNB*} for the provision of "forward security" [22]. NH is derived by UE and MME from K_{ASME} and K_{eNB} when the security context is established, or from K_{ASME} and previous NH, otherwise.
- Next Hop Chaining Count (**NCC**) is a counter related to NH (i.e. the amount of Key chaining that has been performed) which allow the UE to be synchronised with the eNB and to determine whether the next **K_{eNB*}** needs to be based on the current K_{eNB} or a fresh NH.

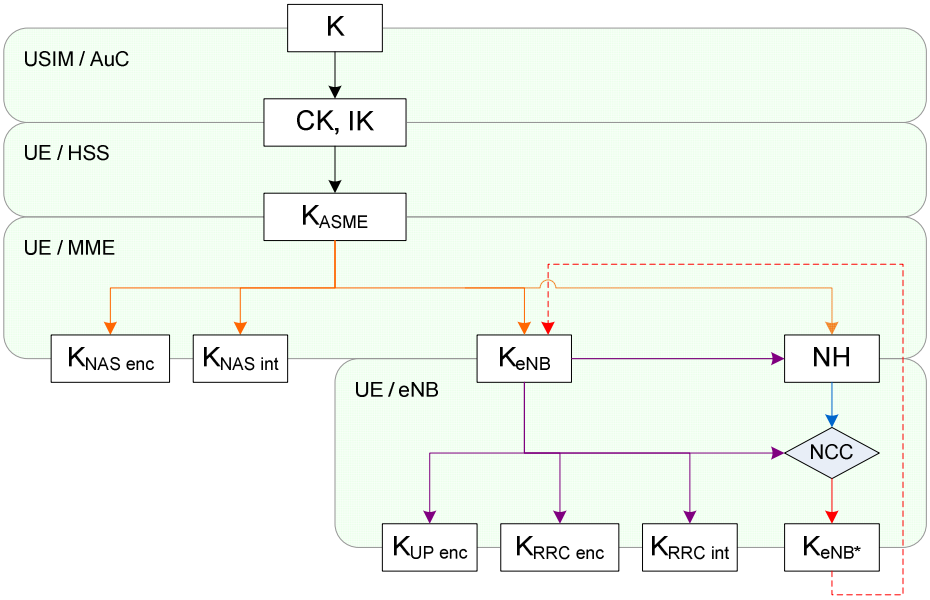


Figure 14.1-1: Key Derivation

Key derivation for SCG bearers in DC is depicted on Figure 14.1-2 below, where:

- SCG Counter is a counter used as freshness input into S-K_{eNB} derivations (see TS 33.401 Annex E.2.4 [22]).

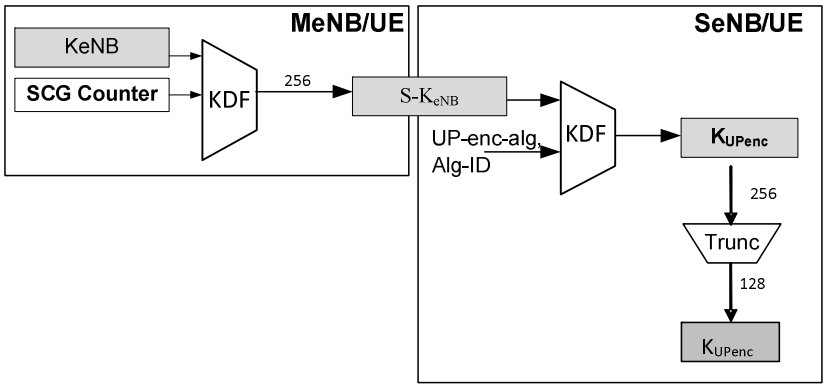


Figure 14.1-2: DC Key Derivation

The MME invokes the AKA procedures by requesting authentication vectors to the HE (Home environment) if no unused EPS authentication vectors have been stored. The HE sends an authentication response back to the MME that contains a fresh authentication vector, including a base-key named K_{ASME}. Thus, as a result of an AKA run, the EPC and the UE share K_{ASME}. From K_{ASME}, the NAS keys, (and indirectly) K_{eNB} keys and NH are derived. The K_{ASME} is never transported to an entity outside of the EPC, but K_{eNB} and NH are transported to the eNB from the EPC when the UE transitions to ECM-CONNECTED. From the K_{eNB}, the eNB and UE can derive the UP and RRC keys.

RRC and UP keys are refreshed at handover. K_{eNB*} is derived by UE and source eNB from target PCI, target frequency and K_{eNB} (this is referred to as a *horizontal* key derivation and is indicated to UE with an NCC that does not increase) or from target PCI, target frequency and NH (this is referred to as a *vertical* key derivation and is indicated to UE with an NCC increase). K_{eNB*} is then used as new K_{eNB} for RRC and UP traffic at the target. When the UE goes into ECM-IDLE all keys are deleted from the eNB.

For SCG Bearers in DC, UP keys are updated at SCG change by indicating in RRC signalling to the UE the value of the SCG Counter to be used in key derivation. When K_{eNB} is refreshed, SCG Counter shall be reset and S-K_{eNB} shall be newly derived from the K_{eNB}.

COUNT reusing avoidance for the same radio bearer identity in RRC_CONNECTED mode without K_{eNB} change is left to eNB implementation e.g. by using intra-cell handover, smart management of radio bearer identities or triggering a transition to RRC_IDLE.

SCG bearers in DC share a common pool of radio bearer identities (DRB IDs) together with the MCG bearers and when no new DRB ID can be allocated for an SCG bearer without guaranteeing COUNT reuse avoidance, the MeNB shall derive a new S-K_{eNB}. SeNB indicates to MeNB when uplink or downlink PDCP COUNTs are about to wrap around and MeNB shall update the S-K_{eNB}. To update the S-K_{eNB}, the MeNB increases the SCG Counter and uses it to derive a new S-K_{eNB} from the currently active KeNB in the MeNB. The MeNB sends the newly derived S-K_{eNB} to the SeNB. The newly derived S-K_{eNB} is then used by the SeNB in computing a new encryption key K_{UPenc} which is used with all DRBs in the SeNB for this UE. Furthermore, when the SCG Counter approaches its maximum value, the MeNB refreshes the currently active KeNB, before any further S-K_{eNB} is derived.

In case of HFN de-synchronisation in RRC_CONNECTED mode between the UE and eNB, the UE is pushed to IDLE.

14.2 Security termination points

The table below describes the security termination points.

Table 14.2-1 Security Termination Points

	Ciphering	Integrity Protection
NAS Signalling	Required and terminated in MME	Required and terminated in MME
U-Plane Data	Required and terminated in eNB	Not Required (NOTE 1)
RRC Signalling (AS)	Required and terminated in eNB	Required and terminated in eNB
MAC Signalling (AS)	Not required	Not required
NOTE 1: Integrity protection for U-Plane is not required and thus it is not supported between UE and Serving Gateway or for the transport of user plane data between eNB and Serving Gateway on S1 interface.		

The table below describes the security termination points for DC with SCG bearers and split bearers.

Table 14.2-2 Security Termination Points in DC

	Ciphering	Integrity Protection
NAS Signalling	Required and terminated in MME	Required and terminated in MME
U-Plane Data for MCG bearers	Required and terminated in MeNB	Not Required
U-Plane Data for SCG bearers	Required and terminated in SeNB	Not Required
U-Plane Data for split bearers	Required and terminated in MeNB	Not Required
RRC Signalling (AS)	Required and terminated in MeNB	Required and terminated in MeNB

14.3 State Transitions and Mobility

14.3.1 RRC_IDLE to RRC_CONNECTED

As a general principle, on RRC_IDLE to RRC_CONNECTED transitions, RRC protection keys and UP protection keys shall be generated while keys for NAS protection as well as higher layer keys are assumed to be already available in the MME. These higher layer keys may have been established in the MME as a result of an AKA run, or as a result of a transfer from another MME during handover or idle mode mobility [22].

14.3.2 RRC_CONNECTED to RRC_IDLE

On RRC_CONNECTED to RRC_IDLE transitions, eNBs shall delete the keys they store such that state for idle mode UEs only has to be maintained in MME. It is also assumed that eNB does no longer store state information about the corresponding UE and deletes the current keys from its memory. In particular, on connected to idle transitions:

- The eNB and UE deletes NH, K_{eNB} , K_{RRCenc} , K_{RRCint} and K_{UPenc} and related NCC.
- MME and UE keeps K_{ASME}, K_{NASint} and K_{NASenc} stored.

14.3.3 Intra E-UTRAN Mobility

The key hierarchy does not allow, as is, explicit RRC and UP key updates, but RRC and UP keys are derived based on the algorithm identifiers and K_{eNB} which results with new RRC and UP keys at every handover:

- Source eNB and UE independently create K_{eNB*} with the input parameters as described in 3GPP TS 33.401 [22];
- K_{eNB*} is given to Target eNB during the HO preparation phase;
- Both Target eNB and UE considers the new K_{eNB} equal to the received K_{eNB*}.

The handling of HFN and PDCP SN at handover depends on the type of radio bearer:

- SRB: HFN and PDCP SN are reset.
- RLC-UM bearers: HFN and PDCP SN are reset.
- RLC-AM bearers: PDCP SN and HFN are maintained (10.1.2.3).

NOTE: COUNT reusing avoidance is left to network implementation.

14.3.4 SeNB Removal

For SCG bearers in DC, at SeNB removal, the SeNB shall delete the keys it stores. It is also assumed that SeNB does no longer store state information about the corresponding UE and deletes the current keys from its memory. In particular, at SeNB removal:

- The SeNB and UE delete S-K_{eNB} and K_{UPenc}.
- The MeNB and UE keep K_{eNB}.

14.4 AS Key Change in RRC_CONNECTED

If AS Keys (K_{UPenc} , K_{RRCint} and K_{RRCenc}) need to be changed in RRC_CONNECTED, an intra-cell handover shall be used.

For SCG bearers in DC, if AS Key (K_{UPenc}) needs to be changed, the SCG change shall be performed.

14.5 Security Interworking

Inter-RAT handover from UTRAN to E-UTRAN is only supported after activation of integrity protection in UTRAN. Security may be activated in the target RAN using null ciphering algorithms. If ciphering was not running in UTRAN, it will be activated at handover to E-UTRAN. Integrity protection shall be activated in E-UTRAN on handover from UTRAN/GERAN.

For E-UTRAN to UTRAN/GERAN mobility, the MME shall derive and transfer to the SGSN a confidentially key and an integrity key derived from K_{ASME} and other input parameters as specified in 3GPP TS 33.401 [22]. Based on this information, the SGSN can in turn derive appropriate keys to be used in the target RAN.

Similarly for UTRAN/GERAN to E-UTRAN mobility, the SGSN shall derive and transfer to the MME a confidentially key and an integrity key CK and IK. Based on this information and other input parameters as specified in 3GPP TS 33.401 [22], the MME and UE can in turn derive K_{ASME}.

14.6 RN integrity protection for DRB(s)

Between the DeNB and the RN, integrity protection is required for the DRB(s) carrying S1AP and/or X2AP signalling and optional for other DRB(s).

K_{UPint}, used for the integrity protection of the DRBs, is derived by the RN and the DeNB from KeNB, as well as an identifier for the integrity algorithm used as specified in 3GPP TS 33.401 [22]. K_{UPint} is generated, changed or deleted when other AS keys are generated, changed or deleted.

15 MBMS

For MBMS, the following definitions are introduced:

MBSFN Synchronization Area: an area of the network where all eNodeBs can be synchronized and perform MBSFN transmissions. MBSFN Synchronization Areas are capable of supporting one or more MBSFN Areas. On a given frequency layer, a eNodeB can only belong to one MBSFN Synchronization Area. MBSFN Synchronization Areas are independent from the definition of MBMS Service Areas

MBSFN Transmission or a transmission in MBSFN mode: a simulcast transmission technique realised by transmission of identical waveforms at the same time from multiple cells. An MBSFN Transmission from multiple cells within the MBSFN Area is seen as a single transmission by a UE.

MBSFN Area: an MBSFN Area consists of a group of cells within an MBSFN Synchronization Area of a network, which are co-ordinated to achieve an MBSFN Transmission. Except for the MBSFN Area Reserved Cells, all cells within an MBSFN Area contribute to the MBSFN Transmission and advertise its availability. The UE may only need to consider a subset of the MBSFN areas that are configured, i.e. when it knows which MBSFN area applies for the service(s) it is interested to receive.

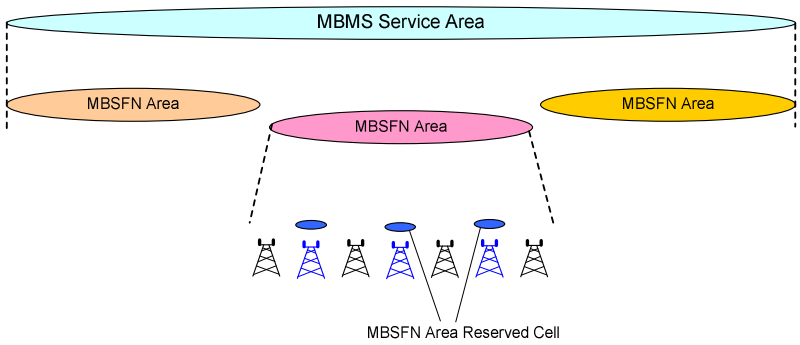


Figure 15-1: MBMS Definitions

MBSFN Area Reserved Cell: A cell within a MBSFN Area which does not contribute to the MBSFN Transmission. The cell may be allowed to transmit for other services but at restricted power on the resource allocated for the MBSFN transmission.

Synchronisation Sequence: Each SYNC PDU contains a time stamp which indicates the start time of the synchronisation sequence. For an MBMS service, each synchronisation sequence has the same duration which is configured in the BM-SC and the MCE.

Synchronisation Period: The synchronisation period provides the time reference for the indication of the start time of each synchronisation sequence. The time stamp which is provided in each SYNC PDU is a relative value which refers to the start time of the synchronisation period. The duration of the synchronisation period is configurable.

15.1 General

In E-UTRAN, MBMS can be provided with single frequency network mode of operation (MBSFN) only on a frequency layer shared with non-MBMS services (set of cells supporting both unicast and MBMS transmissions i.e. set of "MBMS/Unicast-mixed cells").

MBMS reception is possible for UEs in RRC_CONNECTED or RRC_IDLE states. Whenever receiving MBMS services, a user shall be notified of an incoming call, and originating calls shall be possible. ROHC is not supported for MBMS.

RNs do not support MBMS.

15.1.1 E-MBMS Logical Architecture

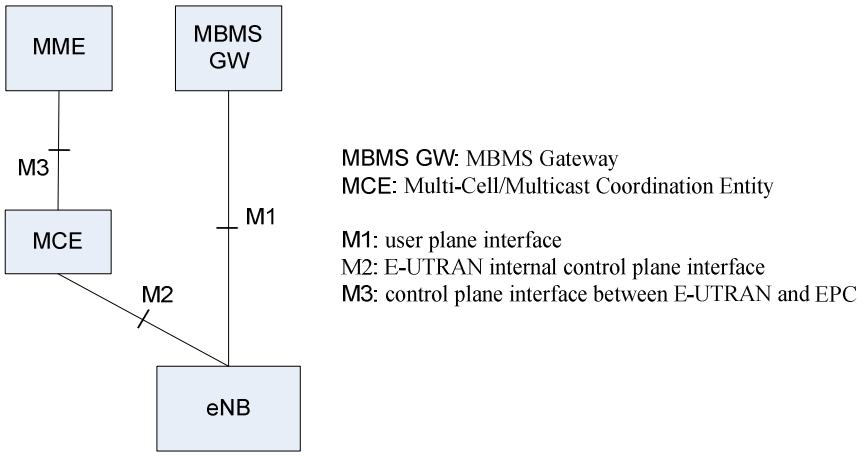


Figure 15.1.1-1: E-MBMS Logical Architecture

Figure 15.1.1-1 depicts the E-MBMS Logical Architecture.

Multi-cell/multicast Coordination Entity (MCE)

The MCE is a logical entity – this does not preclude the possibility that it may be part of another network element – whose functions are:

- the admission control and the allocation of the radio resources used by all eNBs in the MBSFN area for multi-cell MBMS transmissions using MBSFN operation. The MCE decides not to establish the radio bearer(s) of the new MBMS service(s) if the radio resources are not sufficient for the corresponding MBMS service(s) or may pre-empt radio resources from other radio bearer(s) of ongoing MBMS service(s) according to ARP. Besides allocation of the time/ frequency radio resources this also includes deciding the further details of the radio configuration e.g. the modulation and coding scheme.

- counting and acquisition of counting results for MBMS service(s).

- resumption of MBMS session(s) within MBSFN area(s) based on e.g. the ARP and/or the counting results for the corresponding MBMS service(s).

- suspension of MBMS session(s) within MBSFN area(s) based e.g. the ARP and/or on the counting results for the corresponding MBMS service(s).

NOTE: In case of distributed MCE architecture, the MCE manages the above functions for a single eNB of a MBSFN. The coordination of the functions between MCEs is provided by OAM, if needed.

The MCE is involved in MBMS Session Control Signalling. The MCE does not perform UE - MCE signalling.

An eNB is served by a single MCE.

E-MBMS Gateway (MBMS GW)

The MBMS GW is a logical entity – this does not preclude the possibility that it may be part of another network element – that is present between the BMSC and eNBs whose principal functions is the sending/broadcasting of MBMS packets to each eNB transmitting the service. The MBMS GW uses IP Multicast as the means of forwarding MBMS user data to the eNB. The MBMS GW performs MBMS Session Control Signalling (Session start/update/stop) towards the E-UTRAN via MME.

Control Plane Interfaces

"M3" Interface: MCE – MME

An Application Part is defined for this interface between MME and MCE. This application part allows for MBMS Session Control Signalling on E-RAB level (i.e. does not convey radio configuration data). The procedures comprise e.g. MBMS Session Start and Stop. SCTP is used as signalling transport i.e. Point-to-Point signalling is applied.

"M2" Interface: MCE – eNB

An Application Part is defined for this interface, which conveys at least radio configuration data for the multi-cell transmission mode eNBs and Session Control Signalling. SCTP is used as signalling transport i.e. Point-to-Point signalling is applied.

User Plane Interface

"M1" Interface: MBMS GW – eNB

This interface is a pure user plane interface. Consequently no Control Plane Application Part is defined for this interface. IP Multicast is used for point-to-multipoint delivery of user packets.

Deployment consideration

The two envisaged alternatives are shown in Figure 15.1.1-2.

The architecture on the right part is defined as the "distributed MCE architecture". In this architecture, a MCE is part of the eNB and the M2 interface should be kept between the MCE and the corresponding eNB.

The architecture on the left part is defined as the "centralized MCE architecture". In this architecture, the MCE is a logical entity which means it can be deployed as a stand-alone physical entity or collocated in another physical entity e.g. eNB. In both cases of the centralized MCE architecture, the M2 interface is kept between the MCE and all eNB(s) belonging to the corresponding MBSFN area.

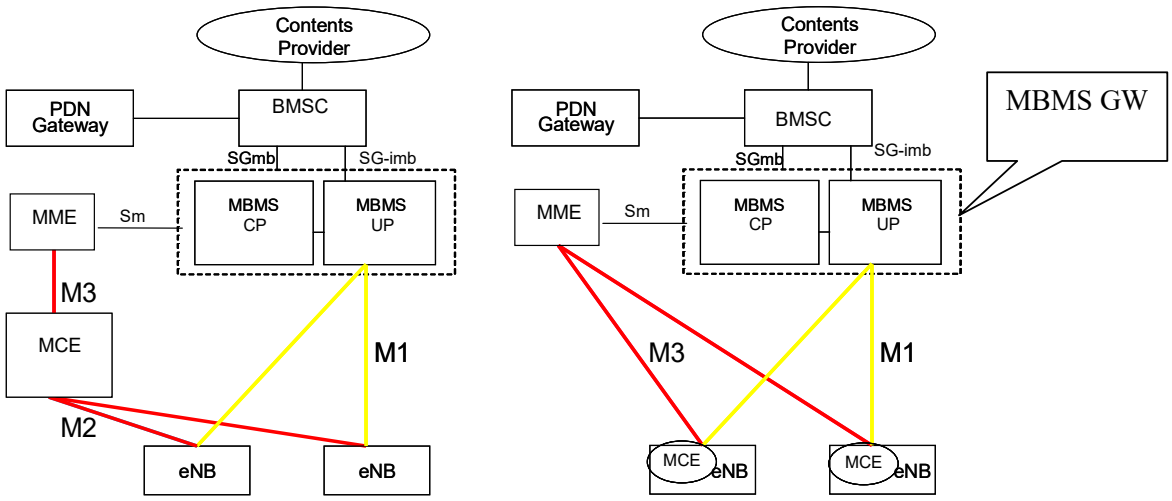


Figure 15.1.1-2: eMBMS Architecture deployment alternatives

15.1.2 E-MBMS User Plane Protocol Architecture

The overall U-plane architecture of content synchronization is shown in Figure 15.1.2-1. This architecture is based on the functional allocation for Unicast and the SYNC protocol layer is defined additionally on transport network layer to support content synchronization mechanism.

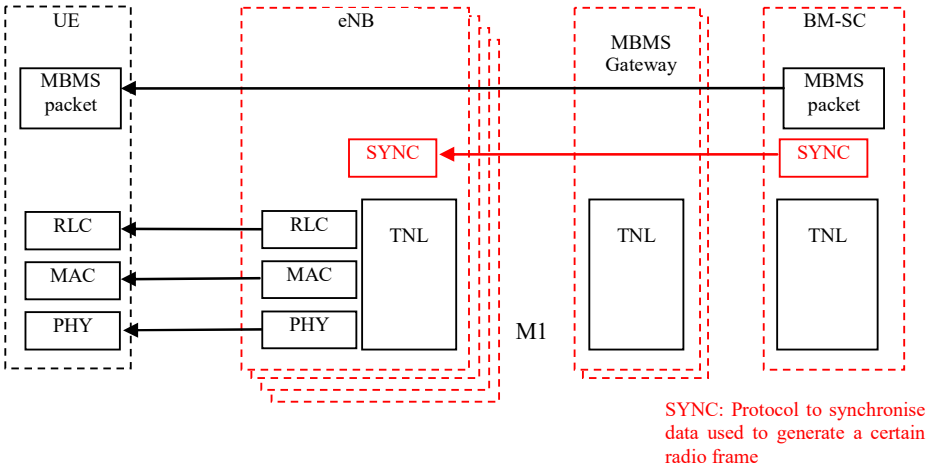


Figure 15.1.2-1: The overall u-plane architecture of the MBMS content synchronization

The SYNC protocol is defined as a protocol to carry additional information that enable eNBs to identify the timing for radio frame transmission and detect packet loss. Every E-MBMS service uses its own SYNC entity. The SYNC protocol is applicable to DL and is terminated in the BM-SC.

15.1.3 E-MBMS Control Plane Protocol Architecture

The E-MBMS C-plane protocol architecture is shown in Figure 15.1.3-1.

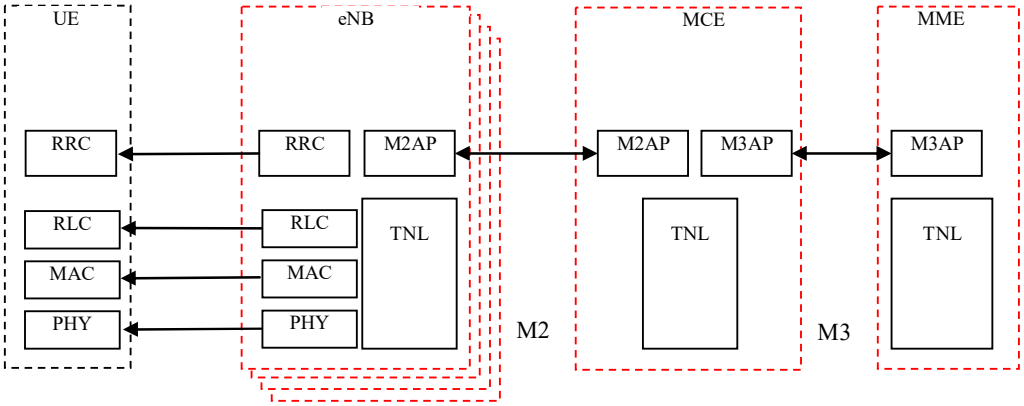


Figure 15.1.3-1: The E-MBMS c-plane architecture

MCCH is terminated in the eNB on the network side. How to achieve the synchronisation of MCCH signalling is described in subclause 15.3.8.

15.2 MBMS Cells

15.2.1 MBMS-dedicated cell

Void

15.2.2 MBMS/Unicast-mixed cell

In E-UTRAN, MBMS is only supported in a carrier shared with unicast traffic. Cells performing MBMS transmissions are referred to as MBMS/Unicast-mixed cells. MBMS is not supported for HeNB.

For MBMS/Unicast mixed cells:

- MTCH and MCCH are mapped on MCH for p-t-m transmission;
- Transmission of both unicast and MBMS in the cell is done in a co-ordinated manner.

15.3 MBMS Transmission

15.3.1 General

Void.

15.3.2 Single-cell transmission

Void.

15.3.3 Multi-cell transmission

Multi-cell transmission of MBMS is characterized by:

- Synchronous transmission of MBMS within its MBSFN Area;
- Combining of MBMS transmission from multiple cells is supported;
- Scheduling of each MCH is done by the MCE;
- A single transmission is used for MCH (i.e. neither blind HARQ repetitions nor RLC quick repeat);
- A single Transport Block is used per TTI for MCH transmission, that TB uses all the MBSFN resources in that subframe;
- MTCH and MCCH can be multiplexed on the same MCH and are mapped on MCH for p-t-m transmission;
- MTCH and MCCH use the RLC-UM mode;
- The MAC subheader indicates the LCID for MTCH and MCCH;
- The MBSFN Synchronization Area, the MBSFN Area, and the MBSFN cells are semi-statically configured e.g. by O&M;
- MBSFN areas are static, unless changed by O&M (i.e. no dynamic change of areas);

NOTE: The UE is not required to receive services from more than one MBSFN Area simultaneously and may support only a limited number of MTCHs.

Multiple MBMS services can be mapped to the same MCH and one MCH contains data belonging to only one MBSFN Area. An MBSFN Area contains one or more MCHs. An MCH specific MCS is used for all subframes of the MCH that do not use the MCS indicated in BCCH. All MCHs have the same coverage area.

For MCCH and MTCH, the UE shall not perform RLC re-establishment at cell change between cells of the same MBSFN area. Within the MBSFN subframes, all MCHs within the same MBSFN area occupy a pattern of subframes, not necessarily adjacent in time, that is common for all these MCHs and is therefore called the Common Subframe Allocation (CSA) Pattern. The CSA pattern is periodically repeated with the CSA period. The actual MCH subframe allocation (MSA) for every MCH carrying MTCH is defined by the CSA pattern, the CSA period, and the MSA end, that are all signalled on MCCH. The MSA end indicates the last subframe of the MCH within the CSA period. Consequently, the MCHs are time multiplexed within the CSA period, which finally defines the interleaving degree between the MCHs. It shall be possible for MCHs to not use all MBSFN resources signalled as part of the Rel-8 MBSFN signalling. Further, such MBSFN resource can be shared for more than one purpose (MBMS, Positioning, etc.). During one MCH scheduling period (MSP), which is configurable per MCH, the eNB applies MAC multiplexing of different MTCHs and optionally MCCH to be transmitted on this MCH.

MCH scheduling information (MSI) is provided per MCH to indicate which subframes are used by each MTCH during the MSP, and to indicate whether transmission for an MTCH is going to be, or has been, suspended by the eNode B. The following principles are used for the MSI:

- it is used both when services are multiplexed onto the MCH and when only a single service is transmitted on the MCH;

- it is generated by the eNB and provided once at the beginning of the MSP;
- it has higher scheduling priority than the MCCH and, when needed, it appears first in the PDU;
- it allows the receiver to determine what subframes are used by every MTCH, sessions are scheduled in the order in which they are included in the MCCH session list;
- it is carried in a MAC control element which cannot be segmented;
- it carries the mapping of MTCHs to the subframes of the associated MSP. This mapping is based on the indexing of subframes belonging to one MSP;
- it carries an indication of whether the transmission of an MTCH is to be suspended by the eNode B.

The content synchronization for multi-cell transmission is provided by the following principles:

1. All eNBs in a given MBSFN Synchronization Area have a synchronized radio frame timing such that the radio frames are transmitted at the same time and have the same SFN.
2. All eNBs have the same configuration of RLC/MAC/PHY for each MBMS service, and identical information (e.g. time information, transmission order/priority information) such that synchronized MCH scheduling in the eNBs is ensured. These are indicated in advance by the MCE.
3. An E-MBMS GW sends/broadcasts MBMS packet with the SYNC protocol to each eNB transmitting the service.
4. The SYNC protocol provides additional information so that the eNBs identify the transmission radio frame(s). The E-MBMS GW does not need accurate knowledge of radio resource allocation in terms of exact time division (e.g. exact start time of the radio frame transmission).
5. eNB buffers MBMS packet and waits for the transmission timing indicated in the SYNC protocol.
6. The segmentation/concatenation is needed for MBMS packets and should be totally up to the RLC/MAC layer in eNB.
7. The SYNC protocol provides means to detect packet loss(es) and supports a recovery mechanism robust against loss of consecutive PDU packets (MBMS Packets with SYNC Header).
8. For the packet loss case the transmission of radio blocks potentially impacted by the lost packet should be muted.
9. The mechanism supports indication or detection of MBMS data burst termination (e.g. to identify and alternately use available spare resources related to pauses in the MBMS PDU data flow).
10. If two or more consecutive SYNC SDUs within a SYNC bearer are not received by the eNB, or if no SYNC PDUs of Type 0 or 3 are received for some synchronization sequence, the eNB may mute the exact subframes impacted by lost SYNC PDUs using information provided by SYNC protocol. If not muting only those exact subframes, the eNB stops transmitting the associated MCH from the subframe corresponding to the consecutive losses until the end of the corresponding MSP and it does not transmit in the subframe corresponding to the MSI of that MSP.
11. The eNB sets VT(US) to zero in the RLC UM entity corresponding to an MCCH at its modification period boundary.
12. The eNB sets VT(US) to zero in each RLC UM entity corresponding to an MTCH at the beginning of its MSP.
13. The eNB sets every bit in the MAC padding on MCH to "0".
14. The eNB’s RLC concatenates as many RLC SDUs from the same radio bearer as possible.
15. The eNB’s MAC multiplexes as many RLC PDUs as fit in the Transport Block.
16. The eNB sets every padding bit in the RLC UM PDU corresponding to an MTCH or MCCH to "0".

15.3.4 MBMS Reception States

UEs that are receiving MTCH transmissions can be in RRC_IDLE or RRC_CONNECTED state.

15.3.5 MCCH Structure

The following principles govern the MCCH structure:

- One MBSFN Area is associated with one MCCH and one MCCH corresponds to one MBSFN Area;
- The MCCH is sent on MCH;
- MCCH consists of a single MBSFN Area configuration RRC message which lists all the MBMS services with ongoing sessions and an optional MBMS counting request message which, when present, comes after the former message in the repetition period;
- MCCH is transmitted by all cells within an MBSFN Area, except the MBSFN Area Reserved Cells;
- MCCH is transmitted by RRC every MCCH repetition period;
- MCCH uses a modification period;
- A notification mechanism is used to announce changes of MCCH due to either Session Start or the presence of an MBMS counting request message;
  - The notification is sent periodically throughout the modification period preceding the change of MCCH, in MBSFN subframes configured for notification;
  - The DCI format 1C with M-RNTI is used for notification and includes an 8-bit bitmap to indicate the one or more MBSFN Area(s) in which the MCCH change(s);
  - The UE monitors more than one notification subframe per modification period;
  - When the UE receives a notification, it acquires the MCCH at the next modification period boundary;
- The UE detects changes to MCCH which are not announced by the notification mechanism by MCCH monitoring at the modification period.

15.3.6 MBMS signalling on BCCH

- BCCH only points to the resources where the MCCH(s) can be found i.e. it does not indicate the availability of the services;
- For each MCCH, BCCH indicates independently:
  - the scheduling of the MCCH for multi-cell transmission on MCH;
  - the MCCH modification period, repetition period radio frame offset and subframe allocation;
  - an MCS which applies to the subframes indicated for MCCH scheduling and for the first subframe of all MSPs in that MBSFN Area.
- For the notification commonly used for all MCCH, BCCH:
  - configures the position of the MCCH change notification subframe and the number of occasions monitored by the UE;
  - indicates the mapping between the PDCCH bit(s) carried in the notification and the MCCH(s).

15.3.7 MBMS User Data flow synchronisation

The synchronised radio interface transmission from the cells controlled by different eNBs requires a SYNC-protocol support between the BM-SC and the eNBs.

As part of the SYNC-protocol procedures the BM-SC shall include within the SYNC PDU packets a time stamp which tells the timing based on which the eNB sends MBMS data over the air interface. This time stamp is based on a common time reference, and common start of the first synchronisation period available at the BM-SC and the concerned eNBs and represents a relative time value which refers to the start time of the synchronisation period.

The BM-SC shall set the timestamp of all SYNC PDU packets in one synchronisation sequence of an MBMS service to the same value. The BM-SC should take into account the following factors for setting the timestamp: arrival time of data, the Maximum Transmission Delay from the BM-SC to the farthermost eNB, the length of the synchronisation sequence used for time stamping and other extra delay (e.g. processing delay in the eNB). The MSP length is one or multiple times of the synchronisation sequence length for MBMS services in the MCH.

MBMS user data shall be time-stamped based on separable synchronisation sequences which are tied to multiples of the TTI length. Each synchronisation sequence for each service is denoted by a single timestamp value working in such a manner that an increase of the timestamp value by one or more synchronisation sequence lengths shall be interpreted as an implicit start-of-a-new-synchronisation-sequence-indicator, so that the eNB becomes aware that a new sequence is starting.

The BM-SC does not know the absolute time point at which a TTI starts, but the sequence length for the time stamp is set by O&M like the delay parameters. The BM-SC will use the delay parameters to define the transmission time point of that user data packet and for the following user data packets the sequence length for the time stamp: following user data packets arriving within e.g. 40ms will receive the same time stamp value as the first data packet, if the sequence length is set to be 40ms.

The eNB shall schedule the received data packets in the first MSP following the time point indicated by the timestamp unless the MBMS service is suspended, in which case no packet shall be sent by eNB. When a suspended MBMS service is resumed, the eNB shall enable the transmission from the beginning of the Modification Period indicated by the *MCCH Update Time*.

The elementary procedures related to the SYNC-protocol are defined in [36].

Based on the parameters in the SYNC Header (e.g. Timestamp, Packet Number, Elapsed Octet Counter), the eNB is able to derive the timing for downlink radio transmission and notice if any SYNC packets are lost during transmission from BM-SC to the eNB. The eNB is also able to know the size of the lost SYNC packet in case a single SYNC packet is lost. Furthermore, the eNB may also be able to know the sizes of each lost SYNC packet if multiple consecutive SYNC packets are lost. Additionally the eNB is able to reorder the PDUs before passing them to RLC processing, if needed.

At the end of each synchronisation sequence the BM-SC shall send to the eNBs a user data frame, which contains counter information including '*Total Number Of Packet Counter*' and '*Total Number Of Octet*' without MBMS payload. This *Total Counter* frame is implicitly marking the end-of-sync.seq. The *Total Counter* frame without payload may be repeated in order to improve the reliability of the delivery to the eNBs.

In case the SYNC protocol delivers more data for an MCH than the air interface can transport in the scheduling period, the following procedure shall be used by the eNB. As long as the eNB must drop a packet because it has too much data for this MCH scheduling period, it does the following,

- select the last bearer according to the order in the MCCH list with a SYNC SDU available for dropping;
- for the selected bearer, drop the available SYNC SDU with the highest Packet Number among the SYNC SDUs with the latest Timestamp.

A SYNC SDU is considered available for dropping when the eNB knows its size and it has not been dropped by the eNB.

15.3.8 Synchronisation of MCCH Update Signalling via M2

The synchronised radio interface transmission from the cells controlled by different eNBs require means to ensure that the MCCH content is updated at the same modification period border in each cell belonging to the same MBSFN Area.

The MCE and the concerned eNBs maintain a common time reference which allows each node to be aware of the modification period boundary within an MBSFN Area. In addition, each node maintains a counter of modification periods which is incremented by one at each modification period boundary. This counter which is based on common start of the first MCCH modification period, allows the MCE to indicate to the eNBs at which modification period the MCCH update shall take place. The MCE shall ensure that it starts to inform all eNBs within the MBSFN Area well in advance. In case of the simultaneously change of the MCCH information and the MCCH related BCCH information, the eNB may use this counter to decide after which BCCH modification period the MCCH related BCCH information update takes place.

15.3.9 IP Multicast Distribution

To improve the transport efficiency the IP Multicast shall be used for the MBMS payload distribution in the backbone network between the MBMS-GW and the eNBs that have joined the IP Multicast Group.

The MBMS-GW allocates the Transport Layer Address used for the IP multicast and the DL TEID used for the M1 Transport association. The MBMS-GW sends this information to the MME(s) during the Session Start and, if needed, during Session Update procedures . The MCE(s) shall receive these parameters from the MME in the MBMS Session Start Request message and pass them to the relevant eNBs. The MCE may also receive these parameters in the MBMS Session Update message as part of the MBMS session attributes, and pass them to the relevant eNBs via the MBMS Session Start procedure or the MBMS Session Update procedure.

If the eNB accepts the MBMS Session Start request, or if it is required following the acceptance of the MBMS Session Update request, the eNB shall join the channel (IP Multicast and Source address) to the backbone in order to join the bearer service multicast distribution.

The MBMS payload is forwarded by the MBMS-GW towards the IP Multicast address. The eNBs having joined that IP Multicast address will receive the user data packets (SYNC PDU) together with the synchronisation-related information in header part of SYNC PDU.

15.4 Service Continuity

Mobility procedures for MBMS reception allow the UE to start or continue receiving MBMS service(s) via MBSFN when changing cell(s). E-UTRAN procedures provide support for service continuity with respect to mobility within the same MBSFN area. Within the same geographic area, MBMS services can be provided on more than one frequency and the frequencies used to provide MBMS services may change from one geographic area to another within a PLMN.

UEs that are receiving MBMS service(s) in RRC_IDLE state performing cell reselection or are in RRC_CONNECTED state obtain target cell MTCH information from the target cell MCCH.

To avoid the need to read MBMS related system information and potentially MCCH on neighbour frequencies, the UE is made aware of which frequency is providing which MBMS services via MBSFN through the combination of the following MBMS assistance information:

- user service description (USD): in the USD (see 3GPP TS 26.346 [49]), the application/service layer provides for each service the TMGI, the session start and end time, the frequencies and the MBMS service area identities (MBMS SAIs, see definition in section 15.3 of 3GPP TS 23.003 [26]) belonging to the MBMS service area (see definition in 3GPP TS 23.246 [48]);

- system information: MBMS and non-MBMS cells indicate in *SystemInformationBlockType15* the MBMS SAIs of the current frequency and of each neighbour frequency.

The MBMS SAIs of the neighbouring cell may be provided by X2 signalling (i.e. X2 Setup and eNB Configuration Update procedures) or/and OAM.

When applying the procedures described below for UEs in RRC_IDLE and RRC_CONNECTED state:

- the UE does not need to verify that a frequency is providing a MBMS service by acquiring MCCH and may apply these procedures even though a MBMS service is not provided via MBSFN;

- the UE may consider that a service is provided if a session of this service is ongoing as derived from the session start and end times indicated for this service in the USD and if a frequency provides this service;

- the UE determines the frequency on which a service is provided according to the following:

  - if the serving cell provides *SystemInformationBlockType15*, the UE considers that a frequency is providing the MBMS service via MBSFN if and only if one of the MBMS SAI(s) of this frequency as indicated in *SystemInformationBlockType15* of the serving cell is indicated for this MBMS service in the USD;

  - if the serving cell does not provide *SystemInformationBlockType15*, the UE in RRC_IDLE state may consider that a frequency included in the USD for the MBMS service is providing this MBMS service as long as the UE reselects cells where *SystemInformationBlockType13* is provided.

In RRC_IDLE, the UE applies the normal cell reselection rules with the following modifications:

- the UE which is receiving MBMS service(s) via MBSFN and can only receive these MBMS service(s) via MBSFN while camping on the frequency providing these MBMS service(s) is allowed to make this frequency highest priority;

- the UE which is interested in receiving MBMS service(s) via MBSFN and can only receive these MBMS service(s) via MBSFN while camping on the frequency providing these MBMS service(s) is allowed to make this frequency highest priority when it intends to receive these MBMS service(s);

- when the MBMS service(s) which the UE is interested in are no longer available (after the end of the session) or the UE is no longer interested in receiving the service(s), the UE no longer prioritises the frequency providing these MBMS service(s);

NOTE 1: In RRC IDLE, when the above modifications to cell reselection rules are applied, the prioritization between the frequency providing these MBMS service(s) and the frequency of a CSG cell, and the autonomous search are left to UE implementation.

In RRC_CONNECTED, the UE that is receiving or interested to receive MBMS via MBSFN informs the network about its MBMS interest via a RRC message and the network does its best to ensure that the UE is able to receive MBMS and unicast services subject to the UE's capabilities:

- the UE indicates the frequencies which provide the service(s) that the UE is receiving or is interested to receive simultaneously, and which can be received simultaneously in accordance with the UE capabilities.

- the UE indicates its MBMS interest at RRC connection establishment (the UE does not need to wait until AS security is activated), and whenever the set of frequencies on which the UE is interested in receiving MBMS services has changed compared with the last indication sent to the network (e.g. due to a change of user interest or of service availability).

- the UE may only indicate its interest when the PCell provides *SystemInformationBlockType15* and after having acquired *SystemInformationBlockType15* of the current PCell.

- the UE may indicate its MBMS interest even if the current configured serving cell(s) do not prevent it from receiving the MBMS services it is interested in.

- the UE indicates with a single bit whether it prioritises MBMS reception over unicast. This priority indication applies to all unicast bearers and all MBMS frequencies. It is sent whether the MBMS frequencies are congested or not.

- the E-UTRAN reuses the *SupportedBandCombination* IE to derive the UEs MBMS related reception capabilities, i.e. the E-UTRAN tries to ensure that the UE is able to receive MBMS and unicast bearers by providing them on the frequencies indicated in *SupportedBandCombination* IE signalled by the UE. The UE shall support MBMS reception on any serving cell and on any cell that may be additionally configured as serving cell according to the UE capabilities.

- for handover preparation, the source eNB transfers the MBMS interest of the UE, if available, to the target eNB. After handover, the UE reads *SystemInformationBlockType15* before updating its MBMS interest. If *SystemInformationBlockType15* is provided on the target cell but not on the source cell, the UE indicates its MBMS interest after handover.

If MBMS is prioritised and the unicast connection cannot be maintained because of congestion on the MBMS carrier then the E-UTRAN releases unicast bearers. It is left to E-UTRAN implementation whether all bearers or only GBR bearers are released. The E-UTRAN does not trigger re-establishment of the released unicast bearers. For congestion control, the E-UTRAN can rely on existing access control mechanisms.

The E-UTRAN may take into account the UE priority for MBMS or unicast reception when receiving an indication of proximity to a CSG cell from a UE which also indicated interest in MBMS reception (or vice-versa).

15.5 Network sharing

Unicast mobility shall not be affected by the sharing of MBMS resources by operators.

15.6 Network Functions for Support of Multiplexing

Considerable gain in radio resource efficiency can be achieved by multiplexing several E-MBMS services on a single MCH. The services that share the resources are called E-MBMS Service Multiplex. The amount of common radio resources allocated to such an E-MBMS Service Multiplex can be smaller than the sum of radio resources, which would need to be allocated for the individual services without multiplexing. This represents the statistical multiplexing gain.

The MCE manages the E-MBMS Service Multiplex e.g. deciding which services are to be multiplexed on which MCH. The duration of each E-MBMS service may be different, so there is a need to manage the Service Multiplex dynamically, i.e. addition or removal of services into/from the E-MBMS Service Multiplex. The MCE allocates the optimal amount of resources to multiplexed services, using service related information. The MCE selects the CSA pattern for the MCHs and also the order in which the services appear in the MCCH. MBSFN transmission is ensured by identical multiplexing of the services in all cells belonging to the same MBSFN area. The location of the multiplexing function is in the eNB MAC layer.

These functions are supported by respective signalling information on M2 interface. This scheduling information is sent to all eNBs via the M2 interface procedure "MBMS Scheduling Information".

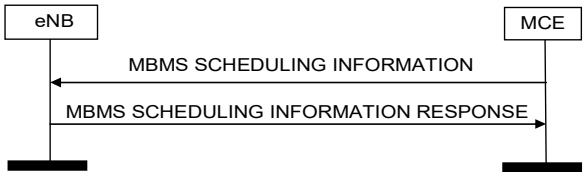


Figure 15.6.1 MBMS Scheduling Information procedure message flow on M2 interface

15.7 Procedures

15.7.1 Procedures for Broadcast mode

15.7.1.1 Session Start procedure

The purpose of the MBMS Session Start procedure is to request the E-UTRAN to notify UEs about an upcoming MBMS Session of a given MBMS Bearer Service and to establish an MBMS E-RAB for this MBMS Session. The MBMS Session Start procedure is triggered by the EPC.

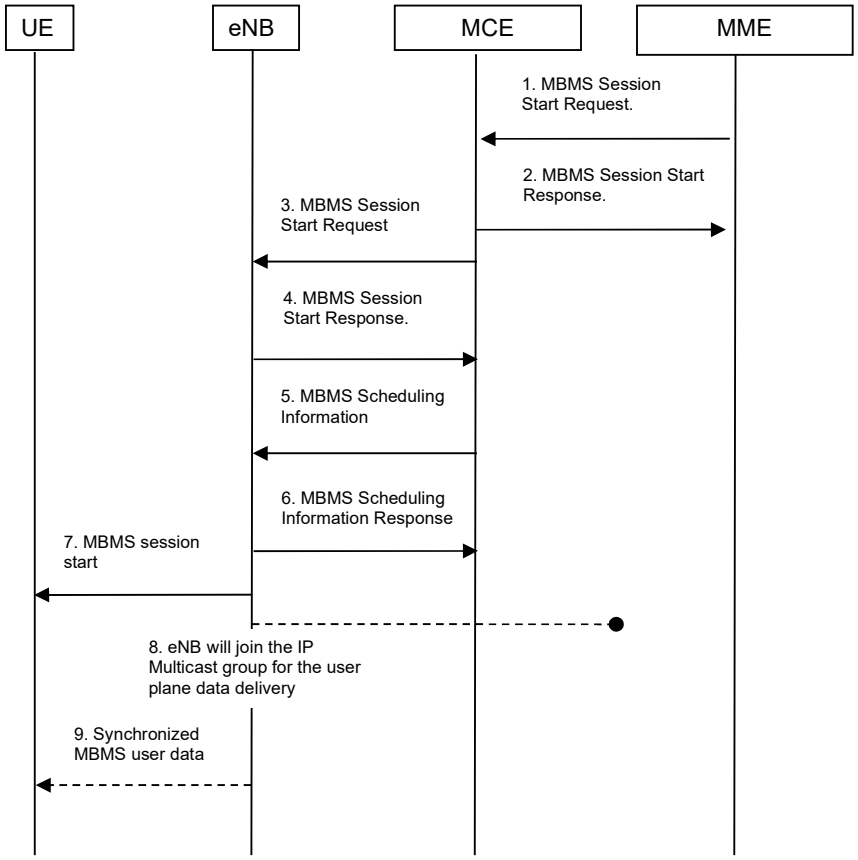


Figure 15.7.1.1-1. Session Start procedure

1. The MME sends MBMS session start request message to the MCE(s) controlling eNBs in the targeted MBMS service area. The message includes the IP multicast address, session attributes and the minimum time to wait before the first data delivery.

2. MCE checks whether the radio resources are sufficient for the establishment of new MBMS service(s) in the area it controls. If not, MCE decides not to establish the radio bearers of the MBMS service(s) and does not forward the MBMS session start request message to the involved eNBs, or may pre-empt radio resources from other radio bearer(s) of ongoing MBMS service(s) according to ARP. The MCE confirms the reception of the MBMS Session Start request to the MME. This message can be transmitted before the step 4. Only in case of distributed MCE architecture radio resource setup is scheduled according to the parameter "time of MBMS data transfer" which indicates an absolute start time of data delivery, otherwise according to the "minimum time to MBMS data transfer" parameter.

3. MCE sends the MBMS Session Start Request message to the eNBs in the targeted MBMS service area. If the MBMS Session Start message includes the MBMS Service Area Identity with value 0 as defined in TS23.003 [26], the MCE shall consider that all those eNBs supporting the PLMN as indicated by the received MBMS Session Start Request message are involved. The MCE then determines in which MBSFN area(s) the service should be delivered.

NOTE: When to send the MBMS Session Start message from MCE to eNB according to the minimum time to wait indication is an MCE implementation issue.

4. eNB confirms the reception of the MBMS Session Start message.

5. MCE sends the MBMS Scheduling Information message to the eNB including the updated MCCH information which carries the MBMS service's configuration information. This message can be transmitted before the step 3.

6. eNB confirms the reception of the MBMS Scheduling Information message.

7. eNB indicates MBMS session start to UEs by MCCH change notification and updated MCCH information which carries the MBMS service's configuration information.

8. eNB joins the IP multicast group to receive the MBMS User Plane data.
9. eNB sends the MBMS data to radio interface at the determined time.

15.7.1.2 Session Stop procedure

The MBMS Session Stop procedure is to request the E-UTRAN to notify UEs about the end of a given MBMS Session and to release the corresponding MBMS E-RAB this MBMS Session. The MBMS Session Stop procedure is triggered by the EPC.

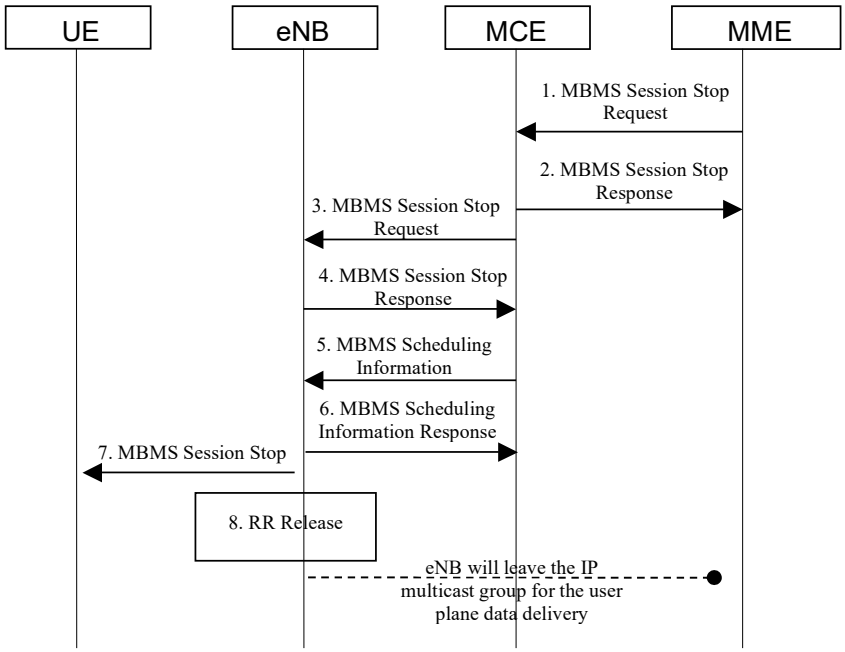


Figure 15.7.1.2-1. Session Stop procedure

1. The MME sends MBMS session stop request message to the MCE(s) controlling eNBs in the targeted MBMS service area.
2. MCE confirms the reception of the MBMS Session stop request to the MME.
3. MCE forwards the MBMS Session stop message to the eNBs in the targeted MBMS service area.
4. eNB confirms the reception of the MBMS Session stop message.
5. MCE sends the MBMS Scheduling Information message to the eNB including the updated MCCH information which carries the MBMS service's configuration information. This message can be transmitted before the step 3.
6. eNB confirms the reception of the MBMS Scheduling Information message.
7. eNB indicates MBMS session stop to UEs by removing any service configuration associated with the stopped session from the updated MCCH message.
8. The corresponding E-RAB is released, and eNB leaves the IP multicast group.

15.7a M1 Interface

15.7a.1 M1 User Plane

The M1 user plane interface is defined between the eNB and the MBMS GW. The M1 user plane interface provides non guaranteed delivery of user plane PDUs between the eNB and the MBMS GW. The user plane protocol stack on the M1 interface is shown in Figure 15.7a.1-1. The transport network layer is built on IP transport and GTP-U is used on top of UDP/IP to carry the user plane PDUs between the eNB and the MBMS GW.

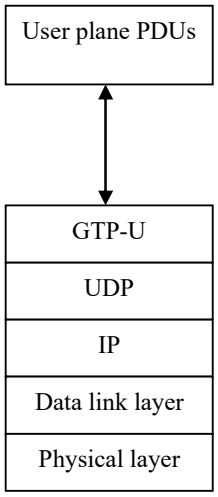


Figure 15.7a.1-1: M1 Interface User Plane (eNB – MBMS GW)

15.8 M2 Interface

15.8.1 M2 Control Plane

The M2 control plane interface is defined between the eNB and the MCE. The control plane protocol stack of the M2 interface is shown on Figure 15.8.1-1. The transport network layer is built on IP transport, for the reliable transport of signalling messages SCTP is added on top of IP. The application layer signalling protocol is referred to as M2AP (M2 Application Protocol).

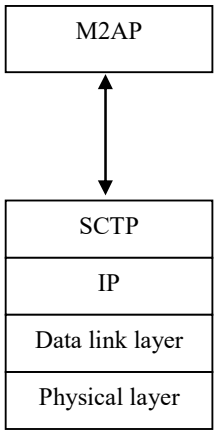


Figure 15.8.1-1: M2 Interface Control Plane (eNB-MCE)

The SCTP layer provides the guaranteed delivery of application layer messages.

In the transport IP layer point-to-point transmission is used to deliver the signalling PDUs.

A single SCTP association per eNB-MCE interface instance shall be used with one pair of stream identifiers for M2 common procedures. Only a few pairs of stream identifiers should be used for M2 MBMS-service-associated procedures. eNB and MCE communication context identifiers that are assigned by the eNB and the MCE for M2 MBMS-service-associated procedures shall be used to distinguish MBMS service specific M2 signalling transport bearers. The communication context identifiers are conveyed in the respective M2AP messages.

15.8.2 M2 Interface Functions

15.8.2.1 General

The M2 interface provides the following functions:

- MBMS Session Handling Function:
  - MBMS Session Start, MBMS Session Stop, MBMS Session Update.
- MBMS Scheduling Information Provision Function.
- M2 Interface Management Function:
  - Reset, Error Indication, Restoration.
- M2 Configuration Function.
- MBMS Service Counting Function.
- MBMS Service Suspension and Resumption Function.

15.8.2.2 MBMS Session Handling Function

The MBMS Session Handling Function enables the MCE to provide Session Start, Session Stop and Session Update messages to the eNBs it is connected to. The MCE provides the information of the MBMS session, e.g., the MBMS Service Area information to the eNB.

15.8.2.3 MBMS Scheduling Information Provision Function

The MBMS Scheduling Information Provision Function enables the MCE to configure MCCH content according to the expected or ongoing MBMS services, and to configure MCH Scheduling Information for suspension notification.

15.8.2.4 M2 Interface Management Function

The M2 interface management functions provide:

- means to ensure a defined start of the M2 interface operation (reset);
- means to handle different versions of application part implementations and protocol errors (error indication);
- means to restore services following an eNB failure or an M2 path failure (restoration). The Restoration function enables the MCE to restore in the eNB the MBMS sessions. This restoration function is implemented by the MBMS Session Start procedure.

15.8.2.5 M2 Configuration Function

The M2 Configuration Function allows the eNB and MCE to exchange configuration information necessary for the operation of the M2 interface, and MCCH related BCCH content.

15.8.2.6 MBMS Service Counting Function

The MBMS Service Counting Function enables the MCE to perform counting and to receive counting results per MBMS service(s) within MBSFN area(s). MCE can perform counting only for those MBMS service(s) for which access has not been denied by the admission control function for the corresponding MBMS session(s).

15.8.2.7 MBMS Service Suspension and Resumption Function

The MBMS Service Suspension and Resumption Function enables the MCE to request the eNB that it may release the allocated RAN resources, may leave the IP multicast if already joined, shall update the MCCH information and shall suspend the MBSFN transmission while keeping the MBMS context for that service in the eNB. If the MCE subsequently requests the eNB for resumption, then the eNB shall allocate the RAN resources, shall send the MCCH change notification, shall update the MCCH information, shall resume the MBSFN transmission and shall join IP multicast if previously left. This MBMS Services Suspension and Resumption function is implemented by the MBMS Scheduling Information procedure as described in subclause 15.8.3.3.

Suspension/Resumption of MBMS service provision is applied to a whole MBSFN area.

15.8.2.8 MBMS Overload Notification Function

The MBMS Overload Notification Function enables the eNB to notify the MCE about MBMS overload status.

15.8.3 M2 Interface Signalling Procedures

15.8.3.1 General

The elementary procedures supported by the M2AP protocol are listed in Table 2 and Table 3 of TS 36.443 [44].

15.8.3.2 MBMS Session signalling procedure

The MBMS Session signalling procedure enables the MCE to deliver Session Start, Session Stop and Session Update messages to the concerned eNBs. At Session Start and Session Update, the MCE provides the information of the MBMS session, e.g., the MBMS Service Area information to the eNB.

15.8.3.3 MBMS Scheduling Information procedure

The MBMS Scheduling Information procedure enables the MCE to update MCCH information whenever necessary. Typically, the MCE issues an MBMS Scheduling Information procedure before user data transmission for an announced MBMS service starts or after it has ended.

The MBMS Scheduling Information procedure also enables the MCE to update MCH Scheduling Information for suspension notification.

15.8.3.4 M2 Interface Management procedures

15.8.3.4.1 Reset procedure

The Reset procedure is issued in order to re-initialize the peer entity or part of the peer entity after node setup and after a failure event occurred. This procedure may be initiated by both the eNB and MCE.

15.8.3.4.2 Error Indication procedure

The Error Indication procedure may be initiated by the eNB and the MCE. It is used to report detected errors in one incoming message, if an appropriate failure message cannot be reported to the sending entity.

15.8.3.5 M2 Configuration procedures

15.8.3.5.1 M2 Setup procedure

The M2 Setup procedure allows the exchange of configured data which is required in the MCE and in the eNB respectively to ensure a proper interoperation and MCCH related BCCH content. The M2 Setup procedure is triggered by the eNB. The M2 Setup procedure is the first M2AP procedure executed on an M2 interface instance.

15.8.3.5.2 eNB Configuration Update procedure

The eNB Configuration Update procedure is used to provide updated configured data in the eNB and receive MCCH related BCCH content from MCE. The eNB Configuration Update procedure is triggered by the eNB.

15.8.3.5.3 MCE Configuration Update procedure

The MCE Configuration Update procedure is used to provide updated configured data in the MCE and tell eNB updated MCCH related BCCH content. The MCE Configuration Update procedure is triggered by the MCE.

15.8.3.6 MBMS Service Counting procedures

15.8.3.6.1 MBMS Service Counting procedure

The MBMS Service Counting procedure is used to trigger the eNB to count the number of connected mode UEs that either are receiving the MBMS service(s) or are interested in the reception of the MBMS service(s).

15.8.3.6.2 MBMS Service Counting Results Report procedure

The MBMS Service Counting Results Report procedure is used by the eNB to provide the MCE with the number of connected mode UEs that either are receiving the MBMS service(s) or are interested in the reception of the MBMS service(s) based on counting performed by the eNB.

15.8.3.7 MBMS Overload Notification procedure

The MBMS Overload Notification procedure enables the eNB to notify the MCE about MBMS overload status.

15.9 M3 Interface

15.9.1 M3 Control Plane

The M3 control plane interface is defined between the MME and the MCE. The control plane protocol stack of the M3 interface is shown on Figure 15.9.1-1. The transport network layer is built on IP transport, for the reliable transport of signalling messages SCTP is added on top of IP. The application layer signalling protocol is referred to as M3AP (M3 Application Protocol).

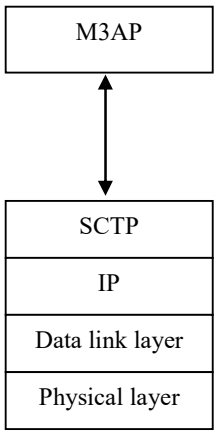


Figure 15.9.1-1: M3 Interface Control Plane (MME-MCE)

The SCTP layer provides the guaranteed delivery of application layer messages.

In the transport IP layer point-to-point transmission is used to deliver the signalling PDUs.

A single SCTP association per MME-MCE interface instance shall be used with one pair of stream identifiers for M3 common procedures. Only a few pairs of stream identifiers should be used for M3 MBMS-service-associated procedures. MME and MCE communication context identifiers that are assigned by the MME and the MCE for M3 MBMS-service-associated procedures shall be used to distinguish MBMS service specific M3 signalling transport bearers. The communication context identifiers are conveyed in the respective M3AP messages.

15.9.2 M3 Interface Functions

15.9.2.1 General

The M3 interface provides the following functions:

- MBMS Session Handling Function:
  - MBMS Session Start, MBMS Session Stop, MBMS Session Update.
- M3 Interface Management Function:
  - Reset, Error Indication, Restoration.
- M3 Configuration Function (distributed MCE architecture only, see clause 15.1.1)
  - M3 Setup, MCE Configuration Update.

15.9.2.2 MBMS Session Handling Function

The MBMS Session Handling Function enables the MME to provided Session Start, Session Stop and Session Update messages to the MCEs it is connected to. The MME provides the information of the MBMS session, e.g., QoS and MBMS Service Area, to the MCEs.

In this release the MBMS Session Update procedure only supports the update of MBMS Service Area, the update of the allocation and retention priority of the MBMS session and the update of time of MBMS data transfer where the last one is used in the distributed MCE architecture only.

15.9.2.3 M3 Interface Management Function

The M3 interface management functions provide:

- means to ensure a defined start of the M3 interface operation (reset);
- means to handle different versions of application part implementations and protocol errors (error indication);
- means to restore services following an MCE failure or an M3 path failure (restoration).The Restoration function enables the MME to restore in the MCE the MBMS sessions as specified in TS 23.007 [56]. This Restoration function is implemented by the MBMS Session Start procedure.

15.9.2.4 M3 Configuration Function

The M3 Configuration Function allows the MCE to exchange with the MME node configuration information necessary for the operation of the M3 interface such as the supported MBMS Service Area information.

15.9.3 M3 Interface Signalling Procedures

15.9.3.1 General

The elementary procedures supported by the M3AP protocol are listed in Table 8-1 and Table 8-2 of TS 36.444 [45].

15.9.3.2 MBMS Session signalling procedure

The MBMS Session signalling procedure enables the MME to deliver Session Start, Session Stop and Session Update messages to the concerned MCEs. At Session Start and Session Update, the MME provides the information of the MBMS session, e.g., QoS and MBMS Service Area, to the MCEs.

In distributed MCE architecture only, the MME may also provide a "time of MBMS data transfer" to indicate the absolute start time of data delivery, and a "time of MBMS data stop" to indicate the absolute end time of data delivery.

In this release the MBMS Session Update procedure only supports the update of MBMS Service Area, the update of the allocation and retention priority of the MBMS session and the update of time of MBMS data transfer where the last one is used in the distributed MCE architecture only.

15.9.3.3 M3 Interface Management procedures

15.9.3.3.1 Reset procedure

The Reset procedure is issued in order to re-initialize the peer entity or part of the peer entity after node setup and after a failure event occurred. This procedure may be initiated by both the MME and MCE.

15.9.3.3.2 Error Indication procedure

The Error Indication procedure may be initiated by the MME and the MCE. It is used to report detected errors in one incoming message, if an appropriate failure message cannot be reported to the sending entity.

15.9.3.4 M3 Configuration procedures

15.9.3.4.1 M3 Setup procedure

The M3 Setup procedure allows the initial exchange of configured data which is required in the MCE and in the MME such as the supported MBMS Service Area information. The M3 Setup procedure is initiated by the MCE.

15.9.3.4.2 MCE Configuration Update procedure

The MCE Configuration Update procedure is used to provide updated configured data in the MCE to the MME. The MCE Configuration Update procedure is triggered by the MCE.

15.10 MBMS Counting

15.10.1 General

MBMS counting in LTE is used to determine if there are sufficient UEs interested in receiving a service to enable the operator to decide if it is appropriate to deliver the service via MBSFN. It allows the operator to choose between enabling or disabling MBSFN transmission for the service. MBMS counting applies only to connected mode UEs. Enabling and disabling MBSFN transmission is realized by MBMS Service Suspension and Resumption function in subclause 15.8.2.7.

The following principles are used for the MBMS counting:

- Counting is supported for both a service already provided by MBSFN in an MBSFN area as well as for a service not yet provided via MBSFN in an MBSFN area. A service not yet provided via MBSFN in an MBSFN area may be:
  - Service provided via unicast bearer.
  - Service not yet provided either by MBSFN or by unicast.
- RAN is not aware of MBMS service provisioning through unicast bearers.

15.10.2 Counting Procedure

The Counting Procedure is initiated by the network. Initiation of the Counting Procedure results in a request to each eNB involved in the providing MBSFN area to send a Counting Request (the Counting Request is included in the directly extended MCCH message), which contains a list of TMGI's requiring UE feedback. The connected mode UEs which are receiving or interested in the indicated services will respond with a RRC Counting Response message, which includes short MBMS service identities (unique within the MBSFN service area) and may optionally include the information to identify the MBSFN Area (if overlapping is configured).

The following principles are used for the Counting Procedure:

- Network has means to disable UE counting per service.
- The UE is able to report on multiple MBMS services via a single Counting Response message.
- It is unnecessary to retransmit the Counting Response when the UE moves within the same MBSFN area.
- The network only gets one response from a UE related to one Counting Request message, which is broadcast for one modification period.
- The UE cannot automatically indicate to network a change of interest in MBMS service(s).
- The network counts UE interest per service.

16 Radio Resource Management aspects

The purpose of radio resource management (RRM) is to ensure the efficient use the available radio resources and to provide mechanisms that enable E-UTRAN to meet radio resource related requirements identified in sub-clause 10 of 3GPP TR 25.913 [2]. In particular, RRM in E-UTRAN provides means to manage (e.g. assign, re-assign and release) radio resources taking into account single and multi-cell aspects.

16.1 RRM functions

16.1.1 Radio Bearer Control (RBC)

The establishment, maintenance and release of Radio Bearers involve the configuration of radio resources associated with them. When setting up a radio bearer for a service, radio bearer control (RBC) takes into account the overall resource situation in E-UTRAN, the QoS requirements of in-progress sessions and the QoS requirement for the new service. RBC is also concerned with the maintenance of radio bearers of in-progress sessions at the change of the radio resource situation due to mobility or other reasons. RBC is involved in the release of radio resources associated with radio bearers at session termination, handover or at other occasions.

RBC is located in the eNB.

16.1.2 Radio Admission Control (RAC)

The task of radio admission control (RAC) is to admit or reject the establishment requests for new radio bearers. In order to do this, RAC takes into account the overall resource situation in E-UTRAN, the QoS requirements, the priority levels and the provided QoS of in-progress sessions and the QoS requirement of the new radio bearer request. The goal of RAC is to ensure high radio resource utilization (by accepting radio bearer requests as long as radio resources available) and at the same time to ensure proper QoS for in-progress sessions (by rejecting radio bearer requests when they cannot be accommodated).

RAC is located in the eNB.

16.1.3 Connection Mobility Control (CMC)

Connection mobility control (CMC) is concerned with the management of radio resources in connection with idle or connected mode mobility. In idle mode, the cell reselection algorithms are controlled by setting of parameters (thresholds and hysteresis values) that define the best cell and/or determine when the UE should select a new cell. Also, E-UTRAN broadcasts parameters that configure the UE measurement and reporting procedures. In connected mode, the mobility of radio connections has to be supported. Handover decisions may be based on UE and eNB measurements. In addition, handover decisions may take other inputs, such as neighbour cell load, traffic distribution, transport and hardware resources and Operator defined policies into account.

CMC is located in the eNB.

16.1.4 Dynamic Resource Allocation (DRA) - Packet Scheduling (PS)

The task of dynamic resource allocation (DRA) or packet scheduling (PS) is to allocate and de-allocate resources (including buffer and processing resources and resource blocks (i.e. chunks)) to user and control plane packets. DRA involves several sub-tasks, including the selection of radio bearers whose packets are to be scheduled and managing the necessary resources (e.g. the power levels or the specific resource blocks used). PS typically takes into account the QoS requirements associated with the radio bearers, the channel quality information for UEs, buffer status, interference situation, etc. DRA may also take into account restrictions or preferences on some of the available resource blocks or resource block sets due to inter-cell interference coordination considerations.

DRA is located in the eNB.

16.1.5 Inter-cell Interference Coordination (ICIC)

Inter-cell interference coordination has the task to manage radio resources such that inter-cell interference is kept under control. ICIC mechanism includes a frequency domain component and time domain component. ICIC is inherently a multi-cell RRM function that needs to take into account information (e.g. the resource usage status and traffic load situation) from multiple cells. The preferred ICIC method may be different in the uplink and downlink.

The frequency domain ICIC manages radio resource, notably the radio resource blocks, such that multiple cells coordinate use of frequency domain resources.

In TDD, intended UL-DL configuration may be exchanged through backhaul signalling, and frequency domain ICIC information may be exchanged per subframe set, such that multiple cells may coordinate the usage of frequency domain resources in the subframe sets.

For the time domain ICIC, subframe utilization across different cells are coordinated in time through backhaul signalling or OAM configuration of so called Almost Blank Subframe patterns. The Almost Blank Subframes (ABSs) in an aggressor cell are used to protect resources in subframes in the victim cell receiving strong inter-cell interference. Almost blank subframes are subframes with reduced transmit power (including no transmission) on some physical channels and/or reduced activity. The eNB ensures backwards compatibility towards UEs by transmitting necessary control channels and physical signals as well as System Information. Patterns based on ABSs are signalled to the UE to restrict the UE measurement to specific subframes, called measurement resource restrictions. There are different patterns depending on the type of measured cell (serving or neighbour cell) and measurement type (e.g. RRM, RLM). MBSFN subframes can be used for time domain ICIC when they are also included in ABS patterns. The eNB cannot configure MBSFN subframes TS 36.211 [4] as ABSs when these MBSFN subframes are used for other usages (e.g., MBMS, LCS).

Extending the coverage of a cell by means of connecting a UE to cell that is weaker than the strongest detected cell is referred to as cell range extension (CRE). With time domain ICIC, a CRE UE may continue to be served by a victim cell (i.e., the weaker cell) even while under strong interference from aggressor cells (i.e., the stronger cell).

A UE under strong interference from aggressor cells may need to mitigate interference from the aggressor cells on some physical channels and signals in order to receive data from serving cell or to detect the weak cells or to perform measurements on the weak cells.

The network may provide SIB1 to the UE in the CRE region by a dedicated RRC signalling to assist UE system information acquisition.

ICIC is located in the eNB.

16.1.5.1 UE configurations for time domain ICIC

For the UE to measure "protected" resources of the serving cell and/or neighbour cells, RRM/RLM/CSI measurement resource restriction is signalled to the UE. There are three kinds of measurement resource restriction patterns that may be configured for the UE.

- Pattern 1: A single RRM/RLM measurement resource restriction for the PCell.
- Pattern 2: A single RRM measurement resource restriction for indicated list of neighbour cells operating in the same carrier frequency as the PCell.
- Pattern 3: Resource restriction for CSI measurement of the PCell. If configured, two subframe subsets are configured per UE. The UE reports CSI for each configured subframe subset.

  For pattern 3, it is up to the network to choose the two subframe subsets but typically the two subframe subsets are chosen with the expectation that CSI measurements using the two configured subframe subsets are subject to different levels of interference (e.g., one subframe subset indicates ABSs while the second subframe subset indicates non-ABSs). For periodic CSI reports, linkage of each CSI report to a configured subset of subframe is defined in TS 36.331 [16]. For aperiodic CSI reports, the UE reports CSI based on the subframe subset containing the CSI reference resource.

In RRC_CONNECTED, the RRM/RLM/CSI measurement resource restrictions are configured by dedicated RRC signalling.

The network may configure the UE with CRS assistance information of the aggressor cells in order to aid the UE to mitigate the interference from CRS of the aggressor cells.

16.1.5.2 OAM requirements for time domain ICIC

16.1.5.2.1 Configuration for CSG cell

When the time-domain inter-cell interference coordination is used for non-members UE in close proximity of a CSG cell, OAM configures a CSG cell not to use a time domain resource set (i.e. a set of subframes), so that a non-member UE in close proximity of the CSG cell can be still served by another cell. OAM also configures a cell neighbour to a CSG cell with the protected time domain resource set not used by the CSG cell, so that the neighbour cell knows which time domain resource can be used for a non-member UE in close proximity of the CSG cell.

16.1.5.2.2 Configuration for interfering non-CSG cell

When the time-domain inter-cell interference coordination is used to mitigate interference between two cells using X2 signalling of ABS patterns from an interfering eNB to an interfered eNB, the following OAM requirements are applied.

- OAM may configure association between eNBs to use the time-domain inter-cell interference coordination.
- For the deployment scenarios where common subset for ABS patterns from multiple interfering cells is desirable, OAM configuration ensures that a 'common subset' exists between the ABS patterns of those interfering cells.

NOTE: The possibility of whether the common ABS pattern from multiple eNBs is desirable or not depends on the deployment cases of the time domain solution of inter-cell interference coordination.

NOTE: It is up to eNB implementation how a receiving eNB derives the 'usable ABS subset' from the ABS patterns coming from multiple neighbour eNBs.

16.1.6 Load Balancing (LB)

Load balancing has the task to handle uneven distribution of the traffic load over multiple cells. The purpose of LB is thus to influence the load distribution in such a manner that radio resources remain highly utilized and the QoS of in-progress sessions are maintained to the extent possible and call dropping probabilities are kept sufficiently small. LB algorithms may result in hand-over or cell reselection decisions with the purpose of redistribute traffic from highly loaded cells to underutilized cells.

LB is located in the eNB.

16.1.7 Inter-RAT Radio Resource Management

Inter-RAT RRM is primarily concerned with the management of radio resources in connection with inter-RAT mobility, notably inter-RAT handover. At inter-RAT handover, the handover decision may take into account the involved RATs resource situation as well as UE capabilities and Operator policies. The importance of Inter-RAT RRM may depend on the specific scenario in which E-UTRAN is deployed. Inter-RAT RRM may also include functionality for inter-RAT load balancing for idle and connected mode UEs.

16.1.8 Subscriber Profile ID for RAT/Frequency Priority

The RRM strategy in E-UTRAN may be based on user specific information.

The Subscriber Profile ID for RAT/Frequency Priority (SPID) parameter received by the eNB via the S1 interface or the X2 interface is an index referring to user information (e.g. mobility profile, service usage profile). The information is UE specific and applies to all its Radio Bearers.

This index is mapped by the eNB to locally defined configuration in order to apply specific RRM strategies (e.g. to define RRC_IDLE mode priorities and control inter-RAT/inter frequency handover in RRC_CONNECTED mode).

16.1.9 Inter-eNB CoMP

The task of inter-eNB CoMP is to coordinate multiple eNBs in order that the coverage of high data rates and the cell-edge throughput are improved, and also the system throughput is increased. The coordination of multiple eNBs is achieved by signalling between eNBs of hypothetical resource allocation information, CoMP hypotheses, associated with benefit metrics. Each of the signalled CoMP hypotheses is concerned with a cell belonging to either the receiving eNB, the sending eNB or their neighbour. The benefit metric associated with the CoMP hypotheses quantifies the benefit assuming that the CoMP hypotheses are applied. The receiving eNB of the CoMP hypotheses and the benefit metrics may take them into account for RRM.

RSRP measurement reports may be exploited for inter-eNB CoMP. For example, the RSRP measurement reports can be used to determine and/or validate CoMP hypotheses and benefit metrics.

Inter-eNB CoMP is located in the eNB.

16.1.10 Cell on/off and cell discovery

The eNB using cell on/off may adaptively turn the downlink transmission of a cell on and off. A cell whose downlink transmission is turned off may be configured as a deactivated SCell for a UE. A cell performing on/off may transmit

only periodic discovery signals and UEs may be configured to measure the discovery signals for RRM. Cell on/off may be performed for the purpose of e.g. inter-cell interference coordination and avoidance, load balancing, and energy saving, etc. The criteria used for cell on/off may be e.g. traffic load increase/decrease, UE arrival/departure (i.e. UE-cell association), and packet arrival/completion.

A UE performs RRM measurement and may discover a cell or transmission point of a cell based on discovery signals when the UE is configured with discovery-signal-based measurements.

16.2 RRM architecture

16.2.1 Centralised Handling of certain RRM Functions

Void.

16.2.2 De-Centralised RRM

16.2.2.1 UE History Information

The source eNB collects and stores the UE History Information for as long as the UE stays in one of its cells.

When information needs to be discarded because the list is full, such information will be discarded in order of its position in the list, starting with the oldest cell record. If the list is full, and the UE history information from the UE is available, the UE history information from the UE should also be discarded.

The resulting information is then used in subsequent handover preparations by means of the Handover Preparation procedures over the S1 and X2 interfaces, which provide the target eNB with a list of previously visited cells and associated (per-cell) information elements. The Handover Preparation procedures also trigger the target eNB to start collection and storage of UE history Information and thus to propagate the collected information.

16.2.3 Void

16.3 UE assistance information for RRM and UE power optimisations

In order to optimise the user experience and (for instance) to assist the eNB in configuring connected mode parameters and connection release handling, the UE may be configured to send assistance information to the eNB comprising:

- UE preference for power optimised configuration (1 bit):
  - When this bit is sent by the UE, the UE shall set this in accordance with its preference for a configuration that is primarily optimised for power saving (e.g. a long value for the long DRX cycle or RRC connection release) or not;
  - The details regarding how the UE sets the indicator are left to UE implementation.

The network response to the UE assistance information is left to network implementation. The eNB ensures that an appropriate QoS level is provided irrespective of received power preference indication.

17 Void

17.1 Void

18 UE capabilities

RRC signalling carries AS capabilities and NAS signalling carries NAS capabilities. The UE capability information is stored in the MME. In the uplink, no capability information is sent early in e.g. *RRCConnectionRequest* message. In the downlink, enquiry procedure of the UE capability is supported.

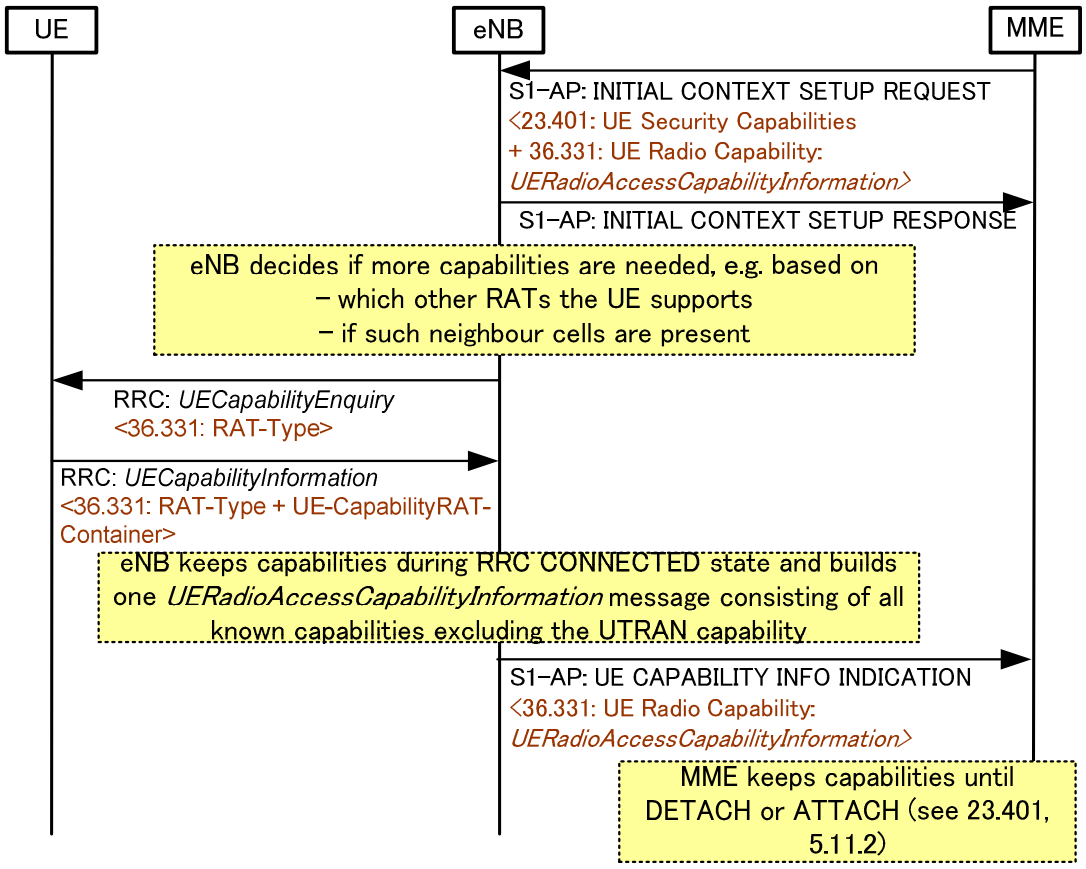


Figure 18-1: Initial UE Capability Handling

The MME stores the UE Radio Capability uploaded in the UE CAPABILITY INFO INDICATION message.

The possible RAT-Types are: EUTRAN, UTRAN, GERAN-PS, GERAN-CS, CDMA2000-1XRTT. The GERAN capability is divided into separate parts. MS Classmark 2 and Classmark 3 are used for CS domain (in both AS and NAS) and MS Radio Access Capability is used for PS domain. The main part of CDMA2000 capabilities is not handled by the eNB or the MME, but is exchanged via tunnelling (see 10.3.2). The small part of CDMA2000 capabilities (for CDMA2000-1XRTT) is needed for the eNB to be able to build messages for the target CDMA2000 RNC (see 10.3.2).

The eNB may acquire the UE capabilities after a Handover completion. The UE capabilities are then uploaded to the MME.

Usually during handover preparation, the source RAN node transfers both the UE source RAT capabilities and the target RAT capabilities to the target RAN node, in order to minimize interruptions and to follow the principles in subclause 10.2.2. The source RAN is not mandated to acquire other RAT capabilities (i.e. other than the source and target RAT capabilities) in order to start a handover preparation. This is described in subclause 19.2.2.5.6. However, there are exceptions to this principle:

- For handover from GERAN to EUTRAN, due to limitations in GERAN radio interface signalling, source RAT (GERAN) never provides the EUTRA capabilities to the target RAN node.

- At handover from UTRAN to EUTRAN, it is optional to forward the UTRAN capabilities to the target RAN.

The UTRAN capabilities, i.e. the INTER RAT HANDOVER INFO, include START-CS, START-PS and "predefined configurations", which are "dynamic" IEs. In order to avoid the START values desynchronisation and the key replaying issue, the eNB always enquiry the UE UTRAN capabilities at transition from RRC_IDLE to RRC_CONNECTED and before Handover to UTRAN. The eNB does not upload the UE UTRAN capabilities to the MME.

Due to limitations in radio interface signalling, transfer of EUTRA capabilities is not supported in GERAN.

19 S1 Interface

19.1 S1 User plane

The S1 user plane interface (S1-U) is defined between the eNB and the S-GW. The S1-U interface provides non guaranteed delivery of user plane PDUs between the eNB and the S-GW. The user plane protocol stack on the S1 interface is shown in Figure 19.1-1. The transport network layer is built on IP transport and GTP-U is used on top of UDP/IP to carry the user plane PDUs between the eNB and the S-GW.

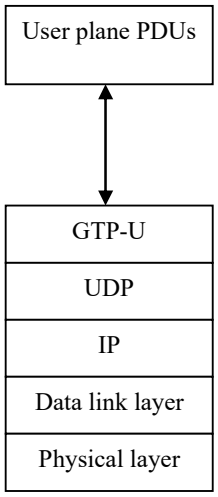


Figure 19.1-1: S1 Interface User Plane (eNB - S-GW)

19.2 S1 Control Plane

The S1 control plane interface (S1-MME) is defined between the eNB and the MME. The control plane protocol stack of the S1 interface is shown on Figure 19.2-1. The transport network layer is built on IP transport, similarly to the user plane but for the reliable transport of signalling messages SCTP is added on top of IP. The application layer signalling protocol is referred to as S1-AP (S1 Application Protocol).

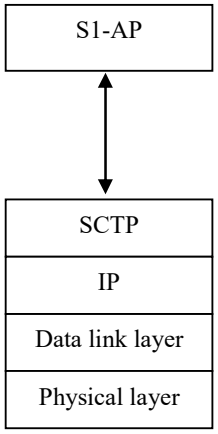


Figure 19.2-1: S1 Interface Control Plane (eNB-MME)

The SCTP layer provides the guaranteed delivery of application layer messages.

In the transport IP layer point-to-point transmission is used to deliver the signalling PDUs.

A single SCTP association per S1-MME interface instance shall be used with one pair of stream identifiers for S1-MME common procedures. Only a few pairs of stream identifiers should be used for S1-MME dedicated procedures.

MME communication context identifiers that are assigned by the MME for S1-MME dedicated procedures and eNB communication context identifiers that are assigned by the eNB for S1-MME dedicated procedures shall be used to distinguish UE specific S1-MME signalling transport bearers. The communication context identifiers are conveyed in the respective S1-AP messages.

If the S1 signalling transport layer notifies the S1AP layer that the signalling connection broke:

- the MME locally changes the state of the UEs which used this signalling connection to the ECM-IDLE state as described in TS 23.401 [17];
- the eNB releases the RRC connection with those UEs.

RNs terminate S1-AP. In this case, there is one S1 interface relation between the RN and the DeNB, and one S1 interface relation between the DeNB and each of the MMEs in the MME pool. The S1 interface relation between the RN and the DeNB carries non-UE-associated S1-AP signalling between RN and DeNB and UE-associated S1-AP signalling for UEs connected to the RN. The S1 interface relation between the DeNB and an MME carries non-UE-associated S1-AP signalling between DeNB and MME and UE-associated S1-AP signalling for UEs connected to the RN and for UEs connected to the DeNB.

19.2.1 S1 Interface Functions

The S1 interface provides the following functions:

- E-RAB Service Management function:
  - Setup, Modify, Release.
- Mobility Functions for UEs in ECM-CONNECTED:
  - Intra-LTE Handover;
  - Inter-3GPP-RAT Handover.
- S1 Paging function:
- NAS Signalling Transport function;
- LPPa Signalling Transport function;
- S1-interface management functions:
  - Error indication;
  - Reset.
- Network Sharing Function;
- Roaming and Access Restriction Support function;
- NAS Node Selection Function;
- Initial Context Setup Function;
- UE Context Modification Function;
- MME Load balancing Function;
- Location Reporting Function;
- PWS (which includes ETWS and CMAS) Message Transmission Function;
- Overload function;
- RAN Information Management Function;
- Configuration Transfer Function;
- S1 CDMA2000 Tunnelling function;

- Trace function;
- UE Radio Capability Match.

19.2.1.1 S1 Paging function

The paging function supports the sending of paging requests to all cells of the TA(s) the UE is registered.

Paging requests are sent to the relevant eNBs according to the mobility information kept in the UE's MM context in the serving MME.

19.2.1.2 S1 UE Context Management function

In order to support UEs in ECM-CONNECTED, UE contexts need to be managed, i.e. established and released in the eNodeB and in the EPC to support user individual signalling on S1.

19.2.1.3 Initial Context Setup Function

The Initial Context Setup function supports the establishment of the necessary overall initial UE Context including E-RAB context, Security context, roaming and access restrictions, UE capability information, Subscriber Profile ID for RAT/Frequency Priority, UE S1 signalling connection ID, etc. in the eNB to enable fast Idle-to-Active transition.

In addition to the setup of overall initial UE Contexts, Initial Context Setup function also supports the piggy-backing of the corresponding NAS messages. Initial Context Setup is initiated by the MME.

19.2.1.3a UE Context Modification Function

The UE Context Modification function supports the modification of UE Context in eNB for UEs in active state.

19.2.1.4 Mobility Functions for UEs in ECM-CONNECTED

19.2.1.4.1 Intra-LTE Handover

The Intra-LTE-Handover function supports mobility for UEs in ECM-CONNECTED and comprises the preparation, execution and completion of handover via the X2 and S1 interfaces.

19.2.1.4.2 Inter-3GPP-RAT Handover

The Inter-3GPP-RAT Handover function supports mobility to and from other 3GPP-RATs for UEs in ECM-CONNECTED and comprises the preparation, execution and completion of handover via the S1 interface.

19.2.1.5 E-RAB Service Management function

The E-RAB Service management function is responsible for establishing, modifying and releasing E-UTRAN resources for user data transport once a UE context is available in the eNB. The establishment and modification of E-UTRAN resources is triggered by the MME and requires respective QoS information to be provided to the eNB. The release of E-UTRAN resources is triggered by the MME either directly or following a request received from the eNB (optional).

For DC when SCG bearer option is applied, the modification of the E-RAB is triggered by the MeNB towards the MME for the modification of the transport information.

19.2.1.6 NAS Signalling Transport function

The NAS Signalling Transport function provides means to transport a NAS message (e.g. for NAS mobility management) for a specific UE on the S1 interface.

19.2.1.7 NAS Node Selection Function (NNSF)

The interconnection of eNBs or HeNB GW, if deployed, to multiple MME/Serving S-GWs is supported in the E-UTRAN/EPC architecture. Therefore a NAS node selection function is located in the eNB or the HeNB GW, if deployed, to determine the MME association of the UE, based on the UE's temporary identifier, which was assigned to the UE by the CN node (e.g. MME or SGSN).

NOTE: In case the UE's temporary identifier is assigned by the SGSN, respective mapping rules are defined in TS 23.003 [26].

Depending on the actual scenario the NNSF determines the UE's MME association either based its S-TMSI (e.g. at service request) or based on its GUMMEI and selected PLMN (e.g. at attach or tracking area update in non-registered TA).

The NNSF in the eNB or HeNB GW, if deployed, may differentiate between a GUMMEI mapped from P-TMSI/RAI and a native GUMMEI as described in TS 23.401 [17].

This functionality is located in the eNB or in the HeNB GW, if deployed, and enables proper routing via the S1 interface. On S1, no specific procedure corresponds to the NAS Node Selection Function.

19.2.1.8 S1-interface management functions

The S1-interface management functions provide

- means to ensure a defined start of S1-interface operation (reset);
- means to handle different versions of application part implementations and protocol errors (error indication).

19.2.1.9 MME Load balancing Function

MME Load balancing is the function which achieves load-balanced MMEs with respect to their processing capacity within a pool area during system operation. The means to load-balance MMEs is to distribute UEs newly entering the pool to different MMEs in the MME pool. In addition the MME load balancing function is able to achieve equally loaded MMEs within a pool area after the introduction of a new MME and after the removal of a MME from the network.

The support of the MME load balancing function is achieved by indicating the relative MME capacity in the S1 Setup procedure to all eNBs served by the MMEs of the pool area per MME. In order to support the introduction and/or removal of MMEs the MME initiated S1 setup update procedure may be used by the operator indicating relative MME capacity value changes. When there are more than one MME operational in the pool, the indicated relative MME capacity steers the UE assignment for UEs newly entering the MME pool. When there is only one MME operational in the pool, UEs may be assigned to this MME.

The MME Load balancing Function is described in detail in TS 23.401 [17].

19.2.1.10 Location Reporting Function

The Location Reporting function supports the MME requests to the eNB to report the location information of the UE.

19.2.1.11 Warning Message Transmission function

The warning message transmission function provides means to transfer warning message via S1 interface.

19.2.1.12 Overload Function

The overload function comprises the signalling means:

- to indicate to a proportion of eNBs that the serving MME is overloaded;
- to indicate to the eNBs that the serving MME is back in the "normal operation mode".

19.2.1.13 RAN Information Management Function

The RAN Information Management (RIM) function is a generic mechanism that allows the request and transfer of information (e.g. GERAN System information) between two RAN nodes via the core network.

19.2.1.14 S1 CDMA2000 Tunnelling function

The S1 CDMA2000 Tunnelling function transports CDMA2000 signalling between UE and CDMA2000 RAT over the S1 Interface for mobility from E-UTRAN to CDMA2000 HRPD and CDMA2000 1xRTT and for circuit switched fallback to CDMA2000 1xRTT.

19.2.1.15 Configuration Transfer Function

The Configuration Transfer function is a generic mechanism that allows the request and transfer of RAN configuration information (e.g. SON information) between two RAN nodes via the core network.

19.2.1.16 LPPa Signalling Transport function

The LPPa Signalling Transport function provides means to transport an LPPa message on the S1 interface.

19.2.1.17 Trace Function

The Trace function provides means to control trace sessions in the eNB. The Trace function also provides means to control MDT sessions as described in TS 32.422 [30] and TS 37.320 [43].

19.2.1.18 UE Radio Capability Match

The UE Radio Capability Match function enables the eNB to provide an indication to the MME whether the UE radio capabilities are compatible with the network configuration for voice continuity.

19.2.2 S1 Interface Signalling Procedures

The elementary procedures supported by the S1AP protocol are listed in Table 1 and Table 2 of TS 36.413 [25].

19.2.2.1 Paging procedure

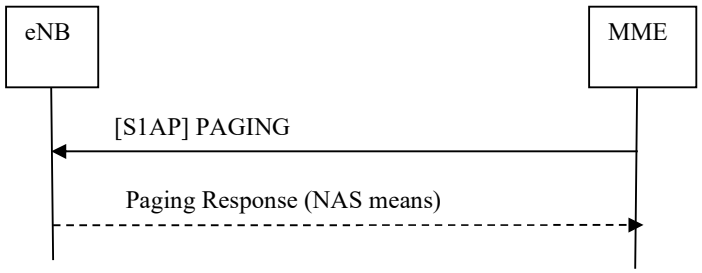


Figure 19.2.2.1-1: Paging procedure

The MME initiates the paging procedure by sending the PAGING message to each eNB with cells belonging to the tracking area(s) in which the UE is registered. Each eNB can contain cells belonging to different tracking areas, whereas each cell can only belong to one TA.

The paging response back to the MME is initiated on NAS layer and is sent by the eNB based on NAS-level routing information.

19.2.2.2 S1 UE Context Release procedure

The S1 UE Context Release procedure causes the eNB to remove all UE individual signalling resources and the related user data transport resources. This procedure is initiated by the EPC and may be triggered on request of the serving eNB.

19.2.2.2.1 S1 UE Context Release (EPC triggered)

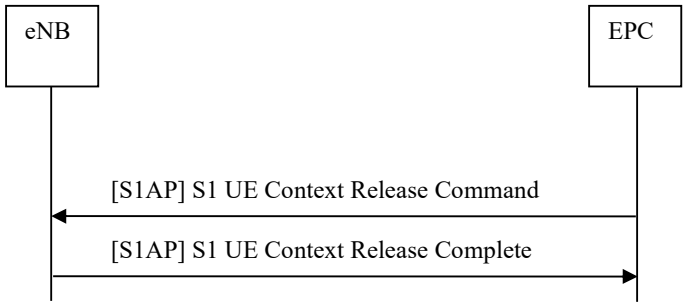


Figure 19.2.2.2.1-1: S1 UE Context Release procedure (EPC triggered)

- The EPC initiates the UE Context Release procedure by sending the S1 UE Context Release Command towards the E-UTRAN. The eNodeB releases all related signalling and user data transport resources.

- The eNB confirms the S1 UE Context Release activity with the S1 UE Context Release Complete message.

- In the course of this procedure the EPC releases all related resources as well, except context resources in the EPC for mobility management and the default EPS Bearer/E-RAB configuration.

19.2.2.2.2 S1 UE Context Release Request (eNB triggered)

The S1 UE Context Release Request procedure is initiated for E-UTRAN internal reasons and comprises the following steps:

- The eNB sends the S1 UE Context Release Request message to the EPC.

- The EPC triggers the EPC initiated UE context release procedure.

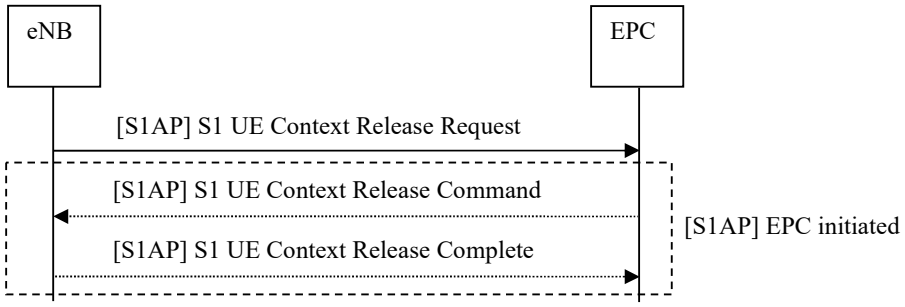


Figure 19.2.2.2.2-1: S1 UE Context Release Request procedure (eNB triggered) and subsequent S1 UE Context Release procedure (EPC triggered)

If the E-UTRAN internal reason is a radio link failure detected in the eNB, the eNB shall wait a sufficient time before triggering the S1 UE Context Release Request procedure in order to allow the UE to perform the NAS recovery procedure, see TS 23.401 [17].

19.2.2.3 Initial Context Setup procedure

The Initial Context Setup procedure establishes the necessary overall initial UE context in the eNB in case of an Idle-to Active transition. The Initial Context Setup procedure is initiated by the MME.

The Initial Context Setup procedure comprises the following steps:

- The MME initiates the Initial Context Setup procedure by sending INITIAL CONTEXT SETUP REQUEST to the eNB. This message may include general UE Context (e.g. security context, roaming and access restrictions, UE capability information, UE S1 signalling connection ID, CN assistance information, etc.), E-RAB context (Serving GW TEID, QoS information, Correlation id i.e. collocated L-GW TEID or GRE key in case of LIPA support or in case of SIPTO@LN with collocated L-GW support), and may be piggy-backed with the corresponding NAS messages. When there are multiple NAS messages in the INITIAL CONTEXT SETUP REQUEST message, the MME shall ensure that the NAS messages in the E-RAB to be Setup List are aligned in the order of reception from the NAS layer to ensure the in-sequence delivery of the NAS messages.

- Upon receipt of INITIAL CONTEXT SETUP REQUEST, the eNB setup the context of the associated UE, and perform the necessary RRC signalling towards the UE, e.g. Radio Bearer Setup procedure. When there are multiple NAS messages to be sent in the RRC message, the order of the NAS messages in the RRC message shall be kept the same as that in the INITIAL CONTEXT SETUP REQUEST message. If present, the eNB uses the CN assistance information as defined in TS 23.401[17] and propagates it during inter-eNB mobility.

- The eNB responds with INITIAL CONTEXT SETUP RESPONSE to inform a successful operation, and with INITIAL CONTEXT SETUP FAILURE to inform an unsuccessful operation.

NOTE: In case of failure, eNB and MME behaviours are not mandated. Both implicit release (local release at each node) and explicit release (MME-initiated UE Context Release procedure) may in principle be adopted. The eNB should ensure that no hanging resources remain at the eNB.

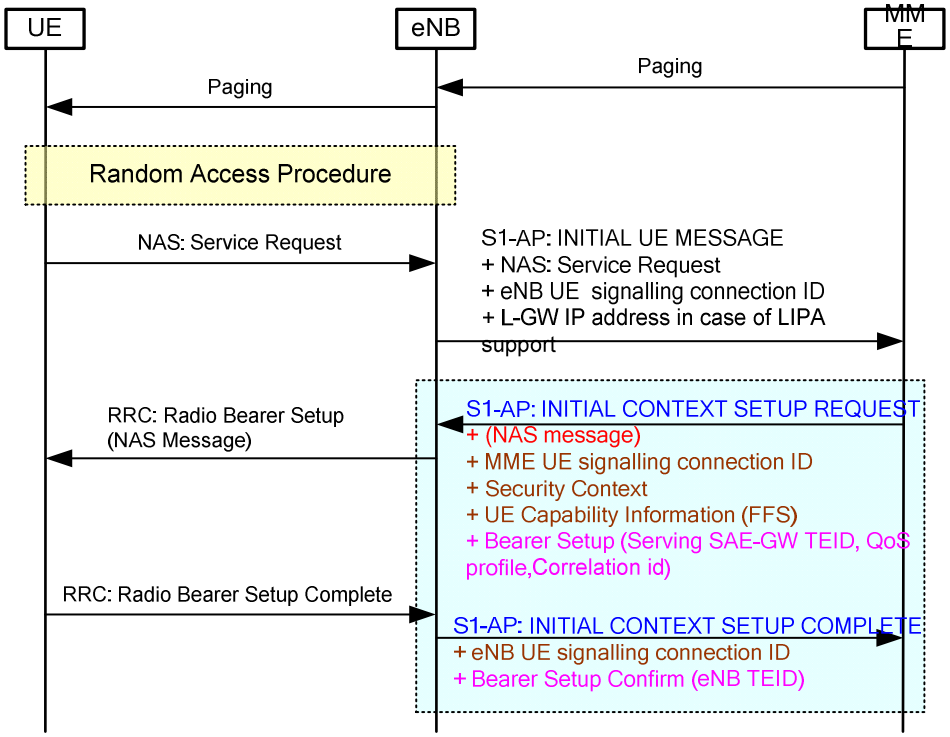


Figure 19.2.2.3-1: Initial Context Setup procedure (highlighted in blue) in Idle-to-Active procedure

19.2.2.3a UE Context Modification procedure

The UE Context Modification procedure enables the MME to modify the UE context in the eNB for UEs in active state. The UE Context Modification procedure is initiated by the MME.

The UE Context Modification procedure comprises the following steps:

- The MME initiates the UE Context Modification procedure by sending UE CONTEXT MODIFICATION REQUEST to the eNB to modify the UE context in the eNB for UEs in active state.
- The eNB responds with UE CONTEXT MODIFICATION RESPONSE in case of a successful operation
  - If the UE is served by a CSG cell, and is no longer a member of the CSG cell, the eNB may initiate a handover to another cell. If the UE is not handed over, the eNB should request the release of UE context;
  - If the UE is served by a hybrid cell, and is no longer a CSG member of the hybrid cell, the eNB may provide the QoS for the UE as a non CSG member.
- The eNB responds with UE CONTEXT MODIFICATION FAILURE in case of an unsuccessful operation.

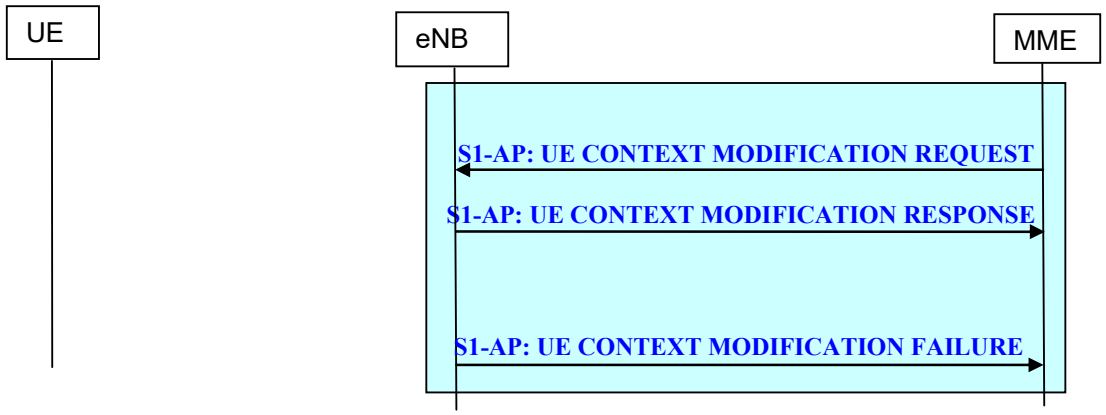


Figure 19.2.2.3a-1: UE Context Modification procedure

19.2.2.4 E-RAB signalling procedures

19.2.2.4.1 E-RAB Setup procedure

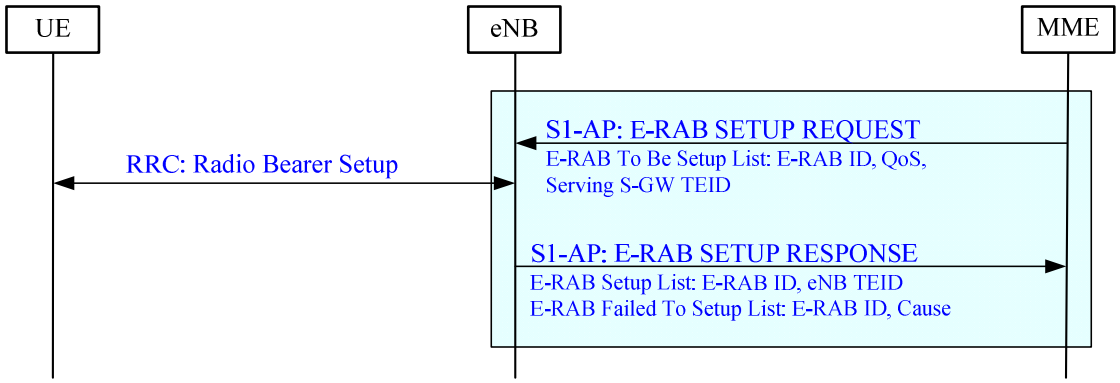


Figure 19.2.2.4.1-1: E-RAB Setup procedure

The E-RAB Setup procedure is initiated by the MME to support:

- Assignment of resources to a dedicated E-RAB.
- Assignment of resources for a default E-RAB.
- Setup of S1 Bearer (on S1) and Data Radio Bearer (on Uu).

The E-RAB Setup procedure comprises the following steps:

- The E-RAB SETUP REQUEST message is sent by the MME to the eNB to setup resources on S1 and Uu for one or several E-RAB(s). The E-RAB SETUP REQUEST message contains the Serving GW TEID, QoS indicator(s) and the corresponding NAS message per E-RAB within the E-RAB To Be Setup List. It may also include the Correlation id i.e. collocated L-GW TEID or GRE key in case of LIPA support or in case of SIPTO@LN with collocated L-GW support. When there are multiple NAS messages in the E-RAB SETUP REQUEST message, the MME shall ensure that the NAS messages in the E-RAB to be Setup List are aligned in the order of reception from the NAS layer to ensure the in-sequence delivery of the NAS messages.
- Upon receipt of the E-RAB SETUP REQUEST message the eNB establishes the Data Radio Bearer(s) (RRC: Radio Bearer Setup) and resources for S1 Bearers. When there are multiple NAS messages to be sent in the RRC message, the order of the NAS messages in the RRC message shall be kept the same as that in the E-RAB SETUP REQUEST message.

- The eNB responds with a E-RAB SETUP RESPONSE messages to inform whether the setup of resources and establishment of each E-RAB was successful or unsuccessful, with the E-RAB Setup list (E-RAB ID, eNB TEID) and the E-RAB Failed to Setup list (E-RAB ID, Cause) The eNB also creates the binding between the S1 bearer(s) (DL/UL TEID) and the Data Radio Bearer(s).

Interactions with UE Context Release Request procedure:

In case of no response from the UE the eNB shall trigger the S1 UE Context Release Request procedure.

19.2.2.4.2 E-RAB Modification procedure

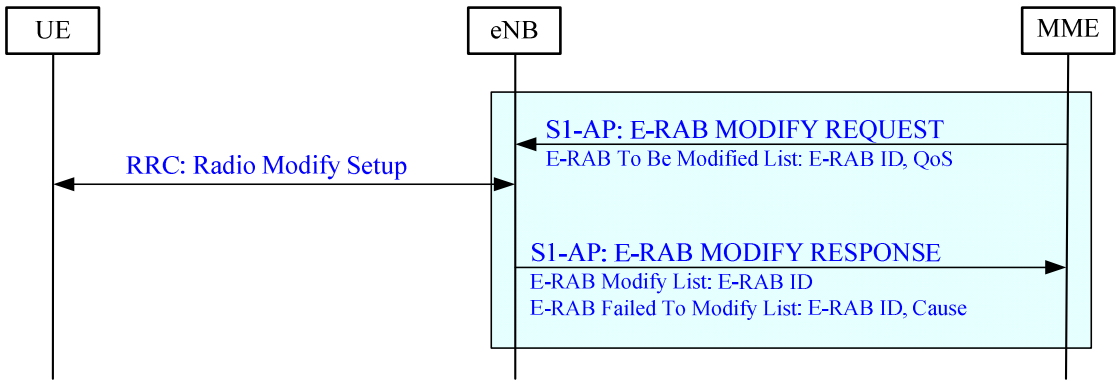


Figure 19.2.2.4.2-1: E-RAB Modification procedure

The E-RAB Modification procedure is initiated by the MME to support the modification of already established E-RAB configurations:

- Modify of S1 Bearer (on S1) and Radio Bearer (on Uu).
- S-GW relocation without UE mobility.

The EPS Bearer Modification procedure comprises the following steps:

- The E-RAB MODIFY REQUEST message is sent by the MME to the eNB to modify one or several E-RAB(s). The E-RAB MODIFY REQUEST message contains the QoS indicator(s), and the corresponding NAS message per E-RAB in the E-RAB To Be Modified List. When there are multiple NAS messages in the E-RAB MODIFY REQUEST message, the MME shall ensure that the NAS messages in the E-RAB to be Modified List are aligned in the order of reception from the NAS layer to ensure the in-sequence delivery of the NAS messages. The transport information for the new S-GW may be included in case of S-GW relocation without UE mobility.
- Upon receipt of the E-RAB MODIFY REQUEST message the eNB modifies the Data Radio Bearer configuration (RRC procedure to modify the Data Radio bearer). When there are multiple NAS messages to be sent in the RRC message, the order of the NAS messages in the RRC message shall be kept the same as that in the E-RAB MODIFY REQUEST message. In case of S-GW relocation without UE mobility, if transport information for the new S-GW is included, the eNB ignores the included QoS indicator and NAS message and uses the included transport information for S-GW selection.
- The eNB responds with an E-RAB MODIFY RESPONSE message to inform whether the E-RAB modification has succeeded or not indicating with the E-RAB Modify list and E-RAB Failed to Modify list. With E-RAB ID(s) in the E-RAB Modify List or E-RAB Failed to Modify List the eNB identifies the E-RAB(s) successfully modified or failed to modify.

Interactions with UE Context Release Request procedure:

In case of no response from the UE the eNB shall trigger the S1 UE Context Release Request procedure.

19.2.2.4.3 E-RAB Release procedure

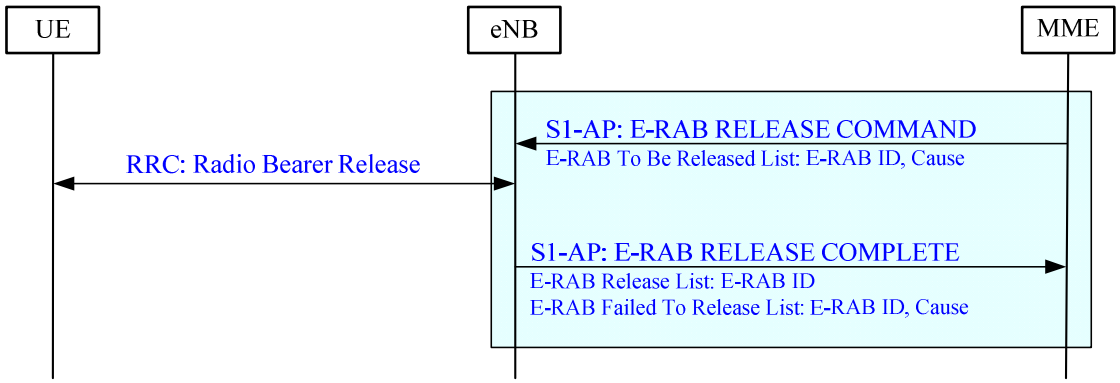


Figure 19.2.2.4.3-1: E-RAB Release procedure

The E-RAB Release procedure is initiated by the MME to release resources for the indicated E-RABs.

The E-RAB Release procedure comprises the following steps:

- The E-RAB RELEASE COMMAND message is sent by the MME to the eNB to release resources on S1 and Uu for one or several E-RAB(s). With the E-RAB ID(s) in the E-RAB To Be Released List contained in E-RAB RELEASE COMMAND message the MME identifies, the E-RAB(s) to be released.
- Upon receipt of the E-RAB RELEASE COMMAND message the eNB releases the Data Radio Bearers (RRC: Radio bearer release) and S1 Bearers.
- The eNB responds with an E-RAB RELEASE COMPLETE message containing E-RAB Release list and E-RAB Failed to Release list. With the E-RAB IDs in the E-RAB Release List/E-RAB Failed to Release List the eNB identifies the E-RAB(s) successfully released or failed to release.

Interactions with UE Context Release Request procedure:

In case of no response or negative response from the UE or in case the eNB cannot successfully perform the release of any of the requested bearers, the eNB shall trigger the S1 UE Context Release Request procedure, except if the eNB has already initiated the procedures associated with X2 Handover.

19.2.2.4.4 E-RAB Release Indication procedure

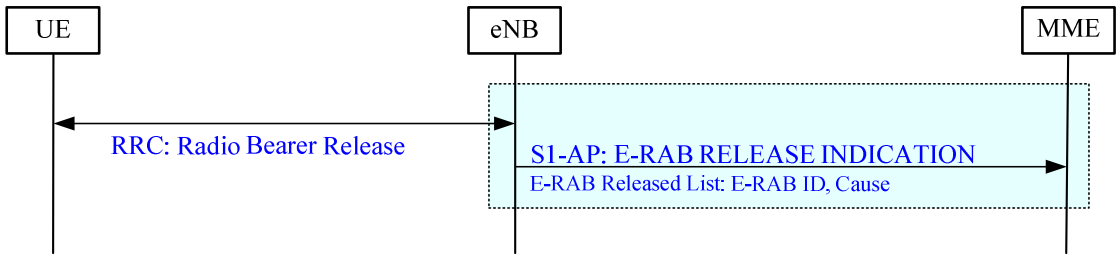


Figure 19.2.2.4.4-1: E-RAB Release Indication procedure

The E-RAB Release Indication procedure enables the E-UTRAN to send information about released resources for one or several E-RABs to the MME. The eNB initiates the procedure by sending the E-RAB RELEASE INDICATION message to the MME. The E-RAB ID(s) in the E-RAB Released List identifies the released E-RAB(s) in the eNB.

19.2.2.4.5 E-RAB Modification Indication procedure

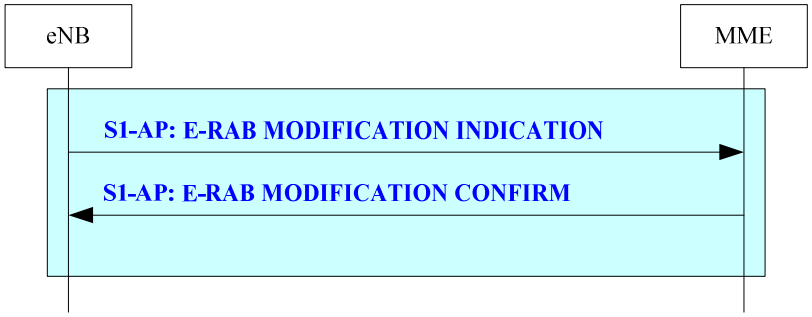


Figure 19.2.2.4.5-1: E-RAB Modification Indication procedure

The E-RAB Modification Indication procedure is initiated by the eNB to support the modification of already established E-RAB configurations. The current version of the specification supports the modification of the transport information only. This procedure is used for DC if the SCG bearer option is applied.

If the EPC is able to apply the requested modification, the MME responds with the E-RAB MODIFICATION CONFIRM.

If the EPC is not able to modify a transport path as requested, the MME responds with the list of E-RABs failed in the E-RAB MODIFICATION CONFIRM, the MeNB either keeps the previous transport path unchanged and, if applicable, triggers to release the corresponding SCG bearers, or tears down the corresponding E-RABs.

19.2.2.5 Handover signalling procedures

Handover signalling procedures support both, inter-eNB handover and inter-RAT handover.

Inter-RAT handovers shall be initiated via the S1 interface.

Inter-eNB handovers shall be initiated via the X2 interface except if any of the following conditions are true:

- the source eNB is not an RN and there is no X2 between source and target eNB.
- the source eNB is an RN and there is no X2 between DeNB and the target eNB or between the source RN and the DeNB.
- the source eNB is an RN and the UE's serving MME is not included in the MME Pool(s) connected with the target eNB.
- the source eNB has been configured to initiate handover to the particular target eNB via S1 interface in order to enable the change of an EPC node (MME and/or Serving GW).
- the source eNB has attempted to start the inter-eNB HO via X2 but receives a negative reply from the target eNB with a specific cause value.

Inter-eNB handovers shall be initiated via the S1 interface, if one of the above conditions applies.

19.2.2.5.1 Handover Preparation procedure

The Handover preparation procedure is initiated by the source eNB if it determines the necessity to initiate the handover via the S1 interface.

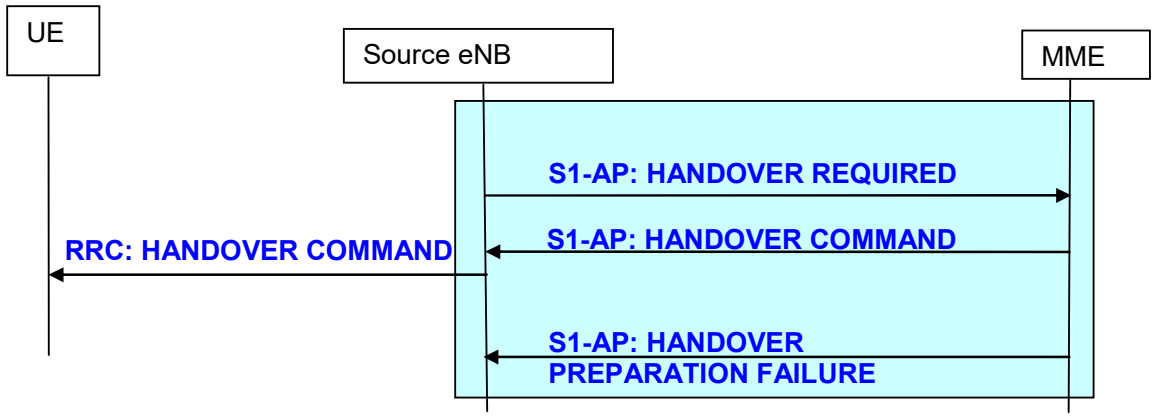


Figure 19.2.2.5.1-1: Handover preparation procedure

The handover preparation comprises the following steps:

- The HANDOVER REQUIRED message is sent to the MME.
- The handover preparation phase is finished upon the reception of the HANDOVER COMMAND message in the source eNB, which includes at least radio interface related information (HO Command for the UE), successfully established E-RAB(s) and E-RAB(s) which failed to setup.
- In case the handover resource allocation is not successful (e.g. no resources are available on the target side) the MME responds with the HANDOVER PREPARATION FAILURE message instead of the HANDOVER COMMAND message.

19.2.2.5.2 Handover Resource Allocation procedure

The handover resource allocation comprises the following steps:

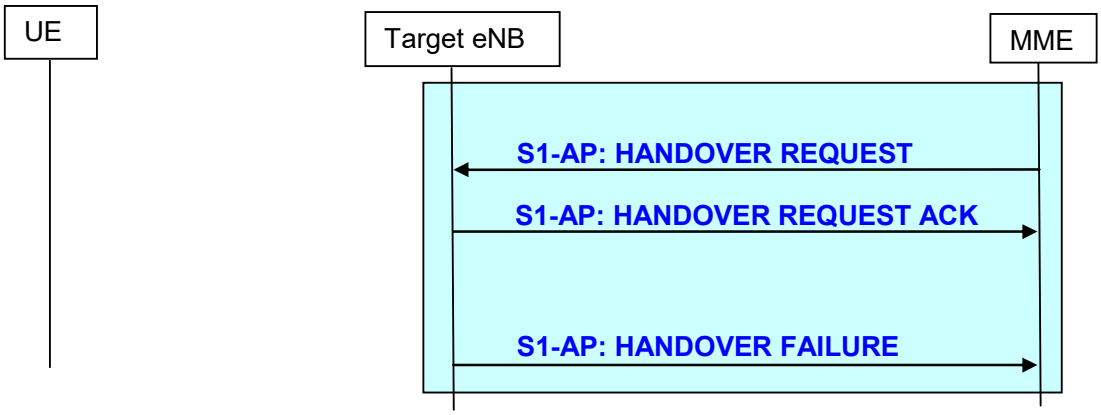


Figure 19.2.2.5.2-1: Handover resource allocation procedure

- The MME sends the HANDOVER REQUEST message including the E-RAB(s) which needs to be setup by the target eNB.

  In the case of a UE performing handover toward an RN, the HANDOVER REQUEST is received by the DeNB, which shall read the target cell ID from the message, find the target RN corresponding to the target cell ID, and forward the message toward the target RN.

- The target eNB responds with the HANDOVER REQUEST ACK message after the required resources for all accepted E-RABs are allocated. The HANDOVER REQUEST ACK message contains successfully established E-RAB(s), E-RAB(s) which failed to setup and radio interface related information (HO Command for the UE), which is later sent transparently via the EPC/CN from the target RAT to the source RAT.

If no resources are available on the target side, the target eNB responds with the HANDOVER FAILURE message instead of the HANDOVER REQUEST ACK message.

19.2.2.5.3 Handover Notification procedure

The Handover Completion for S1 initiated handovers comprises the following steps:

- The HANDOVER NOTIFY message is sent by the target eNB to the MME when the UE has successfully been transferred to the target cell. If the eNB supports SIPTO@LN with stand-alone gateway, the message shall include the LHN ID.

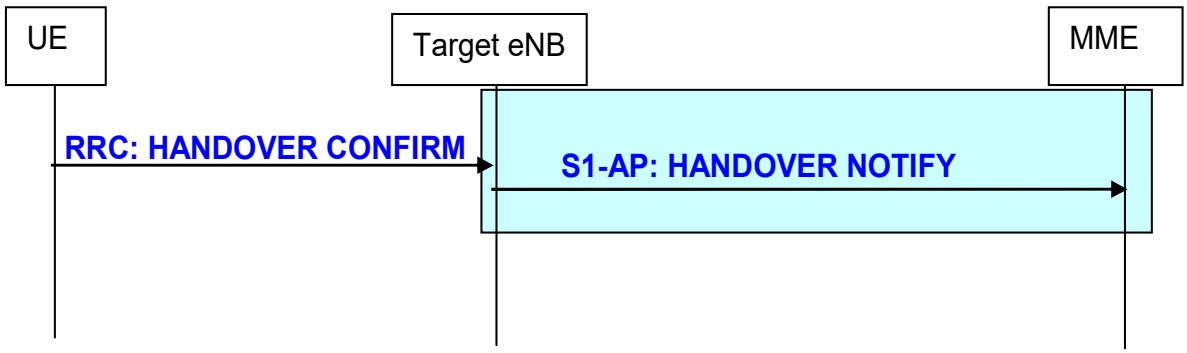


Figure 19.2.2.5.3-1: Handover completion procedure

19.2.2.5.4 Handover Cancellation

This functionality is located in the source eNB to allow a final decision regarding the outcome of the handover, i.e. either to proceed or to cancel the handover procedure.

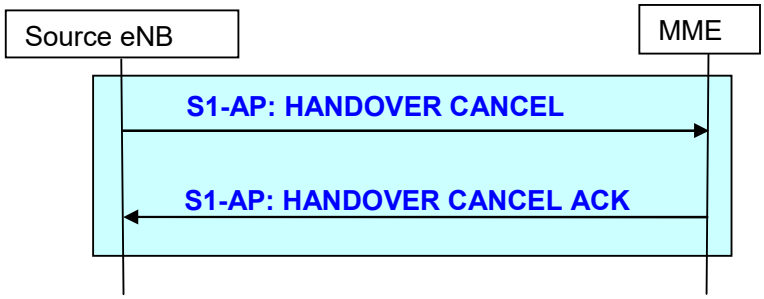


Figure 19.2.2.5.4-1: Handover cancellation procedure

- The source eNB sends a HANDOVER CANCEL message to the MME indicating the reason for the handover cancellation.
- The MME confirms the reception of the HANDOVER CANCEL message by returning the HANDOVER CANCEL ACK message.

19.2.2.5.5 Path Switch procedure

The handover completion phase for X2 initiated handovers comprises the following steps:

- The PATH SWITCH message is sent by the target eNB to the MME when the UE has successfully been transferred to the target cell. The PATH SWITCH message includes the outcome of the resource allocation: successfully established E-RAB(s). If the eNB supports SIPTO@LN with stand-alone gateway, the message shall include the LHN ID.
- The MME responds with the PATH SWITCH ACK message which is sent to the eNB.
- The MME responds with the PATH SWITCH FAILURE message in case a failure occurs in the EPC.

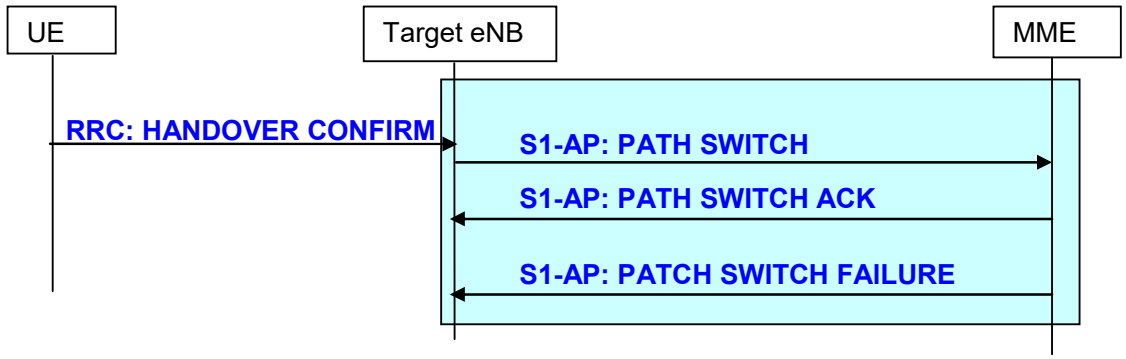


Figure 19.2.2.5.5-1: Path Switch procedure

19.2.2.5.6 Message sequence diagrams

This subclause complements TR 25.922 [27] subclause 5.1.7.2 regarding the E-UTRAN handling of containers.

Most RRC information is carried by means of containers across interfaces other than Uu. The following sequence diagrams illustrate which RRC information should be included within these containers used across the different network interfaces.

NOTE: In order to maintain independence between protocols, no requirements are included in the interface protocols that are used to transfer the RRC information.

SRVCC (see TS 23.216 [28]) is supported from EUTRAN to UTRAN or GERAN A/Gb mode and from UTRAN or GERAN A/Gb mode to EUTRAN.

There is no support for interworking between EUTRAN and GERAN Iu-mode and between EUTRAN and GAN.

Figure 19.2.2.5.6-1 and 19.2.2.5.6-1a illustrate the message sequence for handover from GERAN to EUTRAN procedure:

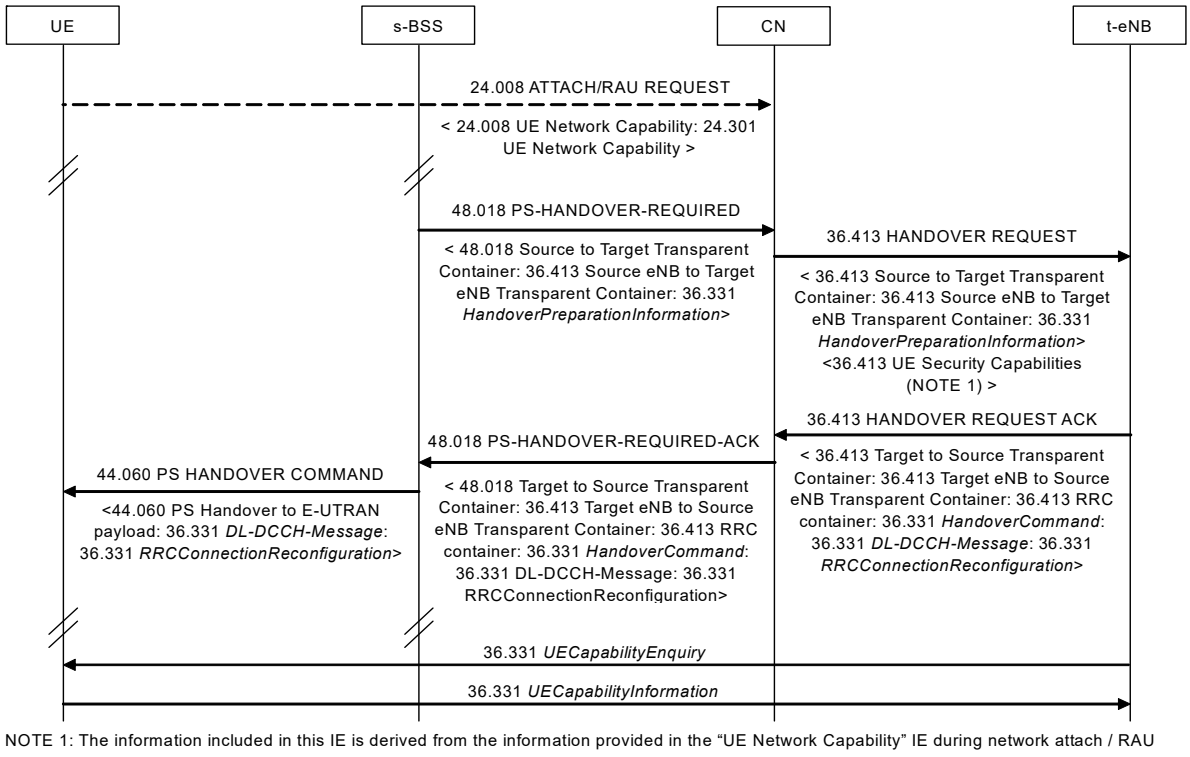
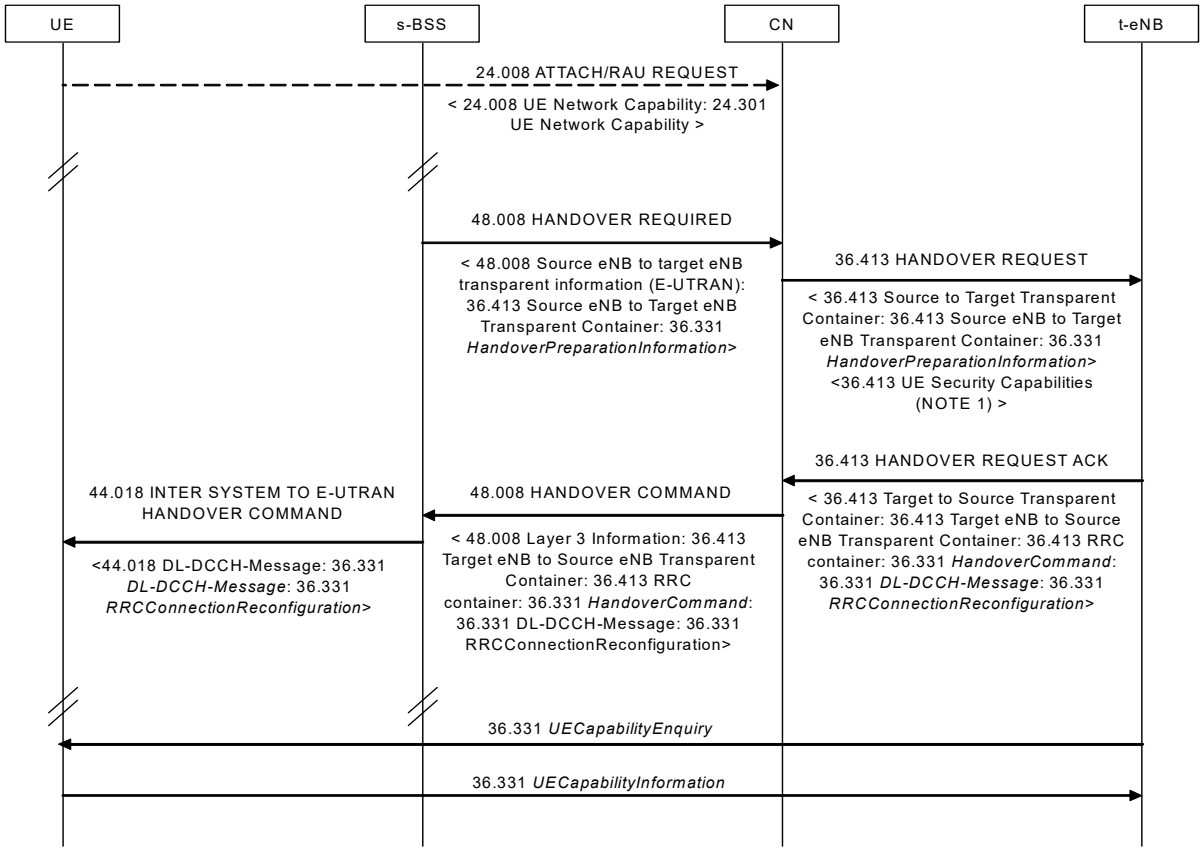


Figure 19.2.2.5.6-1. Handover of PS domain service from GERAN A/Gb mode to EUTRAN, normal flow

UE is not requested to provide E-UTRAN UE capabilities while in GERAN. Hence the HANDOVER REQUEST does not contain E-UTRAN UE capabilities, and the capabilities are fetched by Target eNB from UE after handover is completed.

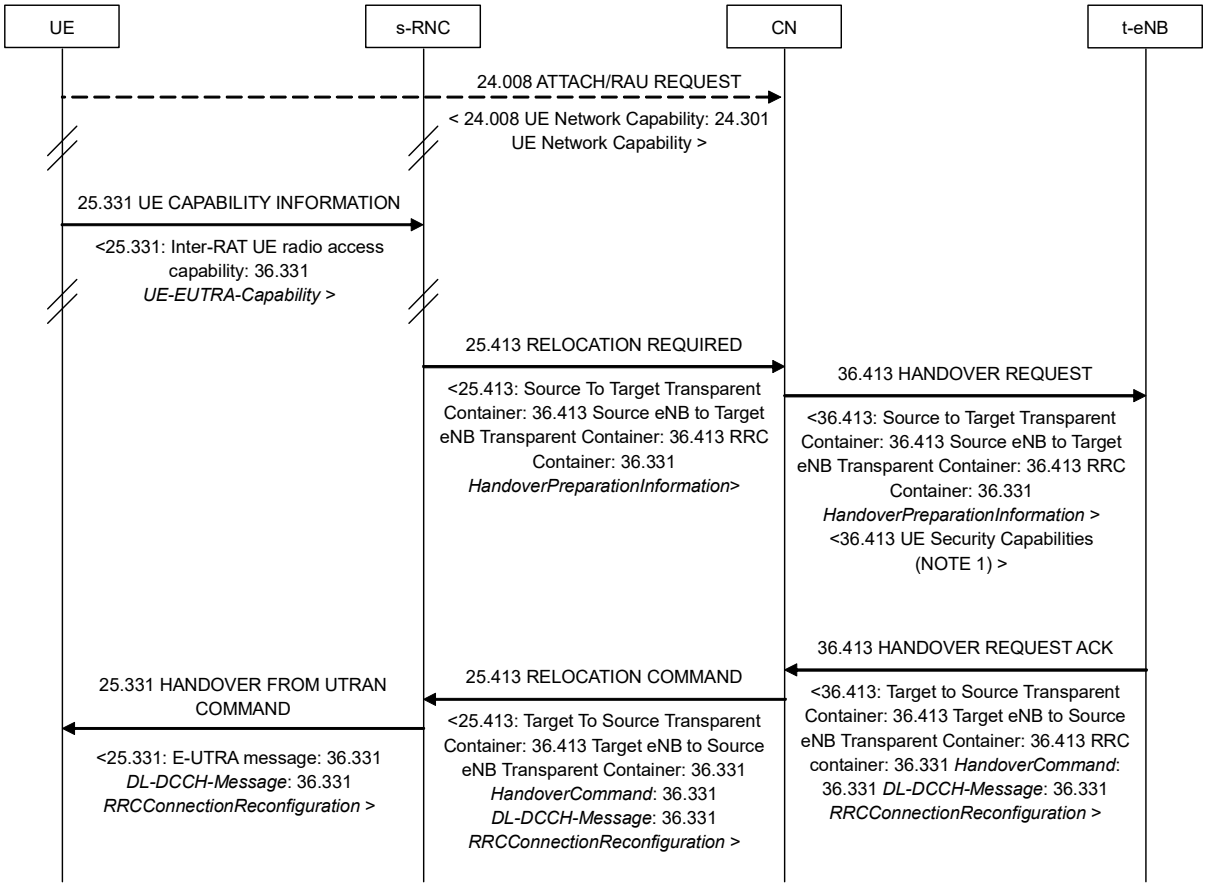


NOTE 1: The information included in this IE is derived from the information provided in the "UE Network Capability" IE during network attach / RAU

Figure 19.2.2.5.6-1a. Handover of CS domain service from GERAN A/Gb mode to PS-domain service in EUTRAN, normal flow

UE is not requested to provide E-UTRAN UE capabilities while in GERAN. Hence the HANDOVER REQUEST does not contain E-UTRAN UE capabilities, and the capabilities are fetched by Target eNB from UE after completed handover.

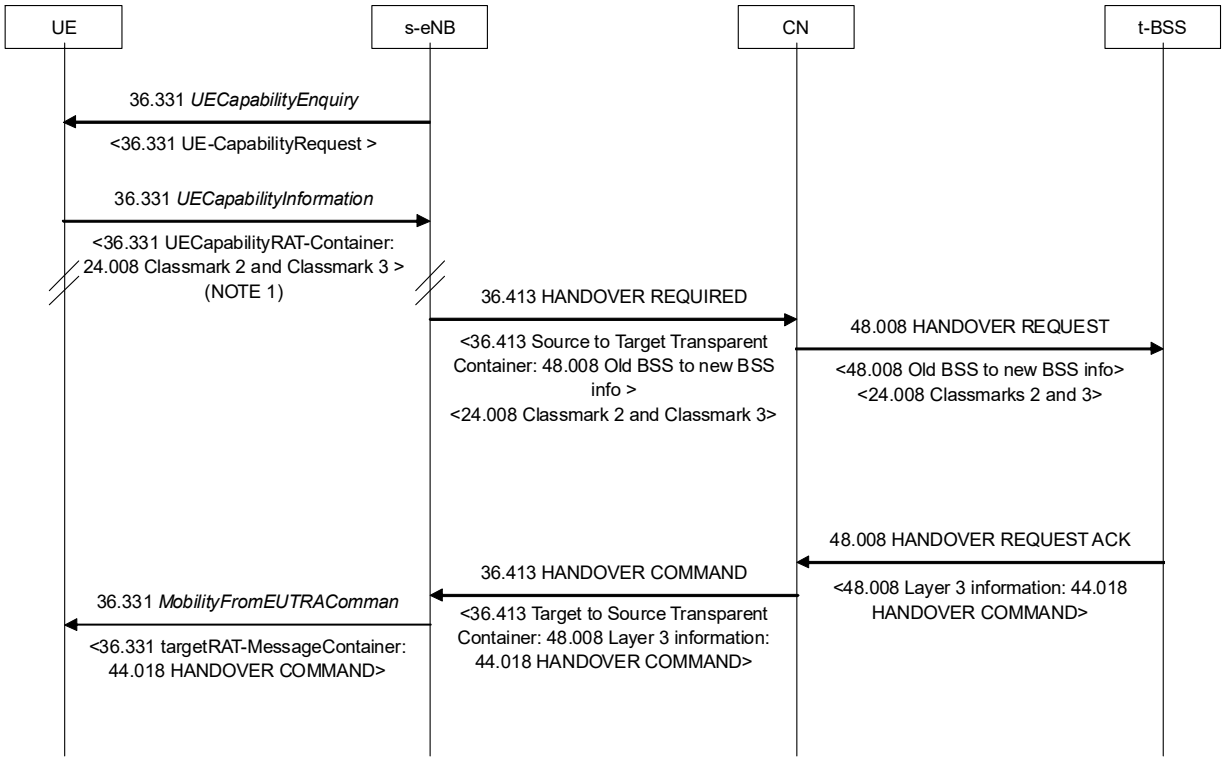
Figure 19.2.2.5.6-2 illustrates the message sequence for PS handover and CS handover from UTRAN to EUTRAN procedure:



NOTE 1: The information included in this IE is derived from the information provided in the "UE Network Capability" IE during network attach / RAU

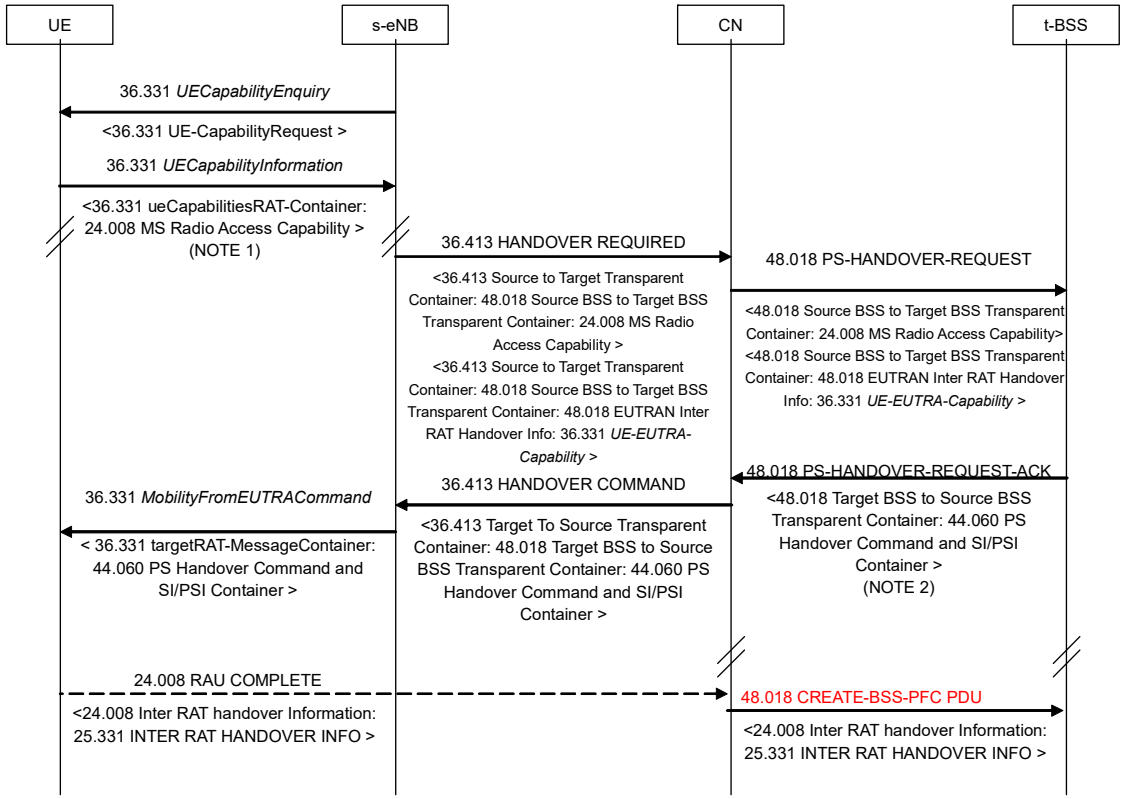
Figure 19.2.2.5.6-2: Handover of PS domain service and handover of CS domain service from UTRAN to EUTRAN, normal flow

Figure 19.2.2.5.6-3 to Figure 19.2.2.5.6-5 illustrate the message sequence for the handover from EUTRAN to GERAN A/Gb mode procedure:



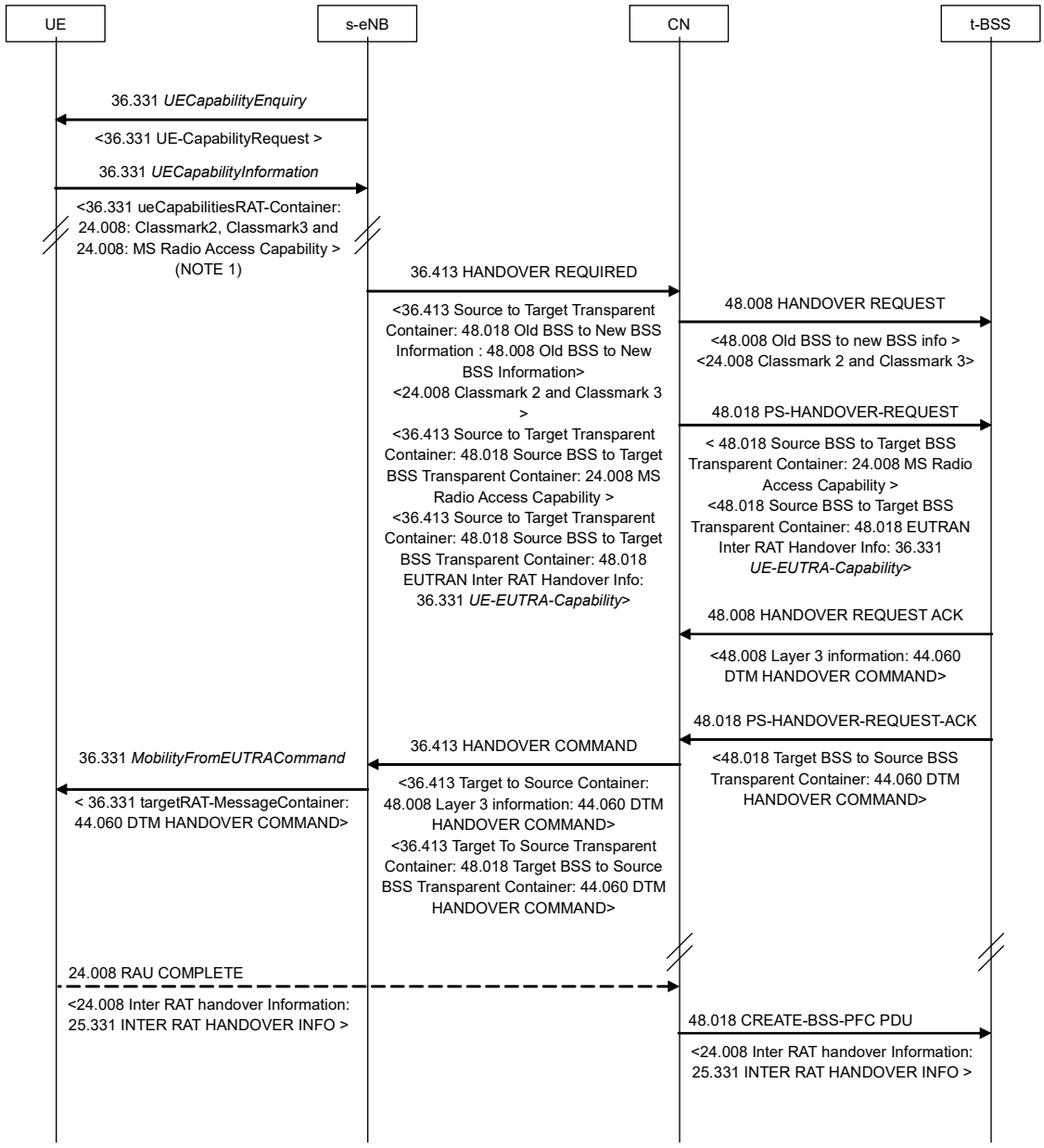
NOTE 1: the GERAN capabilities can be stored by the MME at an earlier opportunity, as shown in Figure 18-1, and transferred to the eNB at connection setup.

Figure 19.2.2.5.6-3: Handover of CS domain service from EUTRAN to GERAN A/Gb mode, normal flow



NOTE 1: the GERAN capabilities can be stored by the MME at an earlier opportunity, as shown in Figure 18-1, and transferred to the eNB at connection setup.
NOTE 2: the inclusion of GERAN SI/PSI is dependent on the PS Handover Indication in the Source BSS to Target BSS Transparent Container in the HANDOVER REQUIRED message.

Figure 19.2.2.5.6-4. Handover of PS domain service from EUTRAN to GERAN A/Gb mode, normal flow



NOTE 1: the GERAN capabilities can be stored by the MME at an earlier opportunity, as shown in Figure 18-1, and transferred to the eNB at connection setup.
NOTE 2: the 36.413 HANDOVER COMMAND includes two identical copies of the 44.060 DTM HANDOVER COMMAND message i.e. the eNB can forward either of the two

Figure 19.2.2.5.6-5: Handover of CS and PS domain services from EUTRAN to GERAN A/Gb mode, normal flow

Figure 19.2.2.5.6-6 and Figure 19.2.2.5.6-7 illustrate the message sequence for the handover from EUTRAN to UTRAN procedure:

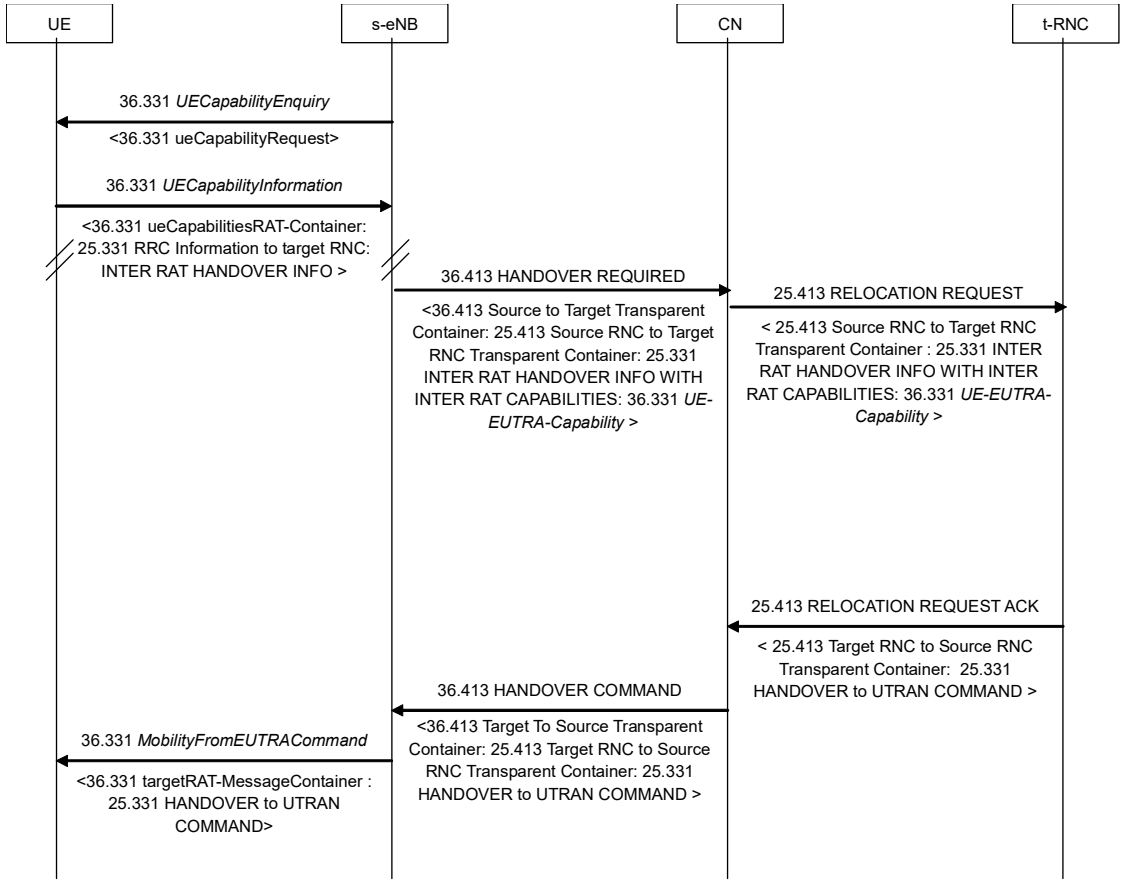


Figure 19.2.2.5.6-6. Handover of PS or CS domain service from EUTRAN to UTRAN, normal flow

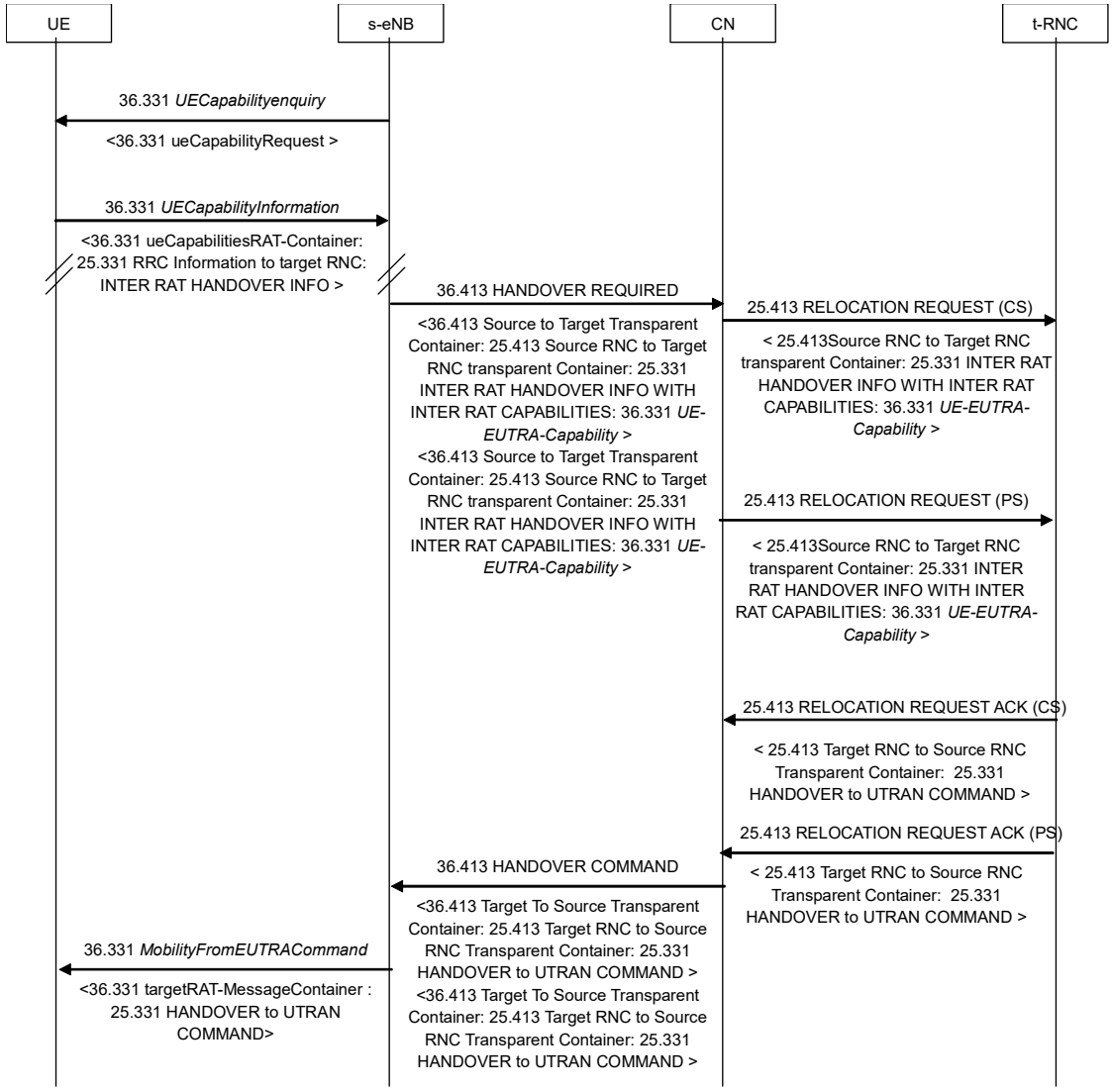


Figure 19.2.2.5.6-7. Handover of PS and CS domain service from EUTRAN to UTRAN, normal flow

19.2.2.5.7 eNB Status Transfer procedure

The purpose of the eNB Status Transfer procedure is to transfer the uplink PDCP SN and HFN receiver status and the downlink PDCP SN and HFN transmitter status from the eNB to the MME during an S1 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

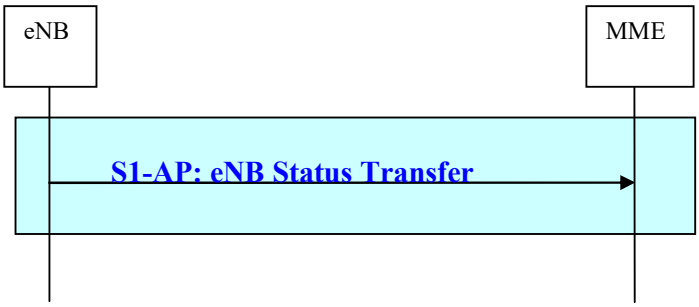


Figure 19.2.2.5.7-1: eNB Status Transfer

19.2.2.5.8 MME Status Transfer procedure

The purpose of the MME Status Transfer procedure is to transfer the uplink PDCP SN and HFN receiver status and the downlink PDCP SN and HFN transmitter status from the MME to the eNB during an S1 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

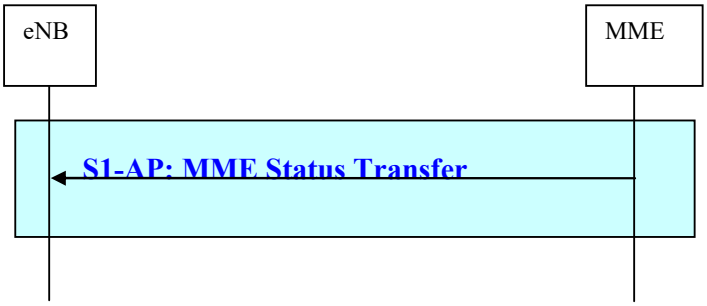


Figure 19.2.2.5.8-1: MME Status Transfer

19.2.2.6 NAS transport procedures

A NAS signalling message is transferred on the S1 interface in both directions. The procedures providing this functionality are:

- Initial UE Message procedure (eNB initiated);
- Uplink NAS transport procedure (eNB initiated);
- Downlink NAS transport procedure (MME initiated);
- Downlink NAS non delivery indication procedure.

i) Initial UE Message procedure

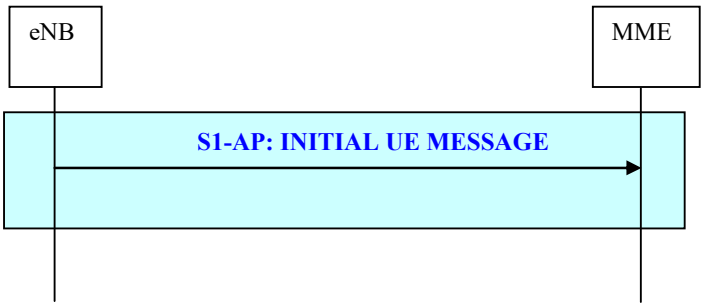


Figure 19.2.2.6-1: Initial UE Message procedure

- The INITIAL UE MESSAGE procedure is initiated by the eNB by sending the INITIAL UE MESSAGE message to the MME. The INITIAL UE MESSAGE contains a NAS message (e.g. Service Request), the UE signalling reference ID and other S1 addressing information. If the eNB is a HeNB supporting LIPA, the message shall include the HeNB collocated L-GW IP address to enable the establishment of a LIPA PDN connection. If the eNB supports SIPTO@LN with collocated L-GW, the message shall include the collocated L-GW IP address to enable the establishment of a SIPTO@LN PDN connection. If the eNB supports SIPTO@LN with stand-alone gateway, the message shall include the LHN ID. In case of UE access to a CSG cell the INITIAL UE MESSAGE contains the CSG id of the cell. In case of UE access to a hybrid cell the INITIAL UE MESSAGE contains the CSG id and Access Mode of the cell.

ii) NAS Transport procedure (eNB initiated)

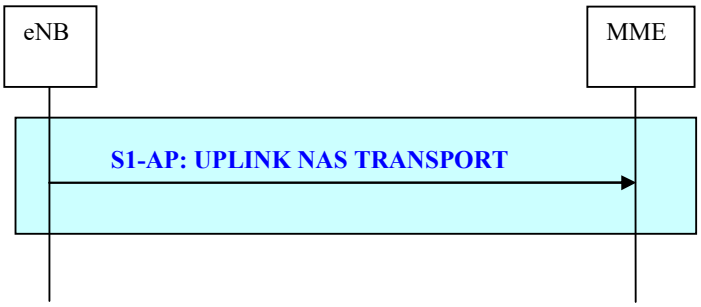


Figure 19.2.2.6-2: Uplink NAS Transport procedure

- The Uplink NAS Transport procedure is initiated by the eNB by sending the UPLINK NAS TRANSPORT message to the MME. The UPLINK NAS TRANSPORT message contains a NAS message, UE identification and other S1 related addressing information. If the eNB is a HeNB supporting LIPA, the message shall include the HeNB collocated L-GW IP address to enable the establishment of a LIPA PDN connection. If the eNB supports SIPTO@LN with collocated L-GW, the message shall include the collocated L-GW IP address to enable the establishment of a SIPTO@LN PDN connection. If the eNB supports SIPTO@LN with stand-alone gateway, the message shall include the LHN ID.

iii) NAS Transport procedure (MME initiated)

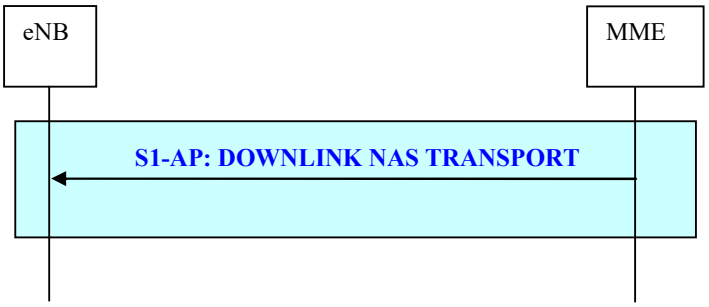


Figure 19.2.2.6-3: Downlink NAS Transport procedure

- The Downlink NAS Transport procedure is initiated by the MME by sending the DOWNLINK NAS TRANSPORT message to the eNB. The DOWNLINK NAS TRANSPORT contains a NAS message, UE identification and other S1 related addressing information.

iv) Downlink NAS non delivery procedure

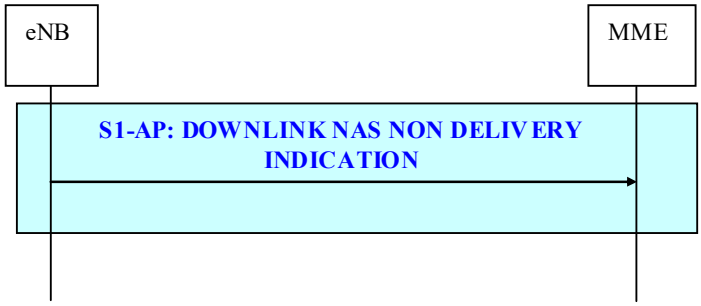


Figure 19.2.2.6-4: Downlink NAS Non Delivery Indication procedure

- When the eNB decides to not start the delivery of a NAS message that has been received from MME, it shall report the non-delivery of this NAS message by sending a DOWNLINK NAS NON DELIVERY INDICATION message to the MME including the non-delivered NAS message and an appropriate cause value.

19.2.2.7 S1 interface Management procedures

19.2.2.7.1 Reset procedure

The purpose of the Reset procedure is to re-initialize the peer entity or part of the peer entity after node setup and after a failure event occurred. This procedure is initiated by both the eNB and MME.

19.2.2.7.1a eNB initiated Reset procedure

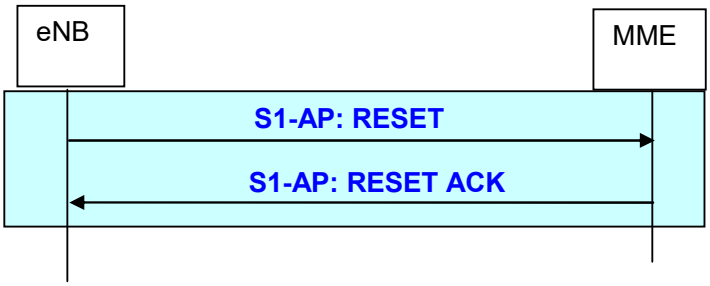


Figure 19.2.2.7.1a-1: eNB initiated Reset procedure

- The eNB triggers the RESET message to indicate that an initialisation in the MME is required. The MME releases the corresponding references and resources.
- Afterwards the MME sends the RESET ACK message to confirm that the resources and references are cleared.

19.2.2.7.1b MME initiated Reset procedure

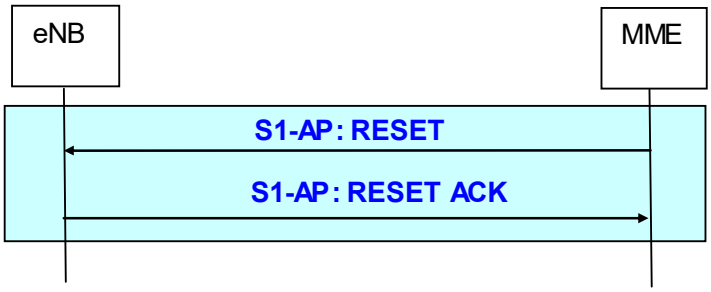


Figure 19.2.2.7.1b-1: MME initiated Reset procedure

- The MME triggers the RESET message to indicate that an initialisation in the eNB is required. The eNB releases the corresponding references and resources.
- Afterwards the eNB sends the RESET ACK message to confirm that the resources and references are cleared.

19.2.2.7.2 Error Indication functions and procedures

The Error Indication procedure is initiated by the eNB and the MME, to report detected errors in one incoming message, if an appropriate failure message cannot be reported to the sending entity.

19.2.2.7.2a eNB initiated error indication

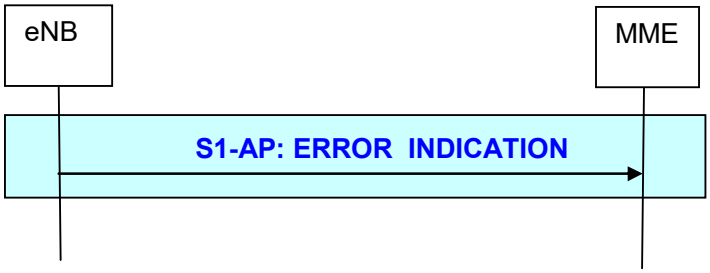


Figure 19.2.2.7.2a-1: eNB initiated Error Indication procedure

The eNB sends the ERROR INDICATION message to report the peer entity which kind of error occurs.

19.2.2.7.2b MME initiated error indication

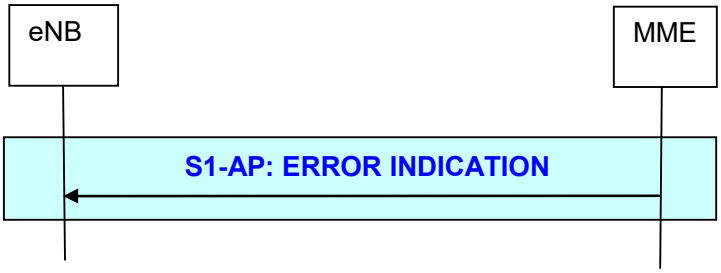


Figure 19.2.2.7.2b-1: MME initiated Error Indication procedure

The MME sends the ERROR INDICATION message to report the peer entity which kind of error occurs.

19.2.2.8 S1 Setup procedure

The S1 Setup procedure is used to exchange configured data which is required in the MME and in the eNB respectively to ensure a proper interoperation. The S1 Setup procedure is triggered by the eNB. The S1 Setup procedure is the first S1AP procedure which will be executed.

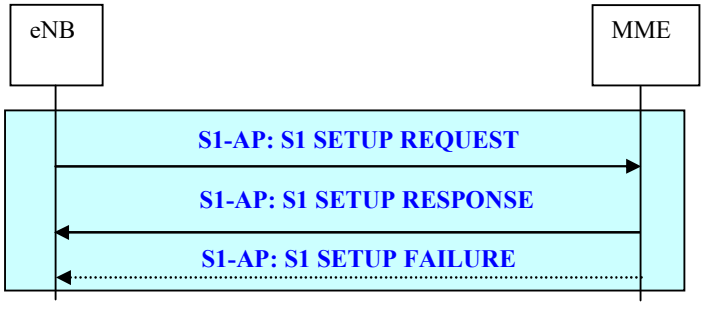


Figure 19.2.2.8-1: S1 Setup procedure

- The eNB initiates the S1 Setup procedure by sending the S1 SETUP REQUEST message including supported TAs and broadcasted PLMNs to the MME.
- In the successful case the MME responds with the S1 SETUP RESPONSE message which includes served PLMNs as well as a relative MME capacity indicator to achieve load balanced MMEs in the pool area.

- If the MME cannot accept the S1 Setup Request the MME responds with the S1 SETUP FAILURE message indicating the reason of the denial. The MME optionally indicates in the S1 SETUP FAILURE message when the eNB is allowed to re-initiate the S1 Setup Request procedure towards the same MME again.

19.2.2.9 eNB Configuration Update procedure

The eNB Configuration Update procedure is used to provide updated configured data in eNB. The eNB Configuration Update procedure is triggered by the eNB.

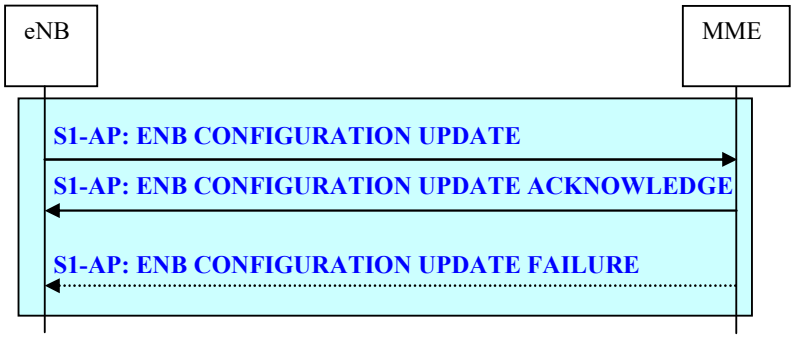


Figure 19.2.2.9-1: eNB Configuration Update procedure

- The eNB initiates the eNB Configuration Update procedure by sending the ENB CONFIGURATION UPDATE message including updated configured data like supported TAs and broadcasted PLMNs to the MME. In case one or more supported TA(s) needs to be updated, the eNB shall provide the whole list of TA(s), including those which has not been changed, in the ENB CONFIGURATION UPDATE message.
- The MME responds with the ENB CONFIGURATION UPDATE ACKNOWLEDGE message to acknowledge that the provided configuration data are successfully updated.
- The MME shall overwrite and store the received configuration data which are included in the ENB CONFIGURATION UPDATE message. Configuration data which has not been included in the ENB CONFIGURATION UPDATE message are interpreted by the MME as still valid. For the provided TA(s) the MME shall overwrite the whole list of supported TA(s).
- In case the MME cannot accept the received configuration updates the MME shall respond with the ENB CONFIGURATION UPDATE FAILURE message including an appropriate cause value to indicate the reason of the denial. The MME optionally indicates in the ENB CONFIGURATION UPDATE FAILURE message when the eNB is allowed to re-initiate the eNB Configuration Update procedure towards the same MME again. For the unsuccessful update case the eNB and the MME shall continue with the existing configuration data.

19.2.2.9a eNB Configuration Transfer procedure

The eNB Configuration Transfer procedure is initiated by the eNB to request and/or transfer RAN configuration information via the core network.

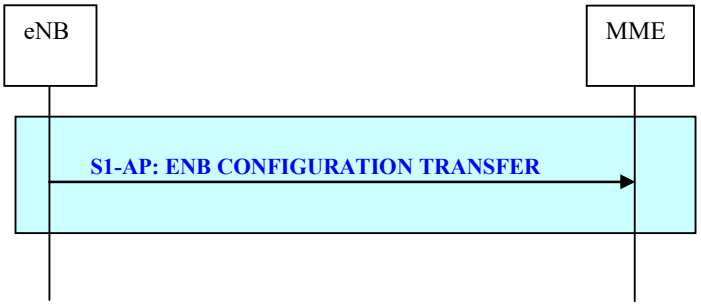


Figure 19.2.2.9a-1: eNB Configuration Transfer procedure

The eNB Configuration Transfer procedure is initiated by the eNB by sending the eNB CONFIGURATION TRANSFER message to the MME. The eNB CONFIGURATION TRANSFER message contains RAN configuration information (e.g. SON information) and other relevant information such as the routing address which identifies the final RAN destination node.

19.2.2.10 MME Configuration Update procedure

The MME Configuration Update procedure is used to provide updated configured data and changes of the relative MME capacity values in the MME. The MME Configuration Update procedure is triggered by the MME.

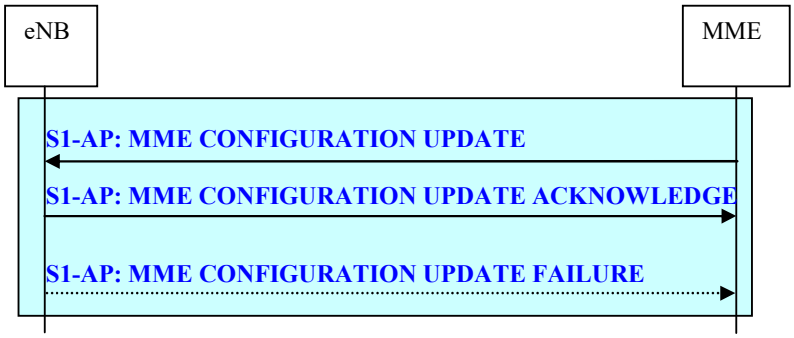


Figure 19.2.2.10-1: MME Configuration Update procedure

- The MME initiates the MME Configuration Update procedure by sending the MME CONFIGURATION UPDATE message including updated configured data like served PLMNs and changes of the relative MME capacity values to the eNB.
- The eNB responds with the MME CONFIGURATION UPDATE ACKNOWLEDGE message to acknowledge that the provided configuration data and the relative MME capacity values are successfully updated.
- The eNB shall overwrite and store the received configuration data and relative MME capacity values which are included in the MME CONFIGURATION UPDATE message. Configuration data which has not been included in the MME CONFIGURATION UPDATE message are interpreted by the eNB as still valid.
- In case the eNB cannot accept the received configuration updates the eNB shall respond with the MME CONFIGURATION UPDATE FAILURE message including an appropriate cause value to indicate the reason of the denial. The eNB optionally indicates in the MME CONFIGURATION UPDATE FAILURE message when the MME is allowed to re-initiate the MME Configuration Update procedure towards the same eNB again. For the unsuccessful update case the eNB and the MME shall continue with the existing configuration data and relative MME capacity values.

19.2.2.10a MME Configuration Transfer procedure

The MME Configuration Transfer procedure is initiated by the MME to request and/or transfer RAN configuration information to the eNB.

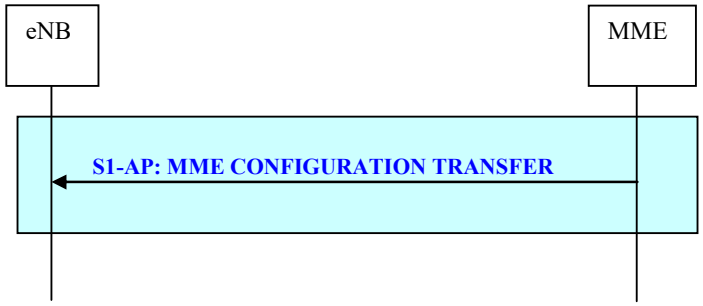


Figure 19.2.2.10a-1: MME Configuration Transfer procedure

The MME Configuration Transfer procedure is initiated by the MME by sending the MME CONFIGURATION TRANSFER message to the eNB. The MME CONFIGURATION TRANSFER message contains RAN configuration information (e.g. SON information) and other relevant information.

19.2.2.11 Location Reporting procedures

The Location Reporting procedures provide the means to report the current location of a specific UE.

The procedures providing this function are:

- Location Reporting Control procedure;
- Location Report procedure;
- Location Report Failure Indication procedure.

If DC is configured for a specific UE, the location reported refers to the cell served by the MeNB.

NOTE: The following S1AP procedures are able to provide location information without the reporting being triggered by the Location Reporting Control procedure:
S1 UE Context Release, E-RAB Release, E-RAB Release Indication, Path Switch, Handover Notification, Initial UE Message, Uplink NAS Transport.

19.2.2.11.1 Location Reporting Control procedure

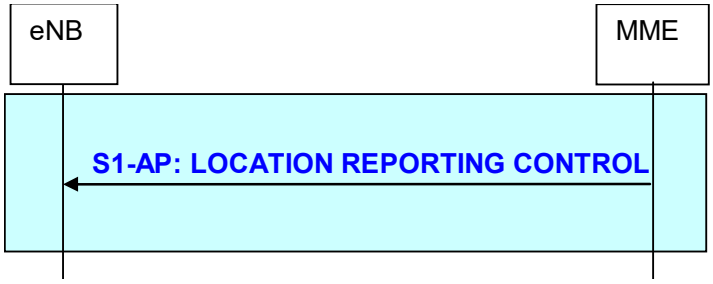


Figure 19.2.2.11.1-1: Location Reporting Control procedure

The Location Reporting Control procedure is initiated by the MME sending the LOCATION REPORTING CONTROL to the eNB to request the current location information, e.g. Cell ID, of a specific UE, and how the information shall be reported, e.g. direct report, report every cell change. The Location Reporting Control procedure is also used to terminate reporting on cell change.

If the Location Reporting Control procedure fails, e.g. due to an interaction with an initiated handover then the eNB shall indicate the failure using the Location Report Failure Indication procedure.

If the Location Reporting Control procedure is on going for a specific UE and the eNB received an UE CONTEXT RELEASE COMMAND message from MME this specific UE then the eNB shall terminate the on-going Location Reporting.

19.2.2.11.2 Location Report procedure

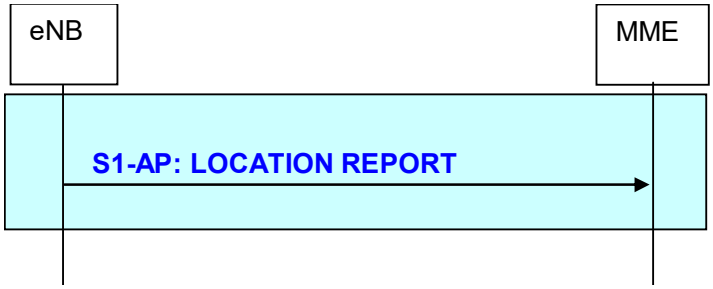


Figure 19.2.2.11.2-1: Location Report procedure

The Location Report procedure is initiated by the eNB by sending the LOCATION REPORT to the MME to report the current location information of a specific UE as a standalone report, or every time UE changes cell.

19.2.2.11.3 Location Report Failure Indication procedure

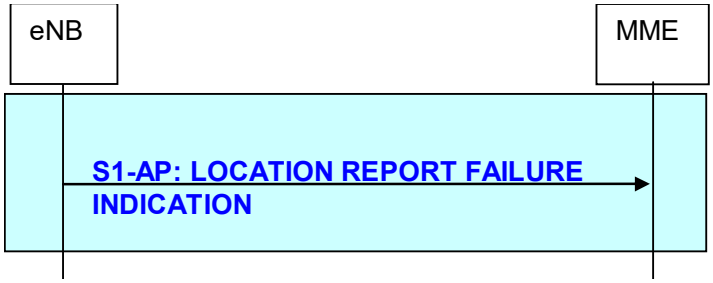


Figure 19.2.2.11.3-1: Location Report Failure Indication procedure

The Location Report Failure Indication procedure is initiated by the eNB by sending the LOCATION REPORT FAILURE INDICATION to the MME to indicate that the Location Report Control procedure has failed due to e.g. UE has performed inter-eNB handover.

19.2.2.12 Overload procedure

19.2.2.12.1 Overload Start procedure

The Overload Start procedure is used by the MME to indicate to a proportion of eNBs to which the MME has an S1 interface connection that the MME is overloaded. The Overload Start procedure is used to provide an indication of which type of RRC connections needs to be rejected/permitted only.

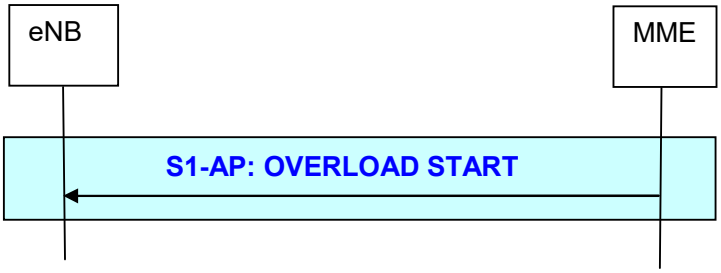


Figure 19.2.2.12.1-1 Overload Start procedure

If the OVERLOAD START message contains a list of GUMMEIs, the eNB shall select the new RRC connections to be rejected based on this list.

The eNB may also trigger EAB as specified in TS 23.401 [17] subclause 4.3.7.4.1 and TS 23.251 [54] subclause 4.6.

19.2.2.12.2 Overload Stop procedure

The Overload Stop procedure is used by the MME to indicate the concerned eNB(s) that the MME is no longer overloaded.

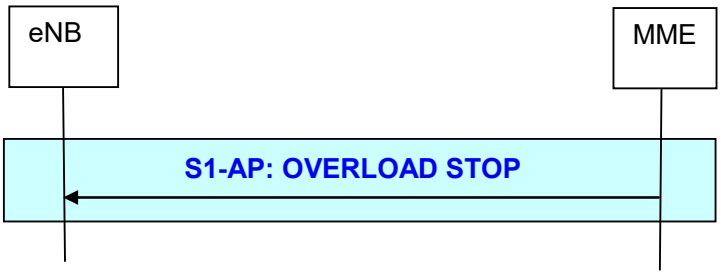


Figure 19.2.2.12.2-1: Overload Stop procedure

If the OVERLOAD STOP message contains a list of GUMMEIs, the eNB shall stop rejecting the new RRC connections corresponding to each received GUMMEI value if applicable.

The eNB may also stop ongoing EAB actions.

19.2.2.13 Write-Replace Warning procedure

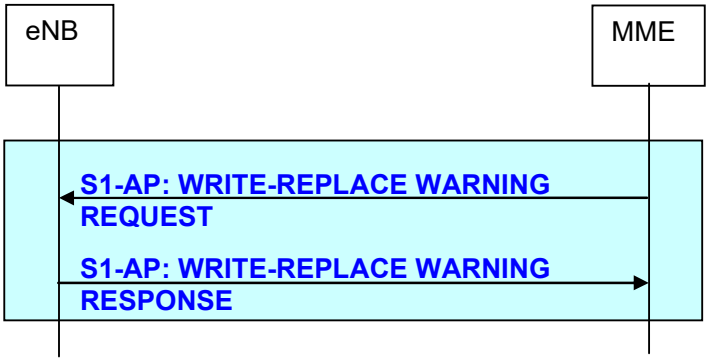


Figure 19.2.2.13.1-1: Write-Replace Warning procedure

The Write-Replace Warning procedure is used to start the broadcasting of a PWS warning message.

ETWS is an example of PWS warning system using this procedure where one message at a time can be delivered over the radio.

CMAS is another example of PWS warning system using this procedure which allows the broadcast of multiple concurrent warning messages over the radio.

The procedure is initiated by the MME by sending WRITE-REPLACE WARNING REQUEST message containing at least the Message Identifier, Warning Area list, information on how the broadcast should be performed, and the contents of the warning message to be broadcast.

The eNB responds with WRITE-REPLACE WARNING RESPONSE message to acknowledge that the requested PWS warning message broadcast was initiated.

ETWS and CMAS are independent services and ETWS and CMAS messages are differentiated over S1 in order to allow different handling.

In the case of ETWS, the Write-Replace Warning procedure can also be used to overwrite the ongoing broadcasting of an ETWS warning message.

19.2.2.14 eNB Direct Information Transfer procedure

The eNB Direct Information Transfer procedure is initiated by the eNB to request and transfer information to the core network.

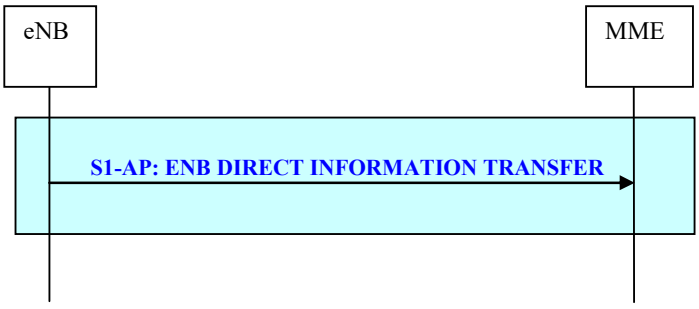


Figure 19.2.2.14-1: eNB Direct Information Transfer procedure

The eNB Direct Information Transfer procedure is initiated by the eNB by sending the eNB DIRECT INFORMATION TRANSFER message to the MME. The eNB DIRECT INFORMATION TRANSFER message contains RIM information and RIM routing address which identifies the final RAN destination node.

19.2.2.15 MME Direct Information Transfer procedure

The MME Direct Information Transfer procedure is initiated by the MME to request and transfer information to the eNB.

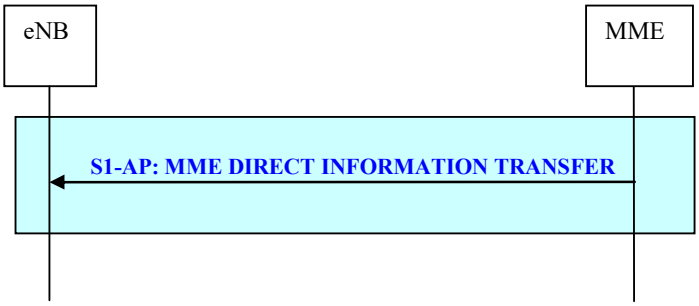


Figure 19.2.2.15-1: MME Direct Information Transfer procedure

The MME Direct Information Transfer procedure is initiated by the MME by sending the MME DIRECT INFORMATION TRANSFER message to the eNB. The MME DIRECT INFORMATION TRANSFER message contains RIM information.

19.2.2.16 S1 CDMA2000 Tunnelling procedures

The S1 CDMA2000 Tunnelling procedures carry CDMA2000 signalling messages between UE and CDMA2000 RAT over the S1 Interface. This includes signalling for pre-registration and handover preparation for optimized mobility from E-UTRAN to CDMA2000 HRPD, signalling for handover preparation for mobility from E-UTRAN to CDMA2000 1xRTT and signalling to support CS fallback to CDMA2000 1xRTT for mobile originated and mobile terminated CS domain services. The CDMA2000 messages are tunnelled transparently to the eNB and MME, however, additional information may be sent along with the tunnelled CDMA2000 message to assist the eNodeB and MME in the Tunnelling procedure. The procedures providing this functionality are:

- Downlink S1 CDMA2000 Tunnelling procedure;
- Uplink S1 CDMA2000 Tunnelling procedure.

19.2.2.16.1 Downlink S1 CDMA2000 Tunnelling procedure

The MME sends the DOWNLINK S1 CDMA2000 TUNNELLING message to the eNB to forward a CDMA2000 message towards an UE for which a logical S1 connection exists (see Figure 19.2.2.16.1-1 below).

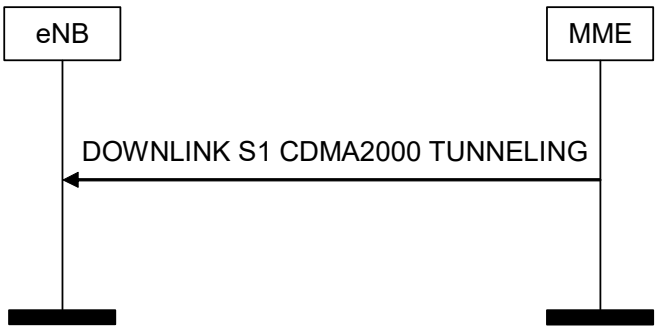


Figure 19.2.2.16.1-1: Downlink S1 CDMA2000 Tunnelling procedure

19.2.2.16.2 Uplink S1 CDMA2000 Tunnelling procedure

The eNB sends the UPLINK S1 CDMA2000 TUNNELLING message to the MME to forward a CDMA2000 message towards the CDMA2000 RAT (HRPD or 1xRTT) as depicted on Figure 19.2.2.16.2-1 below.

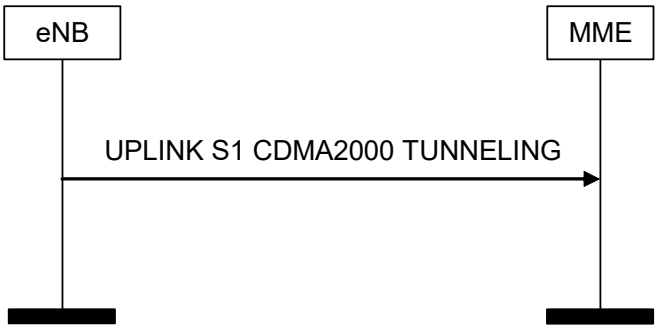


Figure 19.2.2.16.2-1: Uplink S1 CDMA2000 Tunnelling procedure

19.2.2.17 Kill procedure

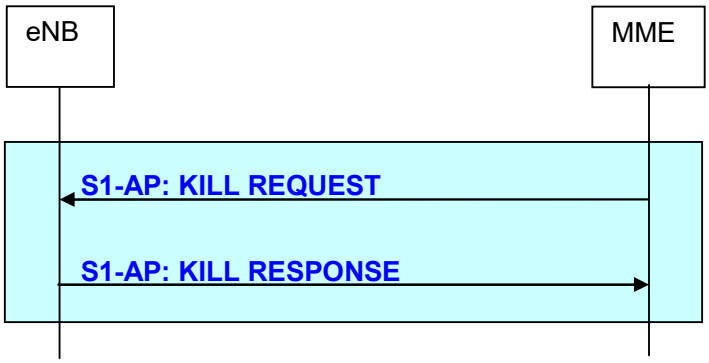


Figure 19.2.2.17-1: Kill procedure

The Kill procedure is used to stop the broadcasting of a PWS warning message or all PWS warning messages.

CMAS is an example of warning system using this procedure. The ETWS warning system doesn't use this procedure.

The procedure is initiated by the MME sending the KILL REQUEST message containing at least the Message Identifier and serial number of the message to be killed and the Warning Area List where it shall be killed.

The eNB responds with a KILL RESPONSE message to acknowledge that the requested PWS message broadcast delivery has actually been stopped.

19.2.2.18 LPPa Transport procedures

An LPPa signalling message is transferred on the S1 interface in both directions. The procedures providing this functionality are:

- Downlink UE Associated LPPa Transport procedure;
- Uplink UE Associated LPPa Transport procedure;
- Downlink Non UE Associated LPPa Transport procedure;
- Uplink Non UE Associated LPPa Transport procedure.

The UE-associated signalling is used to support E-CID positioning of a specific UE. The non-UE associated signalling is used to obtain assistance data from an eNodeB to support OTDOA positioning for any UE.

19.2.2.18.1 Downlink UE Associated LPPa Transport procedure

The Downlink UE Associated LPPa Transport procedure is initiated by the MME by sending the DOWNLINK UE ASSOCIATED LPPA TRANSPORT message to the eNB. The DOWNLINK UE ASSOCIATED LPPA TRANSPORT contains an LPPa message.

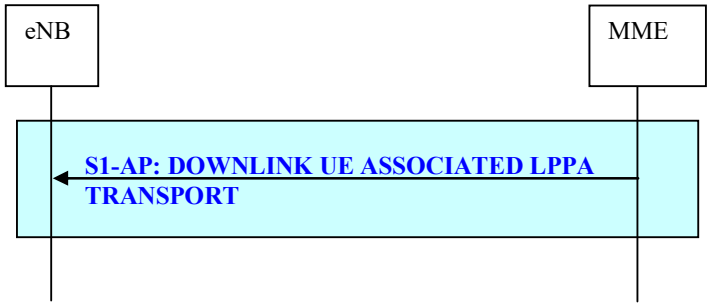


Figure 19.2.2.18.1-1: Downlink UE Associated LPPa Transport procedure

19.2.2.18.2 Uplink UE Associated LPPa Transport procedure

The Uplink UE Associated LPPa Transport procedure is initiated by the eNB by sending the UPLINK UE ASSOCIATED LPPA TRANSPORT message to the MME. The UPLINK UE ASSOCIATED LPPA TRANSPORT message contains a LPPa message.

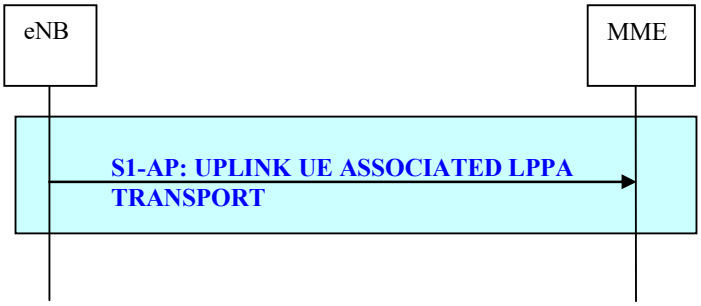


Figure 19.2.2.18.2-1: Uplink UE Associated LPPa Transport procedure

19.2.2.18.3 Downlink Non UE Associated LPPa Transport procedure

The Downlink Non UE Associated LPPa Transport procedure is initiated by the MME by sending the DOWNLINK NON UE ASSOCIATED LPPA TRANSPORT message to the eNB. The DOWNLINK NON UE ASSOCIATED LPPA TRANSPORT contains a LPPa message.

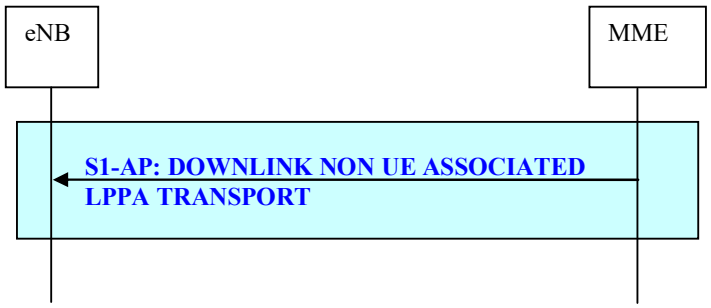


Figure 19.2.2.18.3-1: Downlink Non UE Associated LPPa Transport procedure

19.2.2.18.4 Uplink Non UE Associated LPPa Transport procedure

The Uplink Non UE Associated LPPa Transport procedure is initiated by the eNB by sending the UPLINK NON UE ASSOCIATED LPPA TRANSPORT message to the MME. The UPLINK NON UE ASSOCIATED LPPA TRANSPORT message contains an LPPa message.

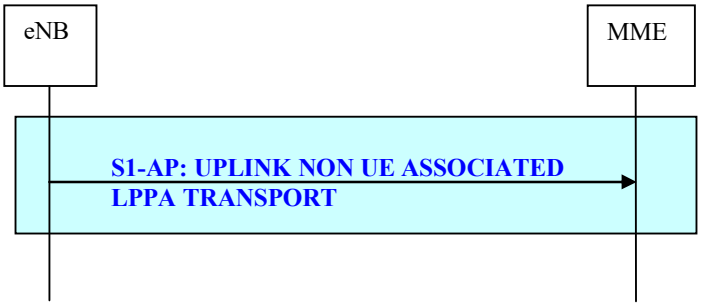


Figure 19.2.2.18.4-1: Uplink Non UE Associated LPPa Transport procedure

19.2.2.19 Trace procedures

The Trace procedures provide the means to control trace sessions and MDT sessions in the eNB for both signalling and management triggered sessions.

The procedures providing this function are:

- Trace Start procedure;
- Trace Failure Indication procedure;
- Deactivate Trace procedure;
- Cell Traffic Trace procedure.

19.2.2.19.1 Trace Start procedure

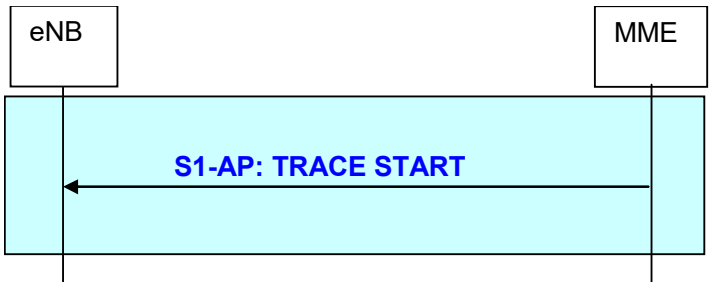


Figure 19.2.2.19.1-1: Trace Start procedure

The Trace Start procedure is initiated by the MME by sending the TRACE START message to the eNB in order to request the initiation of a trace session for a specific UE in ECM_CONNECTED mode or request the initiation of an MDT session for a specific UE.

19.2.2.19.2 Trace Failure Indication procedure

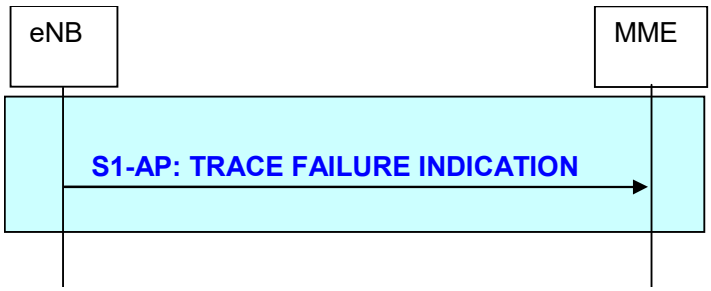


Figure 19.2.2.19.2-1: Trace Failure Indication procedure

The Trace Failure Indication procedure is initiated by the eNB by sending the TRACE FAILURE INDICATION message to the MME to report that a Trace Start procedure or a Deactivate Trace procedure has failed due to an interaction with a handover procedure.

19.2.2.19.3 Deactivate Trace procedure

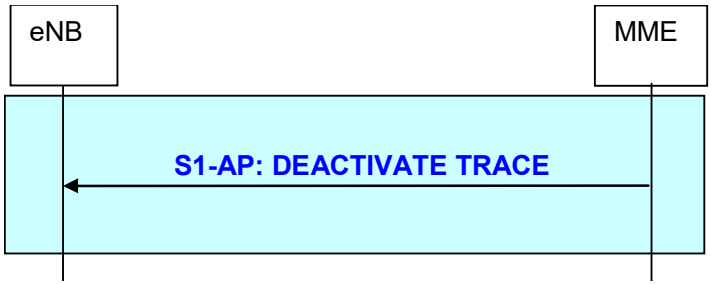


Figure 19.2.2.19.3-1: Deactivate Trace procedure

The Deactivate Trace procedure is initiated by the MME by sending the DEACTIVATE TRACE message to the eNB to request the termination of an ongoing trace session.

19.2.2.19.4 Cell Traffic Trace procedure

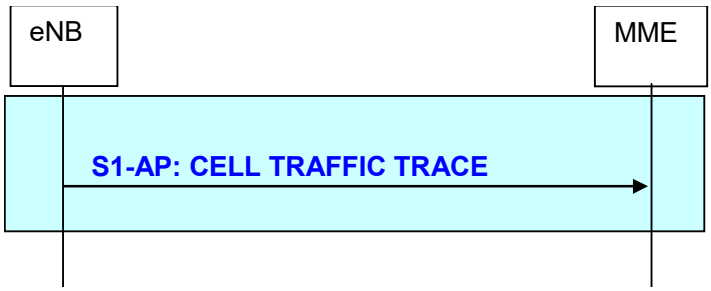


Figure 19.2.2.19.4-1: Cell Traffic Trace procedure

The Cell Traffic Trace procedure is initiated by the eNB by sending the CELL TRAFFIC TRACE message to the MME to report the allocated Trace Recording Session Reference and the Trace Reference to MME. This procedure is used to support management triggered trace.

19.2.2.20 UE Capability Info Indication procedure

The purpose of the UE Capability Info Indication procedure is to enable the eNB to provide to the MME UE capability-related information.

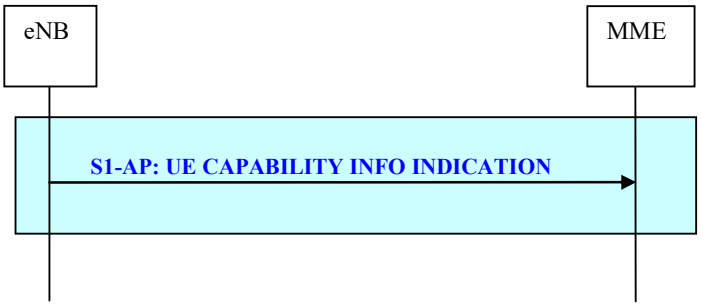


Figure 19.2.2.20-1: UE Capability Info Indication procedure

19.2.2.21 UE Radio Capability Match procedure

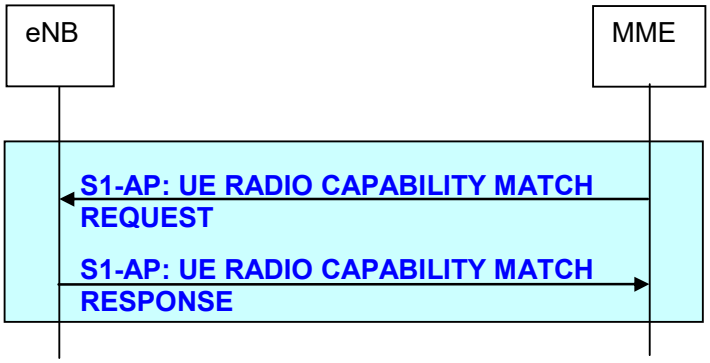


Figure 19.2.2.21-1: UE Radio Capability Match procedure

The UE Radio Capability Match procedure is initiated by the MME to request an indication on whether the UE Radio capabilities match the network configuration for voice continuity.

19.2.2.22 PWS Restart Indication procedure

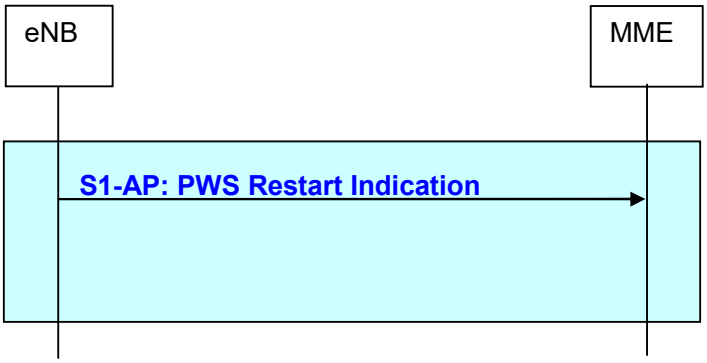


Figure 19.2.2.22-1: PWS Restart Indication procedure

The PWS Restart Indication procedure is used to inform the MME that PWS information for some cells or all cells of the eNB are available for reloading from the CBC if needed.

The procedure is initiated by the eNB sending the PWS RESTART INDICATION message.

20 X2 Interface

20.1 User Plane

The X2 user plane interface (X2-U) is defined between eNBs. The X2-U interface provides non guaranteed delivery of user plane PDUs. The user plane protocol stack on the X2 interface is shown in Figure 20.1-1. The transport network layer is built on IP transport and GTP-U is used on top of UDP/IP to carry the user plane PDUs.

The X2-U interface protocol stack is identical to the S1-U protocol stack.

For DC, if X2-U user data bearers are associated with E-RABs for which the split bearer option is configured, GTP-U conveys PDCP PDUs in uplink and downlink and a RAN Container containing flow control information. The RAN Container is carried in the "RAN Container" field of the GTP-U extension header.

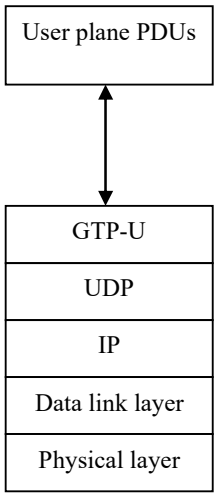


Figure 20.1-1: X2 Interface User Plane (eNB-eNB)

20.1.1 Flow Control Functions

The Flow Control function is applied when an E-RAB is configured for the split bearer option and only for DL i.e. the flow control information is provided only by the SeNB to the MeNB for the MeNB to control the downlink user data flow to the SeNB. The flow control function is further described in TS 36.425 [61].

20.2 Control Plane

The X2 control plane interface (X2-CP) is defined between two neighbour eNBs. The control plane protocol stack of the X2 interface is shown on Figure 20.2-1 below. The transport network layer is built on SCTP on top of IP. The application layer signalling protocol is referred to as X2-AP (X2 Application Protocol).

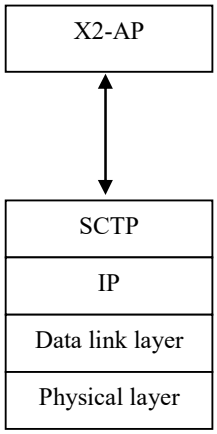


Figure 20.2-1: X2 Interface Control Plane

A single SCTP association per X2-C interface instance shall be used with one pair of stream identifiers for X2-C common procedures. Only a few pairs of stream identifiers should be used for X2-C dedicated procedures.

Source-eNB communication context identifiers that are assigned by the source-eNB for X2-C dedicated procedures, and target-eNB communication context identifiers that are assigned by the target-eNB for X2-C dedicated procedures, shall be used to distinguish UE specific X2-C signalling transport bearers. The communication context identifiers are conveyed in the respective X2AP messages.

RNs terminate X2-AP. In this case, there is one X2 interface relation between the RN and the DeNB.

20.2.1 X2-CP Functions

The X2AP protocol supports the following functions:

- Intra LTE-Access-System Mobility Support for UE in ECM-CONNECTED:
  - Context transfer from source eNB to target eNB;
  - Control of user plane tunnels between source eNB and target eNB;
  - Handover cancellation.
- Support of DC for UE in ECM-CONNECTED:
  - Establishment, Modification and Release of a UE context at the SeNB;
  - Control of user plane tunnels between MeNB and SeNB for a specific UE for split bearer and data forwarding;
  - Provision of the TNL information of the S1 user plane tunnels for SCG bearers.
- Load Management;
- General X2 management and error handling functions:
  - Error indication;
  - Setting up the X2;
  - Resetting the X2;
  - Updating the X2 configuration data;
  - X2 Release;
  - X2AP Message Transfer;
  - Registration;

- X2 Removal.

- Mobility failure event notification and information exchange in support of handover settings negotiation;
- Energy Saving. This function allows decreasing energy consumption by enabling indication of cell activation/deactivation.

20.2.2 X2-CP Procedures

The elementary procedures supported by the X2AP protocol are listed in Table 8.1-1 and Table 8.1-2 of TS 36.423 [42].

20.2.2.1 Handover Preparation procedure

The Handover preparation procedure is initiated by the source eNB if it determines the necessity to initiate the handover via the X2 interface.

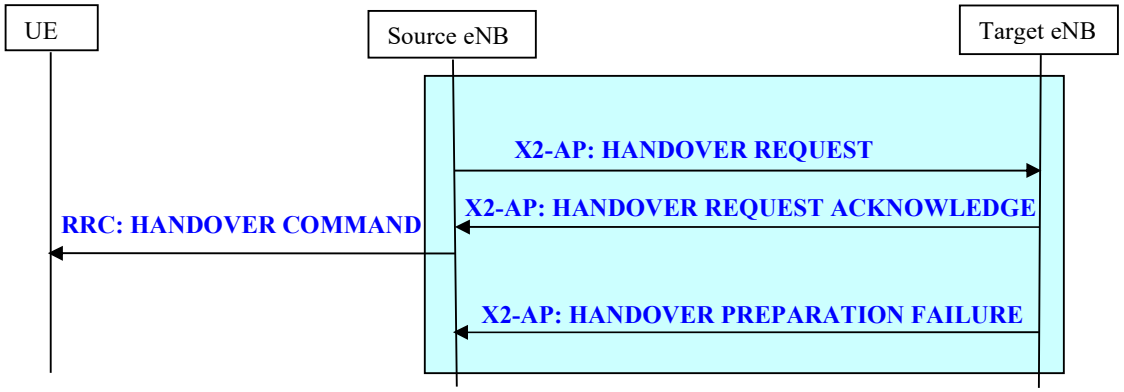


Figure 20.2.2.1-1: Handover Preparation procedure

The source eNB sends a HANDOVER REQUEST to the target eNB including the bearers to be setup by the target ENB.

The handover preparation phase is finished upon the reception of the HANDOVER REQUEST ACKNOWLEDGE message in the source eNB, which includes at least radio interface related information (HO Command for the UE), successfully established E-RAB(s) and failed established E-RAB(s).

In case the handover resource allocation is not successful (e.g. no resources are available on the target side) the target eNB responds with the HANDOVER PREPARATION FAILURE message instead of the HANDOVER REQUEST ACKNOWLEDGE message.

If eNB received NAS message from MME during X2 handover procedure, it shall be acted as specified in subclause 19.2.2.6.

20.2.2.2 Handover Cancel procedure

This functionality is located in the source eNB to allow cancellation of the handover procedure.

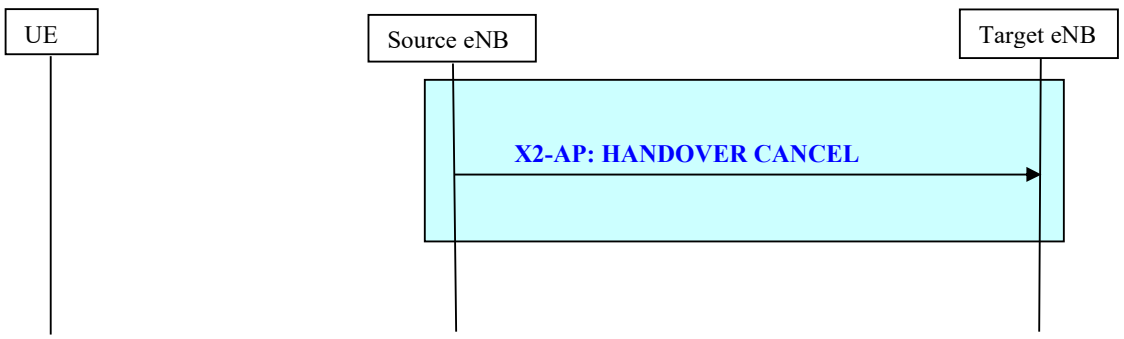


Figure 20.2.2.2-1: Handover Cancel procedure

The source eNB sends a HANDOVER CANCEL message to the target eNB indicating the reason for the handover cancellation.

20.2.2.2a SeNB Addition Preparation procedure

The SeNB Addition Preparation procedure is initiated by the MeNB to request the SeNB to allocate resources for DC operation for a specific UE.

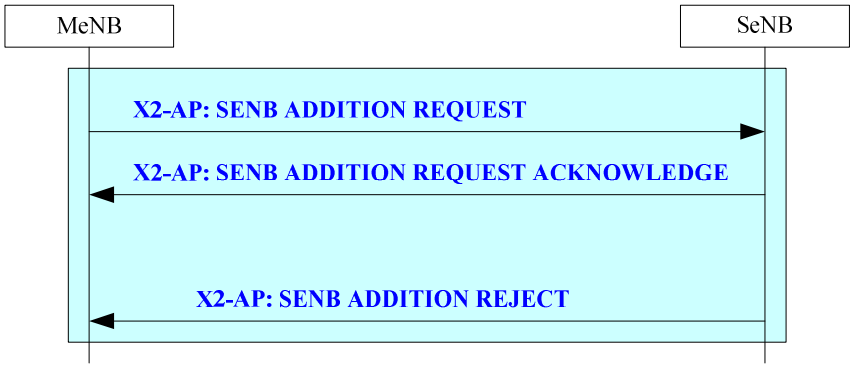


Figure 20.2.2.2a-1: SeNB Addition Preparation procedure

The MeNB sends an SENB ADDITION REQUEST message to the SeNB including the bearers for which DC shall be configured.

In case resource allocation at the SeNB has been performed successfully, the SeNB responds with an SENB ADDITION REQUEST ACKNOWLEDGE message, which includes radio interface related information, successfully established and failed to be established bearers for DC.

In case the SeNB addition is not successful (e.g. no resources are available on the SeNB side) the SeNB responds with the SENB ADDITION REJECT message instead.

20.2.2.2b SeNB Reconfiguration Completion procedure

The SeNB Reconfiguration Complete procedure is initiated by the MeNB to indicate to the SeNB that the UE has been successfully configured with the requested SeNB radio configuration.

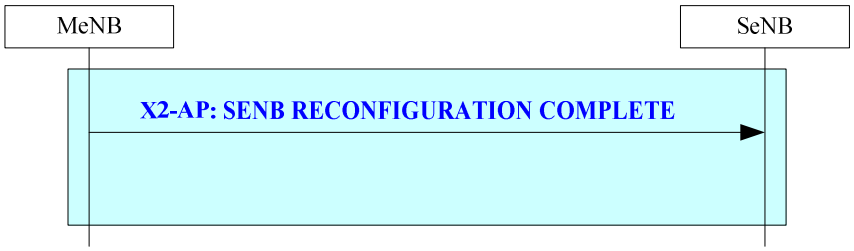


Figure 20.2.2.2b-1: SeNB Reconfiguration Completion procedure

The same procedure is also used by the MeNB to indicate that the MeNB finally decided to not request the UE to apply the radio configuration requested by the SeNB.

The SeNB Reconfiguration Completion procedure is used in the course of an SeNB Addition and in the course of an MeNB initiated SeNB Modification if the MeNB initiated SeNB Modification requires signalling towards the UE.

20.2.2.2c MeNB initiated SeNB Modification Preparation procedure

The MeNB initiated SeNB Modification Preparation procedure is initiated by the MeNB to request the SeNB to modify resources allocated for a specific UE at the SeNB.

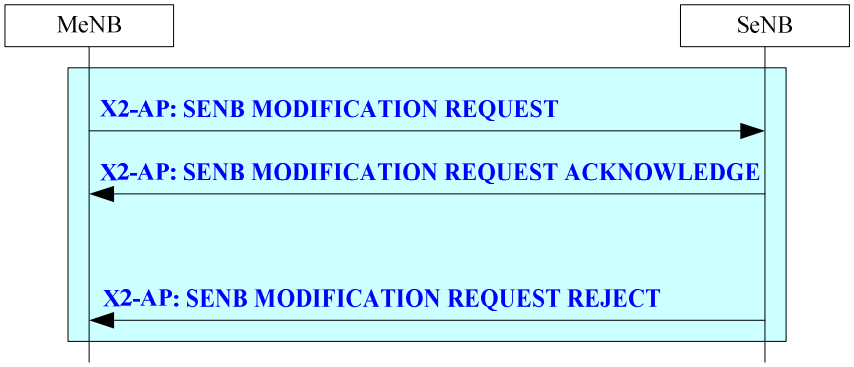


Figure 20.2.2.2c-1: MeNB initiated SeNB Modification Preparation procedure

The MeNB initiated SeNB Modification does not necessarily result in communication towards the UE.

In case resource modification at the SeNB has been performed successfully, the SeNB responds with an SENB MODICATION REQUEST ACKNOWLEDGE message.

In case the SeNB modification is not successful (e.g. no resources are available on the SeNB side), the SeNB responds with the SENB MODIFICATION REQUEST REJECT message instead.

20.2.2.2d SeNB initiated SeNB Modification procedure

The SeNB initiated SeNB Modification Preparation procedure is initiated to request the modification of the UE context at the SeNB.

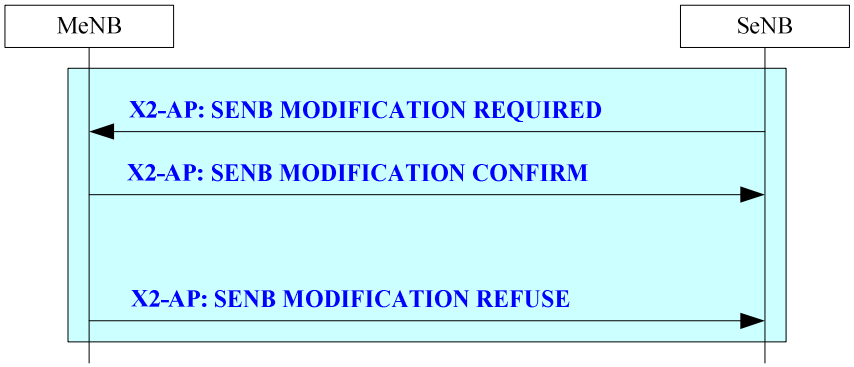


Figure 20.2.2.2d-1: SeNB initiated SeNB Modification procedure

The SeNB initiated SeNB Modification does not necessarily result in communication towards the UE.

If the MeNB decides to not follow the SeNBs request it replies with an SENB MODIFICATION REFUSE message.

20.2.2.2e MeNB initiated SeNB Release procedure

The MeNB initiated SeNB Release procedure is triggered by the MeNB to initiate the release of the resources for a specific UE at the SeNB.

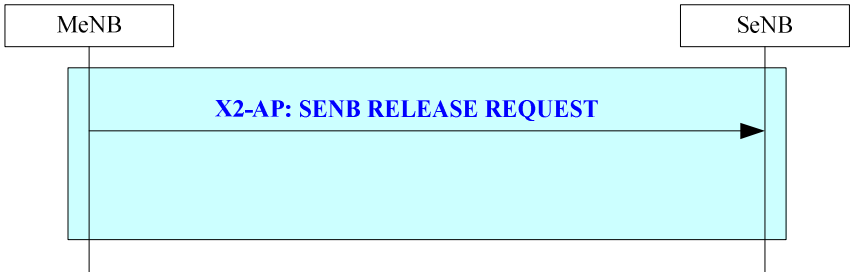


Figure 20.2.2.2e-1: MeNB initiated SeNB Release procedure

20.2.2.2f SeNB initiated SeNB Release procedure

The SeNB initiated SeNB Release procedure is triggered by the SeNB to initiate the release of the resources for a specific UE at the SeNB.

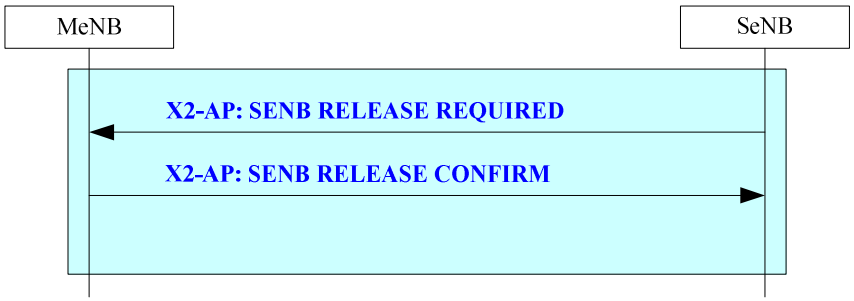


Figure 20.2.2.2f-1: SeNB initiated SeNB Release procedure

20.2.2.2g SeNB Counter Check procedure

The SeNB Counter Check procedure is initiated by the SeNB to request the MeNB to execute a counter check procedure to verify the value of the PDCP COUNTs associated with SCG bearers established in the SeNB.

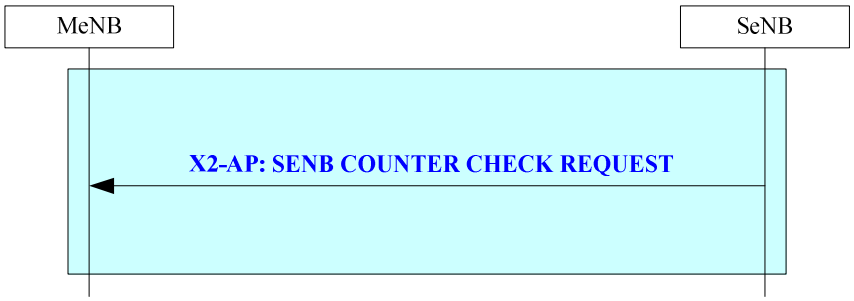


Figure 20.2.2.2g-1: SeNB Counter Check procedure

20.2.2.3 UE Context Release procedure

At handover, the UE Context Release procedure is initiated by the target eNB to signal to the source eNB that resources for the handed over UE context can be released.

For DC, the UE Context Release procedure is initiated by the MeNB to finally release the resources at the SeNB for the specific UE once either the SeNB initiated or the MeNB initiated SeNB Release Procedure has been performed.

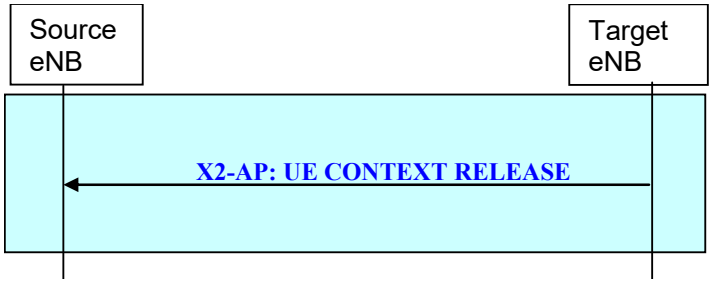


Figure 20.2.2.3-1: UE Context Release procedure

At handover, by sending UE CONTEXT RELEASE the target eNB informs the source eNB of Handover success and triggers the release of resources.

20.2.2.4 SN Status Transfer procedure

The purpose of the SN Status Transfer procedure is to transfer the uplink PDCP SN and HFN receiver status and the downlink PDCP SN and HFN transmitter status from the source to the target eNB during an X2 handover for each respective E-RAB for which PDCP SN and HFN status preservation applies.

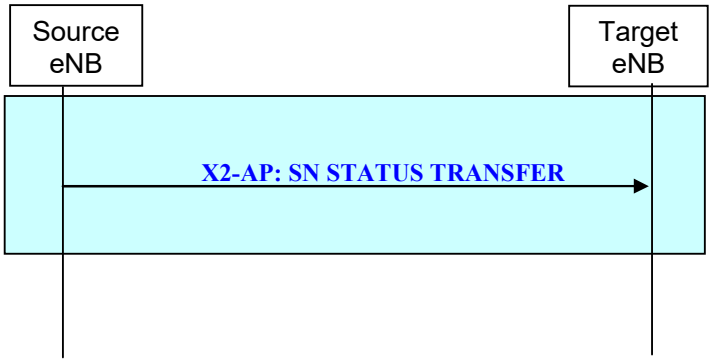


Figure 20.2.2.4-1: SN Status Transfer procedure

20.2.2.5 Error Indication procedure

The Error Indication procedure is initiated by an eNB to signal to a peer eNB an error situation in a received message, provided it cannot be reported by an appropriate failure message.

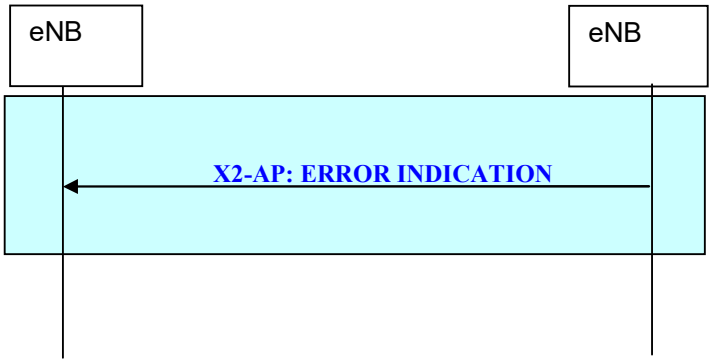


Figure 20.2.2.5-1: Error Indication procedure

20.2.2.6 Load Indication procedure

Inter-cell interference coordination in E-UTRAN is performed through the X2 interface. In case of variation in the interference conditions, the eNB signals the new condition to its neighbour eNBs e.g. the neighbour eNBs for which an X2 interface is configured due to mobility reasons.

When the time-domain inter-cell interference coordination is used to mitigate interference, the eNB signals its almost blank subframe (ABS) patterns to its neighbour eNBs, so that the receiving eNB can utilize the ABS of the sending eNB with less interference.

NOTE: A typical use case of the time-domain solution of inter-cell interference coordination is the one where an eNB providing broader coverage and therefore being more capacity constrained determines its ABS patterns and indicates them to eNBs, providing smaller coverage residing in its area.

When inter-eNB CoMP is used, the eNB signals the CoMP hypotheses and associated benefit metrics to its neighbour eNB(s), so that the receiving eNB may take them into account for RRM.

The Load Indication procedure is used to transfer interference co-ordination information between neighbouring eNBs managing intra-frequency cells, and adjacent frequency TDD cells.

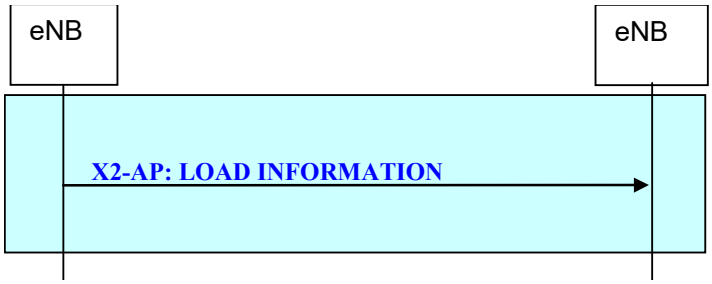


Figure 20.2.2.6-1: Load Indication procedure

20.2.2.7 X2 Setup procedure

The purpose of the X2 Setup procedure is to exchange application level data needed for two eNBs to interoperate correctly over the X2 interface.

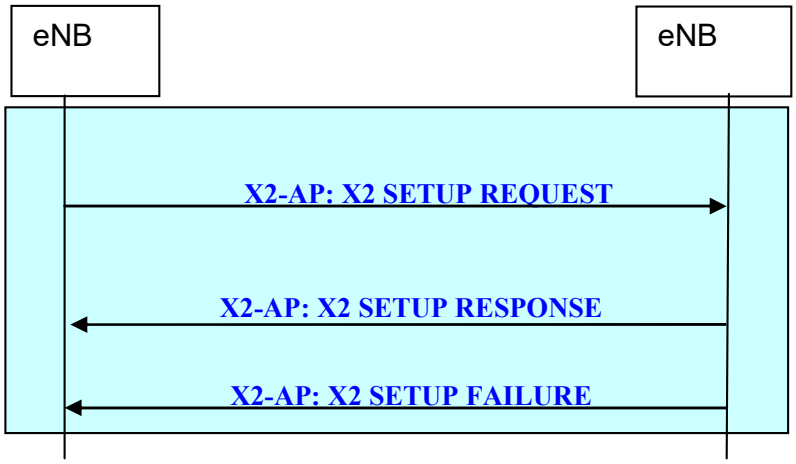


Figure 20.2.2.7-1: X2 Setup procedure

20.2.2.8 eNB Configuration Update procedure

The purpose of the eNB Configuration Update procedure is to update application level configuration data needed for two eNBs to interoperate correctly over the X2 interface.

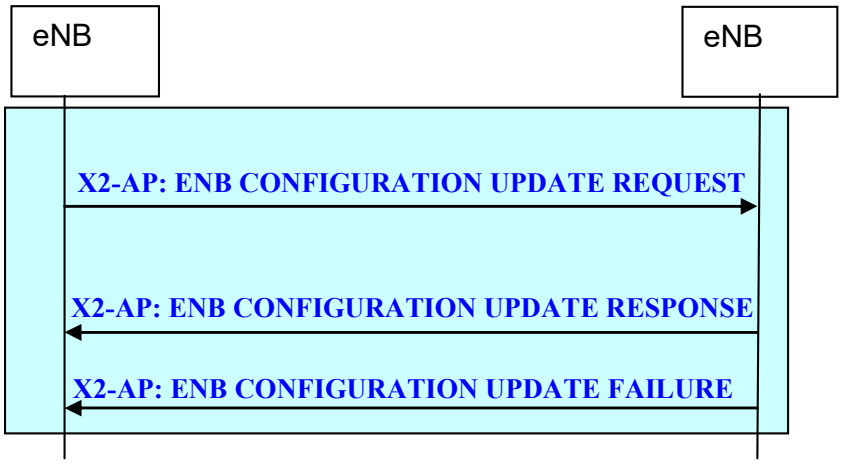


Figure 20.2.2.8-1: eNB Configuration Update procedure

20.2.2.9 Reset procedure

The Reset procedure is initiated by an eNB to align the resources with a peer eNB in the event of an abnormal failure. The procedure resets the whole X2 interface.

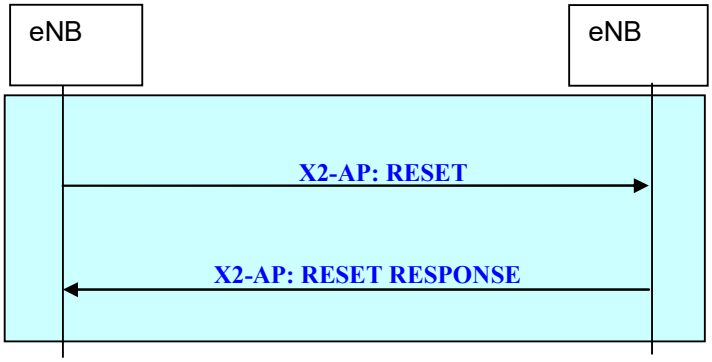


Figure 20.2.2.9-1: Reset procedure

20.2.2.10 Resource Status Reporting Initiation procedure

The Resource Status Reporting Initiation procedure is used by an eNB to request measurements from another eNB.

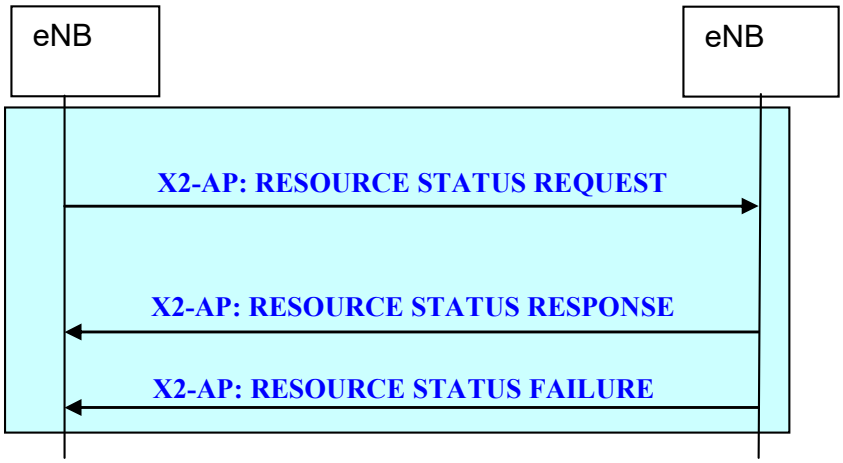


Figure 20.2.2.10-1: Resource Status Reporting Initiation procedure

20.2.2.11 Resource Status Reporting procedure

The Resource Status Reporting procedure reports measurement results requested by another eNB.

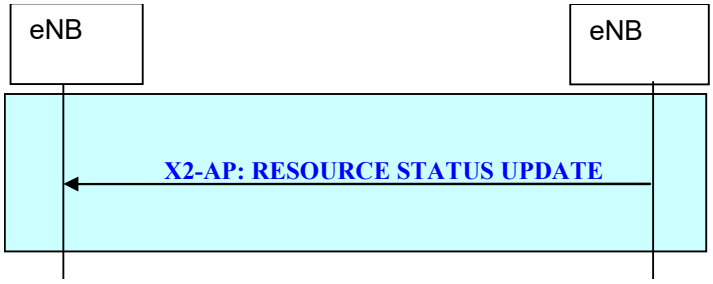


Figure 20.2.2.11-1: Resource Status Reporting procedure

20.2.2.12 Radio Link Failure Indication procedure

The purpose of the Radio Link Failure Indication procedure is to enable mobility robustness and radio link failure recovery improvement in E-UTRAN by passing information about a failure event over the X2 interface.

When a re-establishment request is received or a connection failure reported after RRC connection setup or an incoming successful handover, the eNB uses the cell identifiers provided by the UE to identify the potentially previous serving cell/eNB. The eNB that received the information about the failure sends a RLF INDICATION message to the concerned eNB(s). The previously serving eNB may then match the correct context, or use the information available in the RLF Report, if included in the RLF INDICATION message, to analyze the possible root cause of the failure. If the previous serving eNB matches the correct context, it may also trigger the Handover Preparation procedure towards the eNB that initiated the Radio Link Failure Indication procedure.

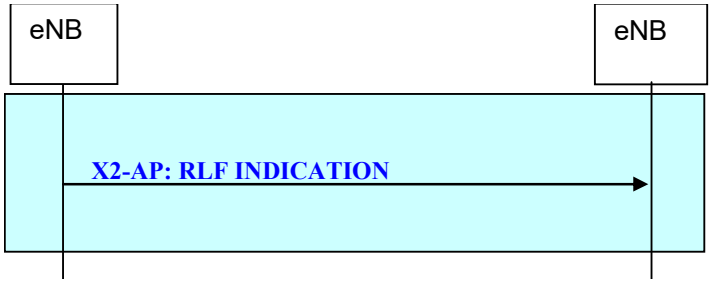


Figure 20.2.2.12-1: Radio Link Failure Indication procedure

20.2.2.13 Handover Report procedure

The purpose of the Handover Report procedure is to enable mobility robustness improvement in E-UTRAN.

The Handover Report procedure is used to pass information connected to the analysis of an RLF which occurred shortly after a successful handover.

The eNB where the RLF occurred (original target eNB) sends a HANDOVER REPORT message to the original source eNB, identifying the source cell, the target cell, and the cell where re-establishment took place.

The Handover Report procedure is also used to pass information connected to potential inter-RAT ping-pong cases. The eNB that detected the potential ping-pong cases sends a HANDOVER REPORT message to the source eNB of the first inter-RAT handover, identifying the source and the target cells of the first inter-RAT handover, and the target cell of the second inter-RAT handover.

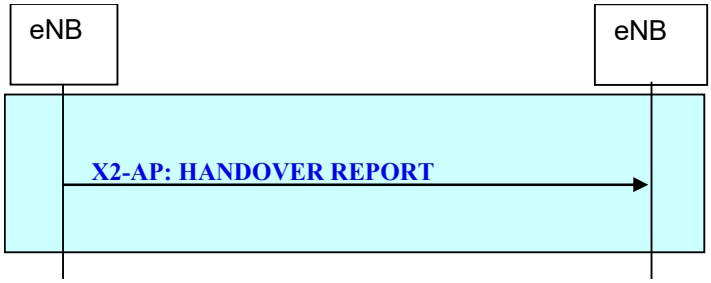


Figure 20.2.2.13-1: Handover Report procedure

20.2.2.14 Mobility Settings Change procedure

The purpose of the MOBILITY SETTINGS CHANGE procedure is to enable an eNB to send a MOBILITY CHANGE REQUEST message to a peer eNB to negotiate the handover trigger settings.

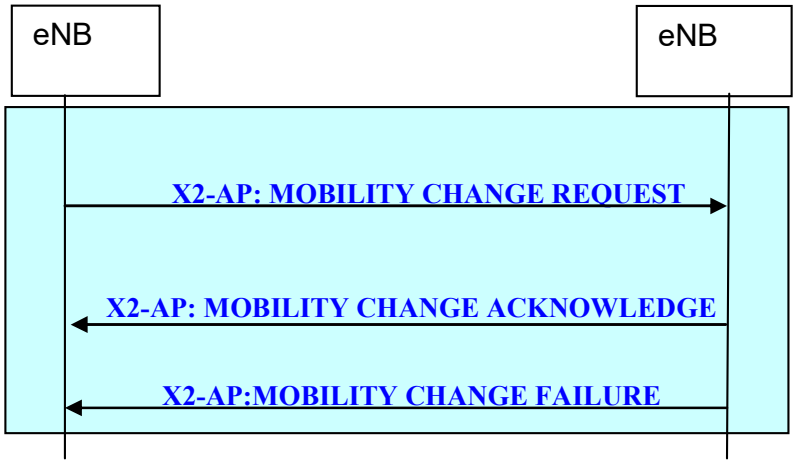


Figure 20.2.2.14-1: Mobility Settings Change procedure

20.2.2.15 Cell Activation procedure

The purpose of the Cell Activation procedure is to enable an eNB to send a CELL ACTIVATION REQUEST message to a peer eNB to request the re-activation of one or more cells, controlled by the peer eNB and which had been previously indicated as dormant.

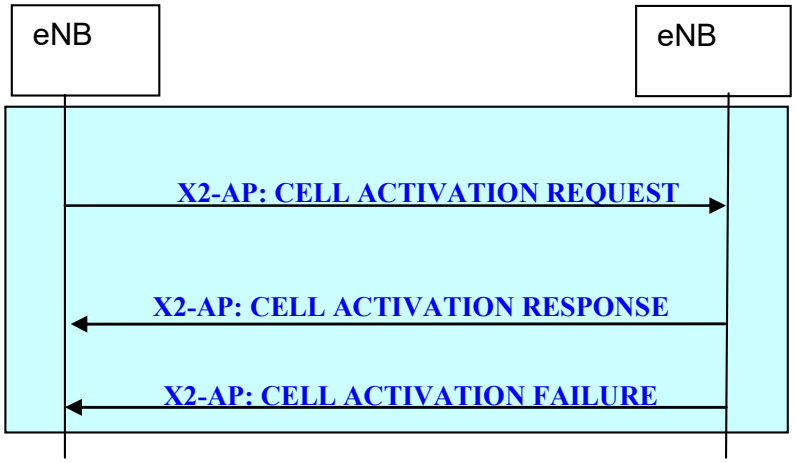


Figure 20.2.2.15-1: Cell Activation procedure

20.2.2.16 X2 Release procedure

The purpose of the X2 Release procedure is to enable an X2 GW to inform the relevant (H)eNBs that the signalling (i.e. SCTP) connection to a peer (H)eNB is unavailable.

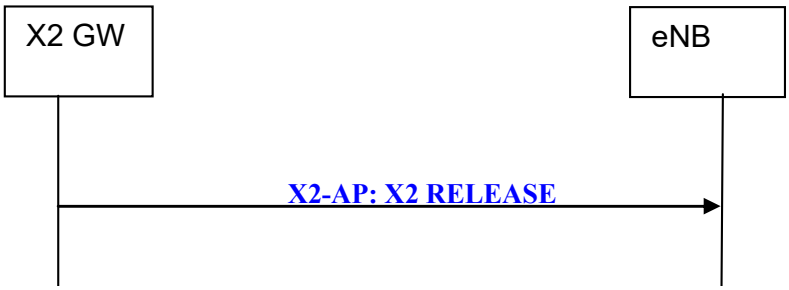


Figure 20.2.2.16-1: X2 Release procedure

20.2.2.17 X2AP Message Transfer procedure

The purpose of the X2AP Message Transfer procedure is to allow indirect transport of an X2AP message (except the X2AP MESSAGE TRANSFER message) between two (H)eNBs through an X2 GW, and to allow an (H)eNB to register with an X2 GW.

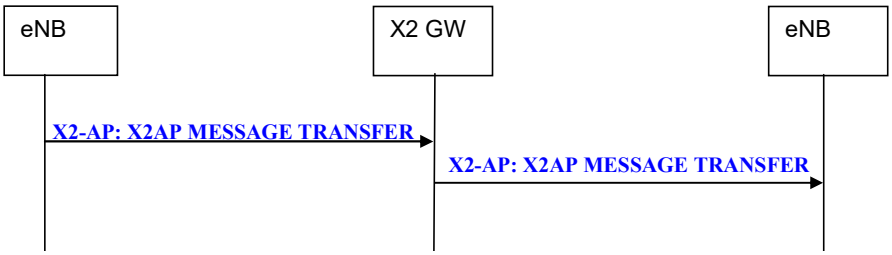


Figure 20.2.2.17-1: X2AP Message Transfer procedure

20.2.2.18 X2 Removal procedure

The purpose of the X2 Removal procedure is to perform the removal of X2 connectivity between two eNBs in a controlled manner. If the procedure is successful, the receiving eNB responds with the X2 REMOVAL RESPONSE message, after which both eNBs remove the X2 signalling connection between them and may release all associated resources. In case the receiving eNB cannot remove the X2 signalling connection (e.g. because of an ongoing procedure and/or due to local configuration), it responds with the X2 REMOVAL FAILURE message.

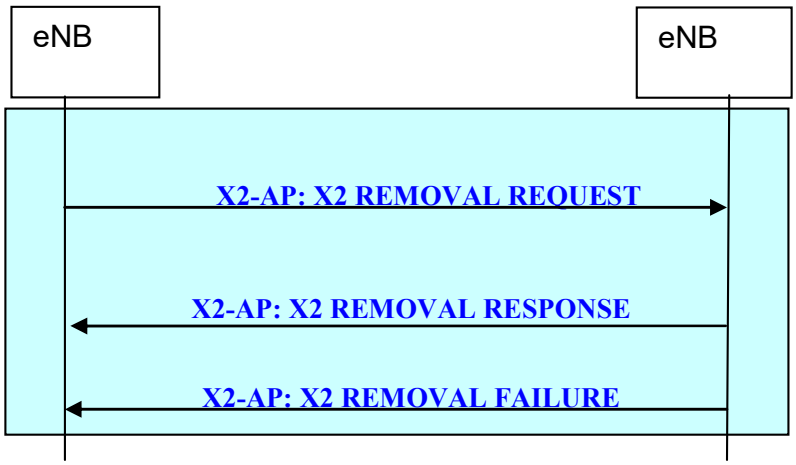


Figure 20.2.2.18-1: X2 Removal procedure

20.2.3 Void

21 Void

21.1 Void

21.2 Void

21.3 Void

22 Support for self-configuration and self-optimisation

22.1 Definitions

This concept includes several different functions from eNB activation to radio parameter tuning. Figure 22.1-1 is a basic framework for all self-configuration /self-optimization functions.

Self-configuration process is defined as the process where newly deployed nodes are configured by automatic installation procedures to get the necessary basic configuration for system operation.

This process works in pre-operational state. Pre-operational state is understood as the state from when the eNB is powered up and has backbone connectivity until the RF transmitter is switched on.

As described in Figure 21.1, functions handled in the pre-operational state like:

- Basic Setup; and
- Initial Radio Configuration.

are covered by the Self Configuration process.

Self-optimization process is defined as the process where UE & eNB measurements and performance measurements are used to auto-tune the network.

This process works in operational state. Operational state is understood as the state where the RF interface is additionally switched on.

As described in Figure 21.1, functions handled in the operational state like:

- Optimization / Adaptation

are covered by the Self Optimization process.

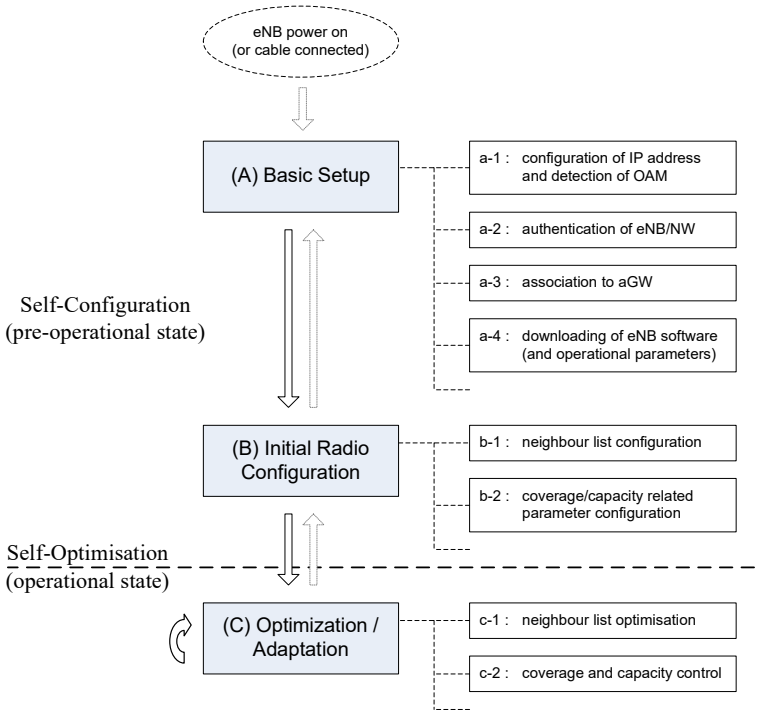


Figure 22.1-1: Ramifications of Self-Configuration /Self-Optimization functionality

22.2 UE Support for self-configuration and self-optimisation

UE shall support measurements and procedures which can be used for self-configuration and self-optimisation of the E-UTRAN system.

- UE shall support measurements and measurement reporting to support self-optimisation of the E-UTRAN system. Measurements and reports used for the normal system operation, should be used as input for the self-optimisation process as far as possible.
- The network is able to configure the measurements and the reporting for self-optimisation support by RRC signalling messages.

22.3 Self-configuration

22.3.1 Dynamic configuration of the S1-MME interface

22.3.1.1 Prerequisites

The following prerequisites are assumed:

- An initial remote IP end point to be used for SCTP initialisation is provided to the eNB for each MME. The eNB may be in pre-operational or operational state when this occurs.

How the eNB gets the remote IP end point(s) and its own IP address are outside the scope of this specification.

22.3.1.2 SCTP initialization

For each MME the eNodeB tries to initialize a SCTP association as described in IETF RFC 4960 [8], using a known initial remote IP Endpoint as the starting point, until SCTP connectivity is established.

22.3.1.3 Application layer initialization

Once SCTP connectivity has been established, the eNodeB and MME shall exchange application level configuration data over the S1-MME application protocol with the S1 Setup Procedure, which is needed for these two nodes to interwork correctly on the S1 interface.

- The eNodeB provides the relevant configuration information to the MME, which includes list of supported TA(s), etc.
- The MME provides the relevant configuration information to the eNodeB, which includes PLMN ID, etc.
- When the application layer initialization is successfully concluded, the dynamic configuration procedure is completed and the S1-MME interface is operational.

22.3.2 Dynamic Configuration of the X2 interface

22.3.2.1 Prerequisites

The following prerequisites are assumed:

- An initial remote IP end point to be used for SCTP initialisation is provided to the eNB.

22.3.2.2 SCTP initialization

For candidate eNB the eNB tries to initialize a SCTP association as described in IETF RFC 4960 [8], using a known initial remote IP Endpoint as the starting point, until SCTP connectivity is established.

22.3.2.3 Application layer initialization

Once SCTP connectivity has been established, the eNB and its candidate peer eNB are in a position to exchange application level configuration data over the X2 application protocol needed for the two nodes to interwork correctly on the X2 interface.

- The eNB provides the relevant configuration information to the candidate eNB, which includes served cell information, etc.
- The candidate eNB provides the relevant configuration information to the initiating eNB, which includes served cell information, etc.
- When the application layer initialization is successfully concluded, the dynamic configuration procedure is completed and the X2 interface is operational.
- eNBs shall keep neighbouring eNBs updated with the complete list of served cells while the X2 interface is operational.

22.3.2a Automatic Neighbour Relation Function

The purpose of the **Automatic Neighbour Relation** (ANR) function is to relieve the operator from the burden of manually managing Neighbour Relations (NRs). Figure 22.3.2a-1 shows ANR and its environment:

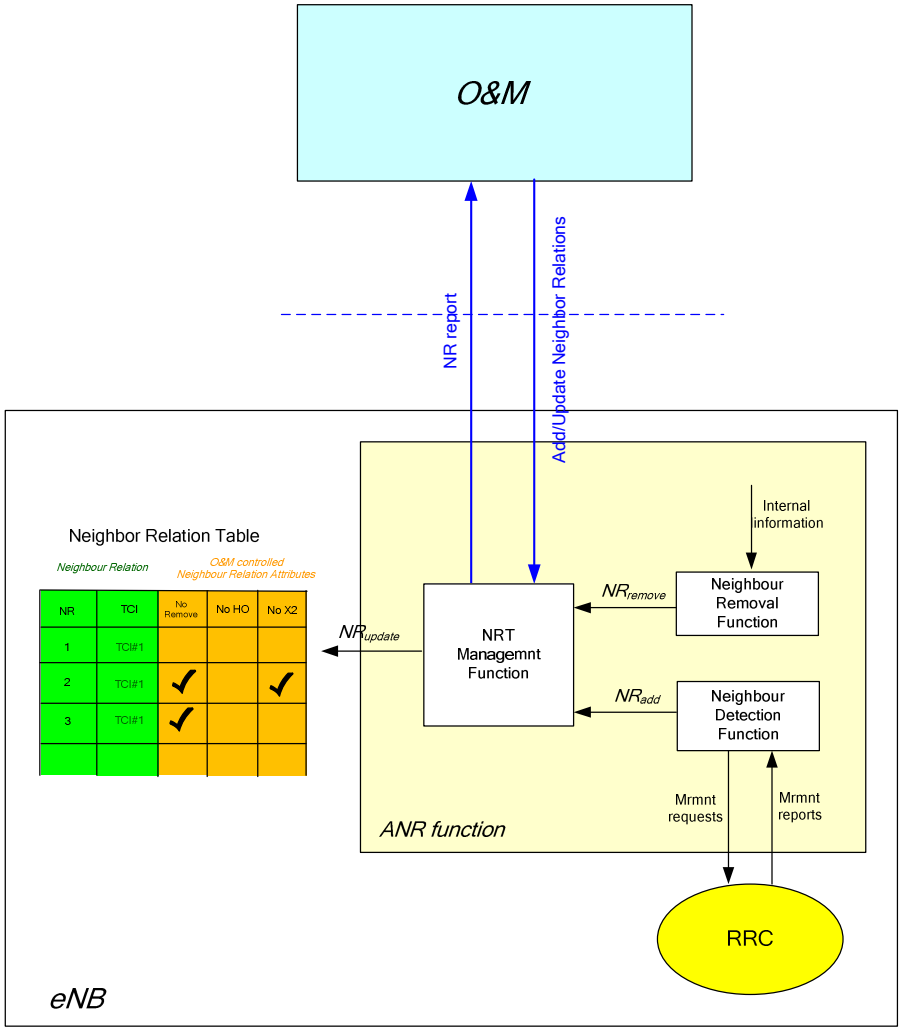


Figure 22.3.2a-1: Interaction between eNB and O&M due to ANR

The ANR function resides in the eNB and manages the conceptual Neighbour Relation Table (NRT). Located within ANR, the Neighbour Detection Function finds new neighbours and adds them to the NRT. ANR also contains the Neighbour Removal Function which removes outdated NRs. The Neighbour Detection Function and the Neighbour Removal Function are implementation specific.

A **Neighbour cell Relation** (NR) in the context of ANR is defined as follows:

An existing Neighbour Relation from a source cell to a target cell means that eNB controlling the source cell:

a) Knows the ECGI/CGI and PCI of the target cell.

b) Has an entry in the Neighbour Relation Table for the source cell identifying the target cell.

c) Has the attributes in this Neighbour Relation Table entry defined, either by O&M or set to default values.

For each cell that the eNB has, the eNB keeps a NRT, see Figure 22.3.2a-1. For each NR, the NRT contains the Target Cell Identifier (TCI), which identifies the target cell. For E-UTRAN, the TCI corresponds to the E-UTAN Cell Global Identifier (ECGI) and Physical Cell Identifier (PCI) of the target cell. Furthermore, each NR has three attributes, the NoRemove, the NoHO and the NoX2 attribute. These attributes have the following definitions:

- **No Remove**: If checked, the eNB shall not remove the Neighbour cell Relation from the NRT.

- **No HO**: If checked, the Neighbour cell Relation shall not be used by the eNB for handover reasons.
- **No X2:** If checked, the Neighbour Relation shall not use an X2 interface in order to initiate procedures towards the eNB parenting the target cell.

Neighbour cell Relations are cell-to-cell relations, while an X2 link is set up between two eNBs. Neighbour cell Relations are unidirectional, while an X2 link is bidirectional.

NOTE: The neighbour information exchange, which occurs during the X2 Setup procedure or in the eNB Configuration Update procedure, may be used for ANR purpose.

The ANR function also allows O&M to manage the NRT. O&M can add and delete NRs. It can also change the attributes of the NRT. The O&M system is informed about changes in the NRT.

22.3.3 Intra-LTE/frequency Automatic Neighbour Relation Function

The ANR (Automatic Neighbour Relation) function relies on cells broadcasting their identity on global level, E-UTRAN Cell Global Identifier (ECGI).

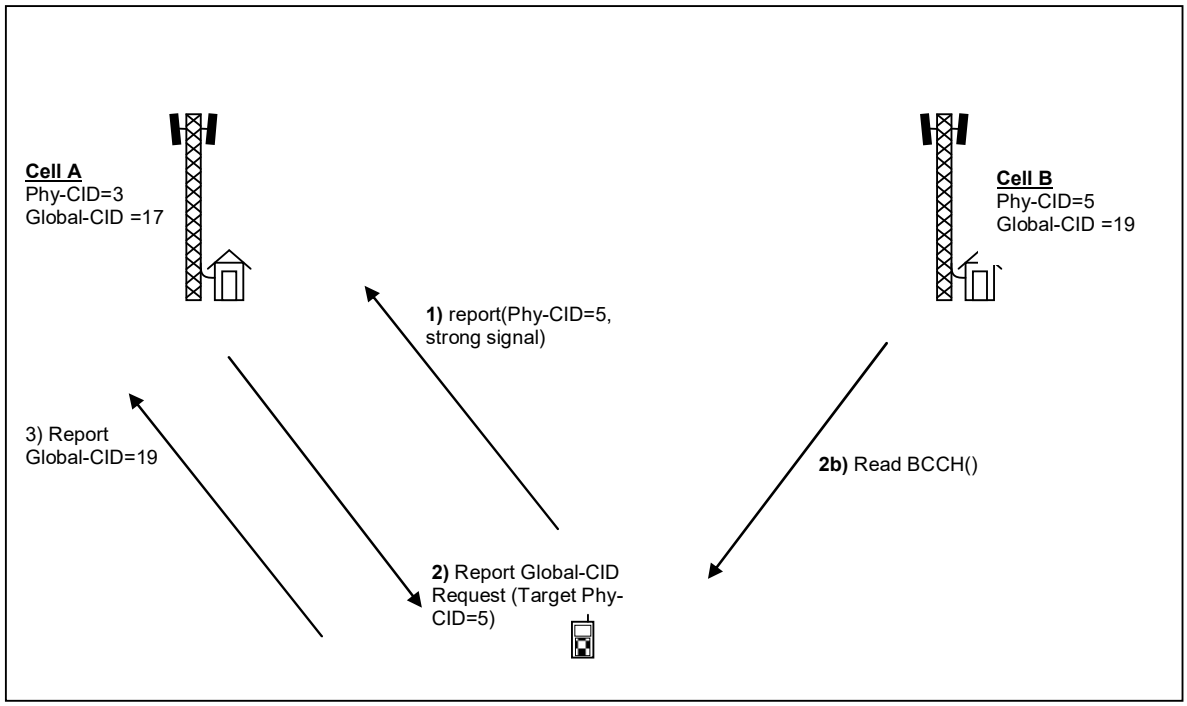


Figure 22.3.3-1: Automatic Neighbour Relation Function

The function works as follows:

The eNB serving cell A has an ANR function. As a part of the normal call procedure, the eNB instructs each UE to perform measurements on neighbour cells. The eNB may use different policies for instructing the UE to do measurements, and when to report them to the eNB. This measurement procedure is as specified in TS 36.331 [16].

1. The UE sends a measurement report regarding cell B. This report contains Cell B's PCI, but not its ECGI.

When the eNB receives a UE measurement report containing the PCI, the following sequence may be used.

2. The eNB instructs the UE, using the newly discovered PCI as parameter, to read the ECGI, the TAC and all available PLMN ID(s) of the related neighbour cell. To do so, the eNB may need to schedule appropriate idle periods to allow the UE to read the ECGI from the broadcast channel of the detected neighbour cell. How the UE reads the ECGI is specified in TS 36.331 [16].
3. When the UE has found out the new cell's ECGI, the UE reports the detected ECGI to the serving cell eNB. In addition the UE reports the tracking area code and all PLMN IDs that have been detected. If the detected cell is a CSG or hybrid cell, the UE also reports the CSG ID to the serving cell eNB.

4. The eNB decides to add this neighbour relation, and can use PCI and ECGI to:

   a Lookup a transport layer address to the new eNB.

   b Update the Neighbour Relation List.

   c If needed, setup a new X2 interface towards this eNB. The setup of the X2 interface is described in section 22.3.2.

NOTE: The eNB may differentiate the open access HeNB from the other types of (H)eNB by the PCI configuration or ECGI configuration.

22.3.4 Inter-RAT/Inter-frequency Automatic Neighbour Relation Function

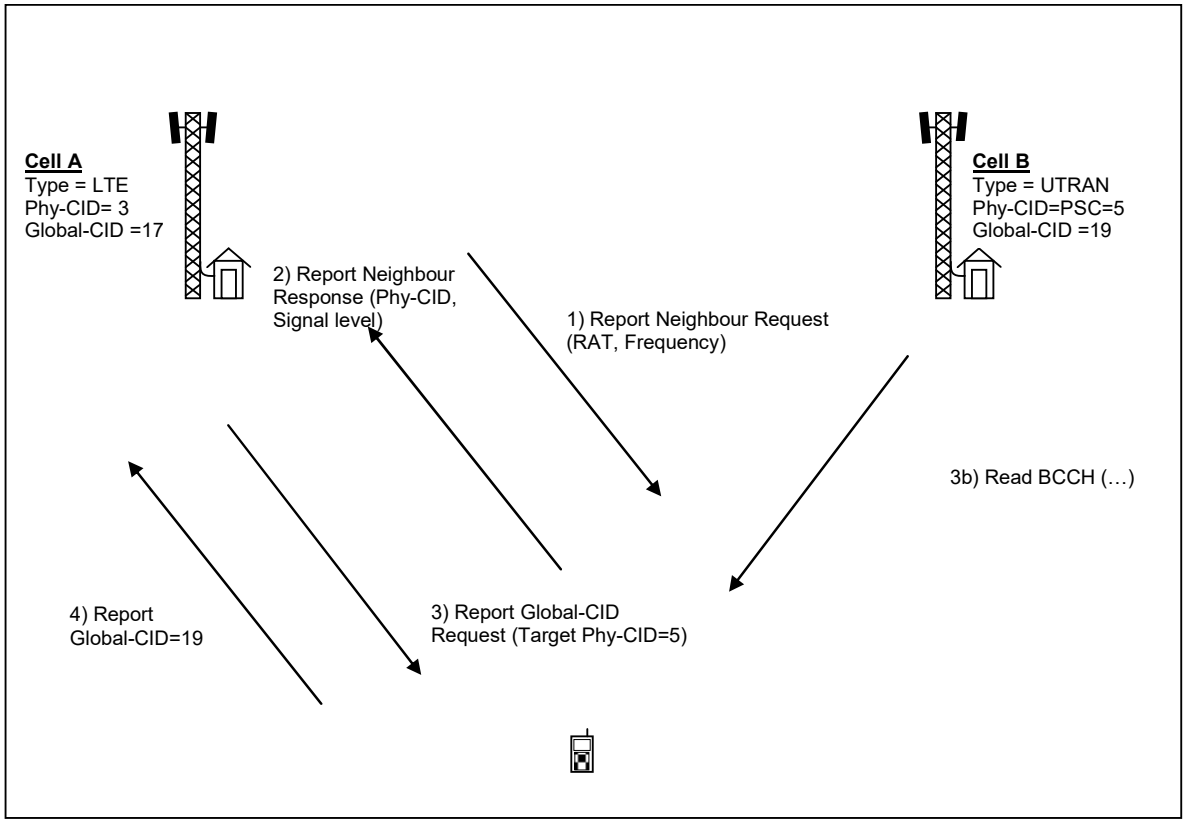


Figure 22.3.4-1: Automatic Neighbour Relation Function in case of UTRAN detected cell

For Inter-RAT and Inter-Frequency ANR, each cell contains an Inter Frequency Search list. This list contains all frequencies that shall be searched.

For Inter-RAT cells, the NoX2 attribute in the NRT is absent, as X2 is only defined for E-UTRAN.

The function works as follows:

The eNB serving cell A has an ANR function. During connected mode, the eNB can instruct a UE to perform measurements and detect cells on other RATs/frequencies. The eNB may use different policies for instructing the UE to do measurements, and when to report them to the eNB.

1 The eNB instructs a UE to look for neighbour cells in the target RATs/frequencies. To do so the eNB may need to schedule appropriate idle periods to allow the UE to scan all cells in the target RATs/frequencies.

2 The UE reports the PCI of the detected cells in the target RATs/frequencies. The PCI is defined by the carrier frequency and the Primary Scrambling Code (PSC) in case of UTRAN FDD cell, by the carrier frequency and the cell parameter ID in case of UTRAN TDD cell, by the Band Indicator + BSIC + BCCH ARFCN in case of GERAN cell and by the PN Offset in case of CDMA2000 cell.

When the eNB receives UE reports containing PCIs of cell(s) the following sequence may be used.

3 The eNB instructs the UE, using the newly discovered PCI as parameter, to read the CGI and the RAC of the detected neighbour cell in case of GERAN detected cells, CGI, LAC, RAC and all broadcasted PLMN-ID(s) in case of UTRAN detected cells and CGI in case of CDMA2000 detected cells. For the Interfrequency case, the eNB instructs the UE, using the newly discovered PCI as parameter, to read the ECGI, TAC and all available PLMN ID(s) of the inter-frequency detected cell. The UE ignores transmissions from the serving cell while finding the requested information transmitted in the broadcast channel of the detected inter-system/inter-frequency neighbour cell. To do so, the eNB may need to schedule appropriate idle periods to allow the UE to read the requested information from the broadcast channel of the detected inter-RAT/inter-frequency neighbour cell.

4 After the UE has read the requested information in the new cell, it reports the detected CGI and RAC (in case of GERAN detected cells) or CGI, LAC, RAC and all broadcasted PLMN-ID(s) (in case of UTRAN detected cells) or CGI (in case of CDMA2000 detected cells) to the serving cell eNB. In the inter-frequency case, the UE reports the ECGI, the, tracking area code and all PLMN-ID(s) that have been detected. If the detected cell is a CSG or hybrid cell, the UE also reports the CSG ID to the serving cell eNB.

5 The eNB updates its inter-RAT/inter-frequency Neighbour Relation Table.

In the inter-frequency case and if needed, the eNB can use the PCI and ECGI for a new X2 interface setup towards this eNB. The setup of the X2 interface is described in section 22.3.2.

NOTE: The eNB may differentiate the open access HeNB from the other types of (H)eNB by the PCI configuration or ECGI configuration.

22.3.5 Framework for PCI Selection

The eNB shall base the selection of its PCI either on a centralized or distributed PCI assignment algorithm:

[Centralized PCI assignment] The OAM signals a specific PCI value. The eNB shall select this value as its PCI.

[Distributed PCI assignment] The OAM signals a list of PCI values. The eNB may restrict this list by removing PCI-s that are:

a) reported by UEs;

b) reported over the X2 interface by neighbouring eNBs; and/or

c) acquired through other implementation dependent methods, e.g. heard over the air using a downlink receiver.

The eNB shall select a PCI value randomly from the remaining list of PCIs.

22.3.6 TNL address discovery

22.3.6.1 TNL address discovery of candidate eNB via S1 interface

If the eNB is aware of the eNB ID of the candidate eNB (e.g. via the ANR function) but not a TNL address suitable for SCTP connectivity, then the eNB can utilize the Configuration Transfer Function to determine the TNL address as follows:

- The eNB sends the eNB CONFIGURATION TRANSFER message to the MME to request the TNL address of the candidate eNB, and includes relevant information such as the source and target eNB ID.

- The MME relays the request by sending the MME CONFIGURATION TRANSFER message to the candidate eNB identified by the target eNB ID.

- The candidate eNB responds by sending the eNB CONFIGURATION TRANSFER message containing one or more TNL addresses to be used for SCTP connectivity with the initiating eNB, and includes other relevant information such as the source and target eNB ID.

- The MME relays the response by sending the MME CONFIGURATION TRANSFER message to the initiating eNB identified by the target eNB ID.

22.4 Self-optimisation

22.4.1 Support for Mobility Load Balancing

22.4.1.1 General

The objective of load balancing is to distribute cell load evenly among cells or to transfer part of the traffic from congested cells. This is done by the means of self-optimisation of mobility parameters or handover actions.

Self-optimisation of the intra-LTE and inter-RAT mobility parameters to the current load in the cell and in the adjacent cells can improve the system capacity compared to static/non-optimised cell reselection/handover parameters. Such optimisation can also minimize human intervention in the network management and optimization tasks.

Support for mobility load balancing consists of one or more of following functions:

- Load reporting;
- Load balancing action based on handovers;
- Adapting handover and/or reselection configuration.

Triggering of each of these functions is optional and depends on implementation. Functional architecture is presented in Figure 22.4.1.1-1.

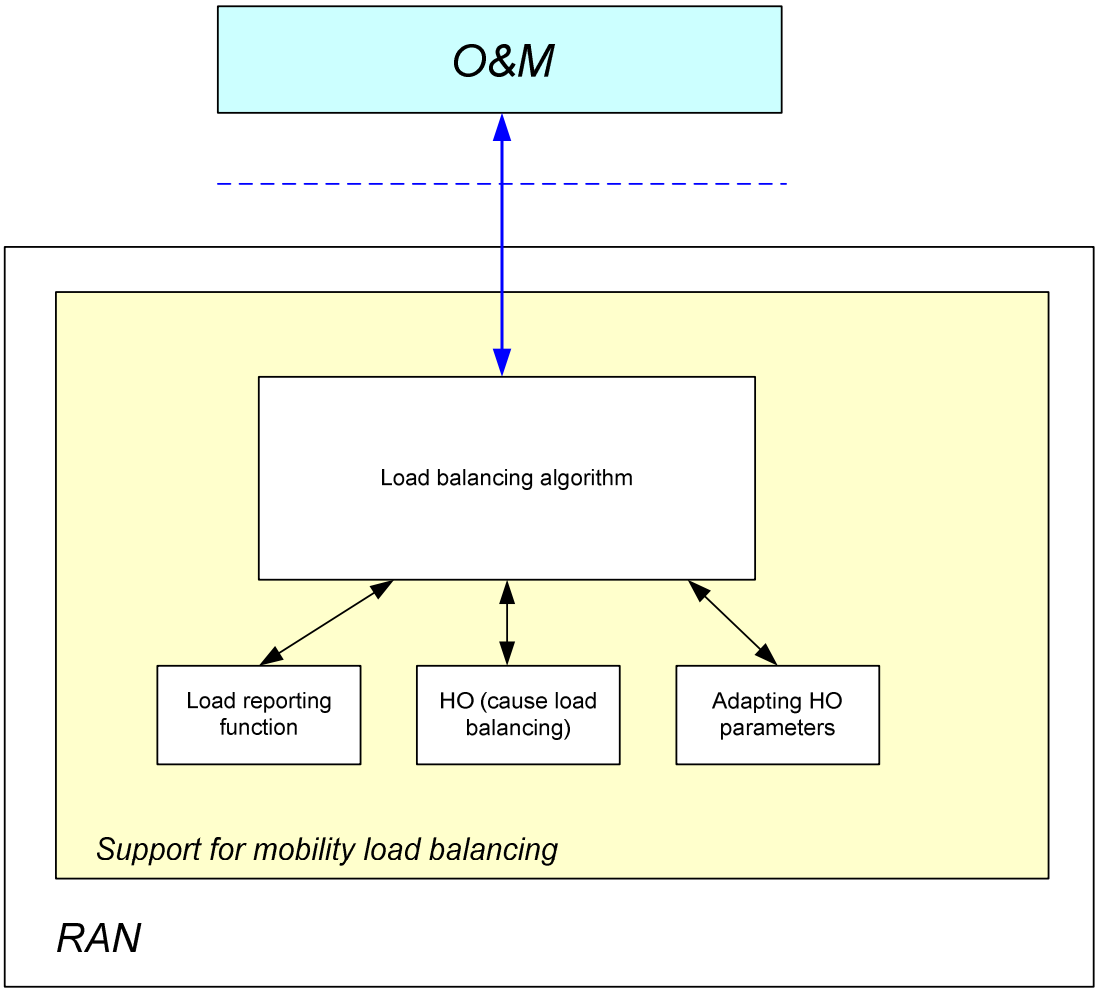


Figure 22.4.1.1-1: Functional architecture of SON load balancing

22.4.1.2 Load reporting

The load reporting function is executed by exchanging cell specific load information between neighbour eNBs over the X2 interface (intra-LTE scenario) or S1 (inter-RAT scenario).

22.4.1.2.1 Load reporting for intra-LTE scenario

The load information consists of:

- radio resource usage (UL/DL GBR PRB usage, UL/DL non-GBR PRB usage, UL/DL total PRB usage);
- HW load indicator (UL/DL HW load: low, mid, high, overload);
- TNL load indicator (UL/DL TNL load: low, mid, high, overload);
- (Optionally) Cell Capacity Class value (UL/DL relative capacity indicator: the same scale shall apply to E-UTRAN, UTRAN and GERAN cells when mapping cell capacities on this value);
- Capacity value (UL/DL available capacity for load balancing as percentage of total cell capacity).

NOTE 1: Capacity value is expressed in available E-UTRAN resources.

NOTE 2: A cell is expected to accept traffic corresponding to the indicated available capacity.

22.4.1.2.2 Load reporting for inter-RAT scenario

The load information consists of:

- Cell Capacity Class value (UL/DL relative capacity indicator: the same scale shall apply to E-UTRAN, UTRAN, GERAN and eHRPD cells when mapping cell capacities on this value);
- Capacity value (UL/DL available capacity for load balancing as percentage of total cell capacity).

NOTE 1: Capacity value is expressed in available E-UTRAN resources.

NOTE 2: A cell is expected to accept traffic corresponding to the indicated available capacity.

Event-triggered inter-RAT load reports are sent when the reporting node detects crossing of cell load thresholds.

Load information shall be provided in a procedure separated from existing active mode mobility procedures, which shall be used infrequently and with lower priority with respect to the UE dedicated signalling.

22.4.1.3 Load balancing action based on handovers

The source cell may initiate handover due to load (see sub-clauses 10.1.2 and 10.2.2). The target cell performs admission control for the load balancing handovers. A handover preparation related to a mobility load balancing action shall be distinguishable from other handovers, so that the target cell is able to apply appropriate admission control.

22.4.1.4 Adapting handover and/or reselection configuration

This function enables requesting of a change of handover and/or reselection parameters at target cell. The source cell that initialized the load balancing estimates if it is needed to change mobility configuration in the source and/or target cell. If the amendment is needed, the source cell initializes mobility negotiation procedure toward the target cell.

The source cell informs the target cell about the new mobility setting and provides cause for the change (e.g. load balancing related request). The proposed change is expressed by the means of the difference (delta) between the current and the new values of the handover trigger. The handover trigger is the cell specific offset that corresponds to the threshold at which a cell initialises the handover preparation procedure. Cell reselection configuration may be amended to reflect changes in the HO setting. The target cell responds to the information from the source cell. The allowed delta range for HO trigger parameter may be carried in the failure response message. The source cell should consider the responses before executing the planned change of its mobility setting.

All automatic changes on the HO and/or reselection parameters must be within the range allowed by OAM.

22.4.2 Support for Mobility Robustness Optimisation

22.4.2.1 General

Mobility Robustness Optimisation aims at detecting and enabling correction of following problems:

- Connection failure due to intra-LTE or inter-RAT mobility;
- Unnecessary HO to another RAT (too early IRAT HO with no radio link failure);
- Inter-RAT ping-pong.

22.4.2.2 Connection failure due to intra-LTE mobility

One of the functions of Mobility Robustness Optimization is to detect connection failures that occur due to Too Early or Too Late Handovers, or Handover to Wrong Cell. These problems are defined as follows:

- [Too Late Handover] An RLF occurs after the UE has stayed for a long period of time in the cell; the UE attempts to re-establish the radio link connection in a different cell.
- [Too Early Handover] An RLF occurs shortly after a successful handover from a source cell to a target cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in the source cell.
- [Handover to Wrong Cell] An RLF occurs shortly after a successful handover from a source cell to a target cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the target cell.

In the definition above, the "successful handover" refers to the UE state, namely the successful completion of the RA procedure.

In addition, MRO provides means to distinguish the above problems from LTE coverage related problems and other problems, not related to mobility.

Solution for failure scenarios consists of one or more of following functions:

- Detection of the failure after RRC re-establishment attempt;
- Detection of the failure after RRC connection setup;
- Retrieval of information needed for problem analysis.

Triggering of each of these functions is optional and depends on situation and implementation.

Detection of the failure after RRC re-establishment attempt:

Detection mechanisms for Too Late Handover, Too Early Handover and Handover to Wrong Cell are carried out through the following:

- [Too Late Handover]
  If the UE attempts to re-establish the radio link connection in a cell that belongs to eNB B, indicating as the last serving cell a cell belonging to eNB A, different from eNB B, then eNB B may report this event to eNB A by means of the RLF Indication Procedure. eNB A may then use information in the RLF INDICATION message to determine whether the failure occurred in the serving cell.
- [Too Early Handover]
  If the target cell belongs to an eNB B different from the eNB A that controls the source cell, the eNB B may send a HANDOVER REPORT message indicating a Too Early Handover event to eNB A upon eNB B receives an RLF INDICATION message from eNB A and if eNB B has sent the UE CONTEXT RELEASE message to eNB A related to the completion of an incoming handover for the same UE within the last Tstore_UE_cntxt seconds or there exists a prepared handover for the same UE in eNB B.
- [Handover to Wrong Cell]
  If the type of the failure is Radio Link Failure and the target cell belongs to eNB B that is different from the eNB A that controls the source cell, the eNB B may send a HANDOVER REPORT message indicating a Handover To Wrong Cell event to eNB A upon eNB B receives an RLF INDICATION message from eNB C, and if eNB

B has sent the UE CONTEXT RELEASE message to eNB A related to the completion of an incoming handover for the same UE within the last Tstore_UE_cntxt seconds or there exists a prepared handover for the same UE in eNB B. This also applies when eNB A and eNB C are the same. The HANDOVER REPORT message may also be sent if eNB B and eNB C are the same and the RLF Indication is internal to this eNB.
If the type of the failure is Handover Failure during a handover from a cell in eNB A, and the UE attempts to re-establish the radio link connection to a cell in eNB C, then eNB C may send a RLF INDICATION message to eNB A.

The detection of the above events, when involving more than one eNB, is enabled by the RLF Indication and Handover Report procedures.

The RLF Indication procedure may be initiated after a UE attempts to re-establish the radio link connection at eNB B after a failure at eNB A. The RLF INDICATION message sent from eNB B to eNB A shall contain the following information elements:

- Failure Cell ID: PCI of the cell in which the UE was connected prior to the failure occurred;
- Reestablishment Cell ID: ECGI of the cell where RL re-establishment attempt is made;
- C-RNTI: C-RNTI of the UE in the cell where UE was connected prior to the failure occurred;
- shortMAC-I (optionally): the 16 least significant bits of the MAC-I calculated using the security configuration of the source cell and the re-establishment cell identity;
- UE RLF Report Container (optionally): the RLF Report received from the UE, as specified in TS 36.331 [16];
- Reestablishment Cause (optionally): provided by the UE during the RRC connection re-establishment attempt.

eNB B may initiate RLF Indication towards multiple eNBs if they control cells which use the PCI signalled by the UE during the re-establishment procedure. The eNB A selects the UE context that matches the received Failure Cell ID and C-RNTI, and, if available, uses the shortMAC-I to confirm this identification, by calculating the shortMAC-I and comparing it to the received IE.

The Handover Report procedure is used in the case of recently completed handovers, when a failure occurs in the target cell (in eNB B) shortly after it sent the UE Context Release message to the source eNB A. The Handover Report procedure is also used when an RLF occurs before the UE Context Release message is sent, if the random access procedure in the target cell was completed successfully. The HANDOVER REPORT message contains the following information:

- Type of detected handover problem (Too Early Handover, Handover to Wrong Cell);
- ECGI of source and target cells in the handover;
- ECGI of the re-establishment cell (in the case of Handover to Wrong Cell);
- Handover cause (signalled by the source during handover preparation);
- C-RNTI allocated for the UE in the source cell (if available);
- Mobility Information (optionally);
- UE RLF Report (optionally): the RLF Report received from the UE and forwarded in the RLF INDICATION message.

UE may provide the RLF Report to the eNB after successful RRC re-establishment. The radio measurements contained in the RLF Report may be used e.g. to identify coverage issues as the potential cause of the failure. The cause for the RLF contained in the RLF Report may be used to identify the cause of the failure and exclude the events that are irrelevant for MRO evaluation.

Detection of the failure after RRC connection setup:

In case the RRC re-establishment fails or the UE does not perform any RRC re-establishment, the UE makes the RLF Report available to the eNB after reconnecting from idle mode. The RLF Report is described in section 22.4.5. Availability of the RLF Report at the RRC connection setup procedure is the indication that the UE suffered from a connection failure and that the RLF Report from this failure was not yet delivered to the network. The RLF Report from the UE includes the following information:

- The E-CGI of the last cell that served the UE (in case of RLF) or the target of the handover (in case of handover failure). If the E-CGI is not known, the PCI and frequency information are used instead.
- E-CGI of the cell that the re-establishment attempt was made at.
- E-CGI of the cell that served the UE at the last handover initialisation, i.e. when message 7 (*RRCConnectionReconfiguration*) was received by the UE, as presented in Figure 10.1.2.1.1-1.
- Time elapsed since the last handover initialisation until connection failure.
- An indication whether the connection failure was due to RLF or handover failure.
- The radio measurements.
- C-RNTI allocated for the UE in the last serving cell.
- RLF trigger of the last RLF that was detected.
- Time elapsed from the connection failure till RLF Report signalling.

The eNB receiving the RLF Report from the UE may forward the report to the eNB that served the UE before the reported connection failure using the RLF INDICATION message. The radio measurements contained in the RLF Report may be used e.g. to identify coverage issues as the potential cause of the failure. The cause for the RLF contained in the RLF Report may be used to identify the cause of the failure and exclude the irrelevant events that are irrelevant for MRO evaluation.

Detection of Too Late Handover, Too Early Handover and Handover to Wrong Cell is carried out through the following:

- [Too Late Handover]
  There is no recent handover for the UE prior to the connection failure i.e. the UE reported timer is absent or larger than the configured threshold, e.g. Tstore_UE_cntxt.
- [Too Early Handover]
  There is a recent handover for the UE prior to the connection failure i.e. the UE reported timer is smaller than the configured threshold, e.g. Tstore_UE_cntxt, and the first re-establishment attempt cell is the cell that served the UE at the last handover initialisation.
- [Handover to Wrong Cell]
  There is a recent handover for the UE prior to the connection failure i.e. the UE reported timer is smaller than the configured threshold, e.g. Tstore_UE_cntxt, and the first re-establishment attempt cell is neither the cell that served the UE at the last handover initialisation nor the cell that served the UE where the RLF happened or the cell that the handover was initialised toward.

The "UE reported timer" above indicates the time elapsed since the last handover initialisation until connection failure.

In case of Too Early Handover or Handover to Wrong Cell, the eNB receiving the RLF INDICATION message may use the HANDOVER REPORT message to inform the eNB controlling the cell where the mobility configuration caused the failure.

Retrieval of information needed for problem analysis

The information needed for detailed problem analysis may be retrieved from both, the UE and the network sides. The information that is collected at the UE is provided to the network with the RLF Report, which may be forwarded to the last serving node in the RLF INDICATION message and, in case of "Too Early HO" or "HO to Wrong Cell", further in the HANDOVER REPORT message.

In order to retrieve relevant information collected at the network side as part of the UE context, the UE provides C-RNTI used in the last serving cell. If the cause for the failure is identified as a "Too Early HO" or a "HO to Wrong Cell", the eNB controlling the last serving cell shall, if supported, include in the HANDOVER REPORT message the C-RNTI used in the source cell of the last completed handover before the failure. If the eNB controlling that source cell provided the Mobility Information, it is included in the HANDOVER REPORT message. If used, the Mobility Information is prepared at the source eNB of a handover and may refer to or identify any handover-related data at this eNB.

Handling multiple reports from a single failure event

In case the RRC re-establishment fails and the RRC connection setup succeeds, MRO evaluation of intra-LTE mobility connection failures may be triggered twice for the same failure event. In this case, only one failure event should be counted.

22.4.2.2a Connection failure due to inter-RAT mobility

One of the functions of Mobility Robustness Optimization is to detect connection failures that occurred due to Too Early or Too Late inter-RAT handovers. These problems are defined as follows:

- [Too Late Inter-RAT Handover] An RLF occurs after the UE has stayed in an E-UTRAN cell for a long period of time; the UE attempts to re-connect to a UTRAN cell.

- [Too Early Inter-RAT Handover] An RLF occurs shortly after a successful handover from a UTRAN cell to a target cell in E-UTRAN; the UE attempts to re-connect to the source cell or to another UTRAN cell.

The UE makes the RLF Report available to an eNB, when RLF happens in E-UTRAN and the UE re-connects to an eNB cell. Availability of the RLF Report at the RRC connection setup or at a handover to E-UTRAN cell is the indication that the UE suffered a connection failure and that the RLF Report from this failure was not yet delivered to the network.

The eNB receiving the RLF Report from the UE may forward the report to the eNB that served the UE before the reported connection failure using the RLF INDICATION message over X2 or by means of the eNB configuration transfer procedure and MME configuration transfer procedure over S1. If present in the RLF Report, the radio measurements may be used to identify lack of coverage as the potential cause of the failure. This information may be used to exclude those events from the MRO evaluation and redirect them as input to other algorithms.

Detection mechanisms for Too Late Inter-RAT Handover and Too Early Inter-RAT Handover are carried out through the following:

- [Too Late Inter-RAT Handover]
  The connection failure occurs while being connected to an LTE cell, and there is no recent handover for the UE prior to the connection failure i.e., the UE reported timer is absent or larger than the configured threshold, e.g., Tstore_UE_cntxt, and the first cell where the UE attempts to re-connect is a UTRAN cell.

- [Too Early Inter-RAT Handover]
  The connection failure occurs while being connected to an LTE cell, and there is a recent inter-RAT handover for the UE prior to the connection failure i.e., the UE reported timer is smaller than the configured threshold, e.g., Tstore_UE_cntxt, and the first cell where the UE attempts to re-connect and the cell that served the UE at the last handover initialisation are both UTRAN cells.

The "UE reported timer" above indicates the time elapsed since the last handover initialisation until connection failure.

In case the failure is a Too Early Inter-RAT Handover, the eNB receiving the RLF INDICATION message may inform the UTRAN node by means of the eNB Direct Information Transfer procedure over S1. The information contains:

- Type of detected handover problem (Too Early Inter-RAT Handover);

- UE RLF Report Container: the RLF Report received from the UE, as specified in TS 36.331 [16];

- Mobility Information (optionally, if provided in the last Handover Resource Allocation procedure from the UTRAN node);

22.4.2.3 Unnecessary HO to another RAT

One of the purposes of inter-RAT Mobility Robustness Optimisation is the detection of a non-optimal use of network resources. In particular, in case of inter-RAT operations and when E-UTRAN is considered, the case known as Unnecessary HO to another RAT is identified. The problem is defined as follows:

- UE is handed over from E-UTRAN to other RAT (e.g. GERAN or UTRAN) even though quality of the E-UTRAN coverage was sufficient for the service used by the UE. The handover may therefore be considered as unnecessary HO to another RAT (too early IRAT HO without connection failure).

In inter-RAT HO, if the serving cell threshold (E-UTRAN) is set too high, and another RAT with good signal strength is available, a handover to another RAT (e.g. UTRAN or GERAN) may be triggered unnecessarily, resulting in an inefficient use of the networks. With a lower threshold the UE could have continued in the source RAT (E-UTRAN).

To be able to detect the Unnecessary HO to another RAT, an eNB may choose to put additional coverage and quality condition information into the HANDOVER REQUIRED message in the Handover Preparation procedure when an inter-RAT HO from E-UTRAN to another RAT occurs. The RAN node in the other RAT, upon receiving this additional coverage and quality information, may instruct the UE to continue measuring the source RAT (E-UTRAN) during a period of time, while being connected to another RAT (e.g. UTRAN or GERAN), and send periodic or single measurement reports to the other RAT (e.g. UTRAN or GERAN). When the period of time indicated by the source RAT (E-UTRAN) expires, the RAN node in the other RAT (e.g. UTRAN or GERAN), may evaluate the received measurement reports with the coverage/quality condition received during the inter-RAT HO procedure and decide if an inter-RAT unnecessary HO report should be sent to the RAN node in the source RAT (E-UTRAN). The inter-RAT unnecessary HO report should include the following information:

- Handover type (LTE to UTRAN, LTE to GERAN);
- Type of detected handover problem (Unnecessary HO to another RAT);
- ECGI of the source cell in the handover;
- Cell ID of the target cell;
- A list of cells whose radio quality, as reported in the UE's first measurement report following the handover, exceeds the threshold indicated in the additional coverage and quality information in the Handover Preparation procedure.

The inter-RAT unnecessary HO report shall only be sent in cases where, in all UE measurement reports collected during the measurement period, any source RAT cells exceed the radio coverage and/or quality threshold (the radio threshold RSRP or/and RSRQ and the measurement period are indicated in the additional coverage and quality information in the Handover Preparation procedure). If an inter-RAT handover towards LTE is executed from RNC within the indicated measurement period, the measurement period expires. In this case, the RNC may also send the HO Report. No HO Report shall be sent in case no E-UTRAN cell could be included, or if the indicated period of time is interrupted by an inter-RAT handover to a RAT different than LTE or by an intra-UMTS handover with SRNC relocation or inter-BSS handover.

The RAN node in the source RAT (E-UTRAN) upon receiving of the report, can decide if/how its parameters (e.g., threshold to trigger IRAT HO) should be adjusted.

22.4.2.4 O&M Requirements

All automatic changes of the HO and/or reselection parameters for mobility robustness optimisation shall be within the range allowed by OAM.

The following control parameters shall be provided by OAM to control MRO behaviour:

- Maximum deviation of Handover Trigger
  This parameter defines the maximum allowed absolute deviation of the Handover Trigger (as defined in 22.4.1.4), from the default point of operation defined by the parameter values assigned by OAM.
- Minimum time between Handover Trigger changes
  This parameter defines the minimum allowed time interval between two Handover Trigger change performed by MRO. This is used to control the stability and convergence of the algorithm.

Furthermore, in order to support the solutions for detection of Too Late and Too Early HO, the parameter Tstore_UE_cntxt shall be configurable by the OAM system.

22.4.2.5 Inter-RAT ping-pong

One of the functions of Mobility Robustness Optimization is to detect ping-pongs that occur in inter-RAT environment. The problem is defined as follows:

- A UE is handed over from a cell in a source RAT (e.g. E-UTRAN) to a cell in a target RAT different from the source RAT (e.g. UTRAN), then within a predefined limited time the UE is handed over back to a cell in the source RAT, while the coverage of the source RAT was sufficient for the service used by the UE. The event may occur more than once.

The solution for the problem may consist of the following steps:

1) Statistics regarding inter-RAT ping-pong occurrences are collected by the responsible node.

2) Coverage verification is performed to check if the mobility to other RAT was inevitable.

The statistics regarding ping-pong occurrence may be based on evaluation of the *UE History Information* IE in the HANDOVER REQUIRED message. If the evaluation indicates a potential ping-pong case and the source eNB of the 1st inter-RAT handover is different than the target eNB of the 2nd inter-RAT handover, the target eNB may use the HANDOVER REPORT message to indicate the occurrence of potential ping-pong cases to the source eNB. The HANDOVER REPORT message for ping-pong indication contains the following information:

- Type of detected handover problem (InterRAT ping-pong);
- ECGI of the source cell in the handover from E-UTRAN to UTRAN;
- ECGI of the target in the handover from UTRAN to E-UTRAN;
- Cell Identifier of the target UTRAN cell in the first inter-RAT handover;
- Cause of the first handover (signalled by the source during handover preparation).

If E-UTRAN coverage during the potential ping-pong event needs to be verified for the purpose of determining corrective measures, the Unnecessary HO to another RAT procedure may be used

22.4.3 Support for RACH Optimisation

The setting of RACH parameters that can be optimized are:

- RACH configuration (resource unit allocation);
- RACH preamble split (among dedicated, group A, group B);
- RACH backoff parameter value;
- RACH transmission power control parameters.

RACH optimization is supported by UE reported information and by PRACH parameters exchange between eNBs.

UEs which receive polling signalling shall report the below information:

- Number of RACH preambles sent until the successful RACH completion;
- Contention resolution failure.

22.4.4 Support for Energy Saving

22.4.4.1 General

The aim of this function is to reduce operational expenses through energy savings.

The function allows, for example in a deployment where capacity boosters can be distinguished from cells providing basic coverage, to optimize energy consumption enabling the possibility for a E-UTRAN cell providing additional capacity, to be switched off when its capacity is no longer needed and to be re-activated on a need basis. The basic coverage may be provided by E-UTRAN, UTRAN or GERAN cells.

22.4.4.2 Solution description

The solution builds upon the possibility for the eNB owning a capacity booster cell to autonomously decide to switch-off such cell to lower energy consumption (dormant state). The decision is typically based on cell load information, consistently with configured information. The switch-off decision may also be taken by O&M.

The eNB may initiate handover actions in order to off-load the cell being switched off and may indicate the reason for handover with an appropriate cause value to support the target node in taking subsequent actions, e.g. when selecting the target cell for subsequent handovers.

All peer eNBs are informed by the eNB owning the concerned cell about the switch-off actions over the X2 interface, by means of the eNB Configuration Update procedure. The eNB indicates the switch-off action to a GERAN and/or UTRAN node by means of the eNB Direct Information Transfer procedure over S1.

All informed nodes maintain the cell configuration data, e.g., neighbour relationship configuration, also when a certain cell is dormant. If basic coverage is ensured by E-UTRAN cells, eNBs owning non-capacity boosting cells may request a re-activation over the X2 interface if capacity needs in such cells demand to do so. This is achieved via the Cell Activation procedure. If basic coverage is ensured by UTRAN or GERAN cells, the eNB owning the capacity booster cell may receive a re-activation request from a GERAN or UTRAN node by means of the MME Direct Information Transfer procedure over S1. The eNB owning the capacity booster cell may also receive from the sending GERAN or UTRAN node the minimum time before that cell switches off; during this time, the same eNB may prevent idle mode UEs from camping on the cell and may prevent incoming handovers to the same cell.

The eNB owning the dormant cell should normally obey a request. The switch-on decision may also be taken by O&M. All peer eNBs are informed by the eNB owning the concerned cell about the re-activation by an indication on the X2 interface. The eNB indicates the re-activation action to a GERAN and/or UTRAN node by means of the eNB Direct Information Transfer procedure over S1. The eNB owning the concerned cell may choose to delay or not to send indication(s) if the sending GERAN or UTRAN node has included the minimum activation time in the re-activation request.

22.4.4.3 O&M requirements

Operators should be able to configure the energy saving function.

The configured information should include:

- The ability of an eNB to perform autonomous cell switch-off.
- The ability of an eNB to request the re-activation of a configured list of dormant cells owned by a peer eNB.

O&M may also configure

- policies used by the eNB for cell switch-off decision.
- policies used by peer eNBs for requesting the re-activation of a dormant cell.

22.4.5 Radio Link Failure report

The RLF Report from the UE can be used for both coverage optimization and mobility robustness optimization.

The UE stores the latest RLF or handover failure related information, and indicates RLF report availability at each subsequent LTE RRC connection (re-)establishment and handover to an LTE cell until the RLF report is fetched by the network or for 48 hours after the RLF or handover failure is detected.

The UE keeps the information during state transitions and RAT changes, and indicates RLF report availability again after it returns to the LTE RAT.

The UE only indicates RLF report availability and only provides the RLF report to the network if the current RPLMN is a PLMN that was present in the UE's EPLMN List or was the RPLMN at the time the RLF or handover failure was detected.

22.5 Void

22.6 Void

23 Others

23.1 Support for real time IMS services

23.1.1 IMS Emergency Call

IMS emergency calls are supported in this release of the specification and UE may initiate an IMS emergency call on the PS domain if the network supports it. IMS Emergency call support indication is provided to inform the UE that emergency bearer services are supported. This is sent via NAS messaging for normal service mode UE and via a BCCH indicator for limited service mode UE TS 23.401 [17]. The BCCH indicator is set to 'support' if any of the MMEs in a non-shared environment or one of PLMNs in a shared network environment supports IMS emergency bearer services.

If at the time of an IMS emergency call origination, the UE is already RRC connected to a CN that does not support IMS emergency calls, it should autonomously release the RRC connection and originate a fresh RRC connection in a cell that is capable of handling emergency calls. Call admission control for IMS emergency call is based on bearer QoS (e.g. the ARP).

Security procedures are activated for emergency calls. For UE in limited service mode and the UE is not authenticated (as defined in TS 33.401 Section 15.2.2 [22]), 'NULL' algorithms for ciphering and integrity protection are used and the related keys are set to specified value and may be ignored by the receiving node. During handover from cell in non-restricted area to restricted area, security is handled normally with normal key derivation etc. for both the intra-LTE and inter-RAT handover. For inter-RAT handover from LTE, if 'NULL' Integrity Protection algorithms are used in LTE, security is stopped after the handover. For inter-RAT handover to LTE, security is activated after the handover with 'NULL' algorithms if security is not activated in the source RAT.

23.2 Subscriber and equipment trace

Support for subscriber and equipment trace for E-UTRAN and EPC shall be as specified in TS 32.421 [29], TS 32.422 [30] and TS 32.423 [31].

23.2.1 Signalling activation

All traces are initiated by the core network, even if the trace shall be carried out in the radio network.

If the eNB has received an UE CONTEXT RELEASE COMMAND message where the UE is associated to an E-UTRAN Trace Id then the eNB shall terminate the on-going Trace.

The following functionality is needed on the S1 and X2 interface:

- Support for inclusion of subscriber and equipment trace information in INITIAL CONTEXT SETUP REQUEST message over the S1 interface.
- Support for an explicit TRACE START message over the S1 interface.
- Support for inclusion of subscriber and equipment trace information in the HANDOVER REQUEST message over the X2 interface.
- Support for inclusion of subscriber and equipment trace information in the HANDOVER REQUEST message over the S1 interface.
- Support for TRACE FAILURE INDICATION for the purpose of informing MME that the requested trace action cannot be performed due to an on-going handover preparation over the X2 interface.

A trace setup in the radio network will be propagated at handover. If the eNB receives trace information for a given UE, and a handover preparation is not already ongoing for the same UE, it shall store the trace information and propagate it to the target eNB in the case of a X2 based HO. In the case of S1 based HO, the propagation is handled by the MME.

23.2.2 Management activation

All conditions for Cell Traffic Trace are defined by the O&M. When the condition to start the trace recording is fulfilled the eNB will allocate a Trace Recording Session Reference and send it together with the Trace Reference to the MME in a CELL TRAFFIC TRACE message over the S1 interface.

Cell Traffic trace actions will not be propagated on the X2 interface or on the S1 interface in case of handover.

23.3 E-UTRAN Support for Warning Systems

The E-UTRAN provides support for warning systems through means of system information broadcast capability. The E-UTRAN performs scheduling and broadcasting of the "warning message content" received from the CBC, which is forwarded to the E-UTRAN by the MME. The schedule information for the broadcast is received along with the "warning message content" from the CBC. The E-UTRAN is also responsible for paging the UE to provide indication that the warning notification is being broadcast. The "warning message content" received by the E-UTRAN contains an instance of the warning notification. Depending on the size, E-UTRAN may segment the secondary notification before sending it over the radio interface.

23.3.1 Earthquake and Tsunami Warning System

ETWS is a public warning system developed to meet the regulatory requirements for warning notifications related to earthquake and/or tsunami events. ETWS warning notifications can either be a primary notification (short notifications delivered within 4 seconds, see TS 25.346 [32]) or secondary notification (providing detailed information). The ETWS primary notification is broadcast in *SystemInformationBlockType10* while the secondary notification is broadcast in *SystemInformationBlockType11*.

23.3.2 Commercial Mobile Alert System

CMAS is a public warning system developed for the delivery of multiple, concurrent warning notifications (see TS 22.268 [34]). The CMAS warning notifications are short text messages (CMAS alerts). The CMAS warning notifications are broadcast in *SystemInformationBlockType12*. The E-UTRAN manages the delivery of multiple, concurrent CMAS warning notifications to the UE and is also responsible for handling any updates of CMAS warning notifications.

23.3.3 Korean Public Alert System

KPAS is a Korean public warning system developed for the delivery of multiple, concurrent warning notifications (see TS 22.268 [34]). The Korean Public Alarm System (KPAS) uses the same AS mechanisms as CMAS. Therefore, the E-UTRAN procedures defined for CMAS equally apply for KPAS.

23.3.4 EU-Alert

The European Union Warning System EU-Alert is a public warning system developed for the delivery of multiple, concurrent warning notifications (see TS 22.268 [34]). The EU-Alert warning system uses the same AS mechanisms as CMAS. Therefore, the E-UTRAN procedures defined for CMAS equally apply for EU-Alert.

23.4 Interference avoidance for in-device coexistence

23.4.1 Problems

In order to allow users to access various networks and services ubiquitously, an increasing number of UEs are equipped with multiple radio transceivers. For example, a UE may be equipped with LTE, WiFi, and Bluetooth transceivers, and GNSS receivers. Due to extreme proximity of multiple radio transceivers within the same UE operating on adjacent frequencies or sub-harmonic frequencies, the interference power coming from a transmitter of the collocated radio may be much higher than the actual received power level of the desired signal for a receiver. This situation causes In-Device Coexistence (IDC) interference and is referred to as IDC problems. The challenge lies in avoiding or minimizing IDC interference between those collocated radio transceivers, as current state-of-the-art filter technology might not provide sufficient rejection for certain scenarios (see 3GPP TR 36.816 [50]).

23.4.2 Solutions

When a UE experiences IDC problems that it cannot solve by itself and a network intervention is required, it sends an IDC indication via dedicated RRC signalling to report the IDC problems to the eNB. The UE may rely on existing LTE measurements and/or UE internal coordination to assess the interference and the details are left up to UE implementation.

NOTE: For instance, the interference is applicable over several subframes/slots where not necessarily all the subframes/slots are affected and consists of interference caused by the aggressor radio to the victim radio during either active data exchange or upcoming data activity which is expected in up to a few hundred milliseconds.

A UE that supports IDC functionality indicates this capability to the network, and the network can then configure by dedicated signalling whether the UE is allowed to send an IDC indication. The IDC indication can only be triggered for frequencies for which a measurement object is configured and when:

- for the primary frequency, the UE is experiencing IDC problems that it cannot solve by itself;
- for a secondary frequency, regardless of the activation state of the corresponding SCell, the UE is experiencing or expects to experience upon activation IDC problems that it cannot solve by itself;
- for a non-serving frequency, the UE expects to experience IDC problems that it cannot solve by itself if that non-serving frequency becomes a serving one.

When notified of IDC problems through an IDC indication from the UE, the eNB can choose to apply a Frequency Division Multiplexing (FDM) solution or a Time Division Multiplexing (TDM) solution:

- The basic concept of an FDM solution is to move the LTE signal away from the ISM band by e.g., performing inter-frequency handover within E-UTRAN, removing SCells from the set of serving cells, or in case of uplink CA operations, allocate uplink PRB resources on CC(s) whose inter-modulation distortion and harmonics does not fall into the frequency range of the victim system receiver.
- The basic concept of a TDM solution is to ensure that transmission of a radio signal does not coincide with reception of another radio signal. LTE DRX mechanism is used to provide TDM patterns (i.e. periods during which the LTE UE may be scheduled or is not scheduled) to resolve the IDC issues. DRX based TDM solution should be used in a predictable way, i.e. the eNB should ensure a predictable pattern of unscheduled periods by means of DRX mechanism.

To assist the eNB in selecting an appropriate solution, all necessary/available assistance information for both FDM and TDM solutions is sent together in the IDC indication to the eNB. The IDC assistance information contains the list of E-UTRA carriers suffering from IDC problems, the direction of the interference and, depending on the scenario (see TR 36.816 [50]), it also contains TDM patterns or parameters to enable appropriate DRX configuration for TDM solutions on the serving E-UTRA carrier. Furthermore, the IDC indication can also be configured to include uplink CA related assistance information containing the victim system as well as the list of supported uplink CA combinations suffering from IDC problems. The IDC indication is also used to update the IDC assistance information, including for the cases when the UE no longer suffers from IDC problems. In case of inter-eNB handover, the IDC assistance information is transferred from the source eNB to the target eNB.

IDC interference situation can be divided into following three phases as shown in Figure 23.4.2-1:

- Phase 1: The UE detects start of IDC interference but does not initiate the transmission of the IDC indication to the eNB yet.
- Phase 2: The UE has initiated the transmission of the IDC indication to the eNB and no solution is yet configured by the eNB to solve the IDC issue.
- Phase 3: The eNB has provided a solution that solved the IDC interference to the UE.

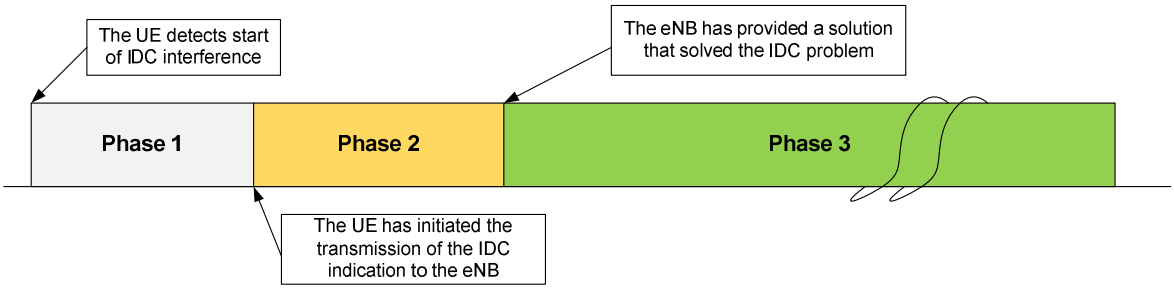


Figure 23.4.2-1: Different phases of IDC interference related operations by UE

In different phases, UE behaviours related to RRM, RLM, and CSI measurements are shown in Table 23.4.2-1.

Table 23.4.2-1: RRM/RLM/CSI measurements in different phases of IDC interference

Phases of IDC Interference	RRM Measurements	RLM Measurements	CSI Measurements
Phase 1	Up to UE implementation and RRM measurement requirements (see TS 36.133 [21]) apply	Up to UE implementation and RLM measurement requirements (see TS 36.133 [21]) apply	Up to UE implementation and CSI measurement requirements (see TS 36.101 [52]) apply
Phase 2	UE shall ensure the measurements are free of IDC interference and RRM measurement requirements (see TS 36.133 [21]) apply	UE shall ensure the measurements are free of IDC interference and RLM measurement requirements (see TS 36.133 [21]) apply (NOTE 1)	
Phase 3	UE shall ensure the measurements are free of IDC interference and RRM measurement requirements (see TS 36.133 [21]) apply	UE shall ensure the measurements are free of IDC interference and RLM measurement requirements (see TS 36.133 [21]) apply	

NOTE 1: The UE should attempt to maintain connectivity to LTE in this phase meaning that RLM measurements are not impacted by IDC interference. If no solution is provided within a time which is up to UE implementation, the UE may need to declare RLF or it may continue to deny the ISM transmission. In DC, when the UE experiences IDC problems in SCG, if no solution is provided within a time which is up to UE implementation, the UE may need to declare RLF in SCG or it may continue to deny the ISM transmission in SCG.
NOTE 2: If the UE determines in Phase 2 that the network does not provide a solution that resolves its IDC problems, it performs measurements as defined for Phase 1.
NOTE 3: If the IDC indication message reports the IDC interference on a neighbour frequency, it performs RRM measurements for that frequency as defined for Phase 2.

In addition, once configured by the network, the UE can autonomously deny LTE UL transmission in all phases to protect ISM in rare cases if other solutions cannot be used. Conversely, it is assumed that the UE also autonomously denies ISM transmission in order to ensure connectivity with the eNB to perform necessary LTE procedures, e.g., RRC connection reconfiguration and paging reception, etc. The network may configure a long-term denial rate by dedicated RRC signalling to limit the amount of LTE UL autonomous denials. Otherwise, the UE shall not perform any LTE UL autonomous denials.

23.5 TDD Enhanced Interference Management and Traffic Adaptation (eIMTA)

TDD enhanced Interference Management and Traffic Adaptation (eIMTA) allows adaptation of uplink-downlink configuration via L1 signalling. The E-UTRAN configures which UEs are subject to the TDD eIMTA operation.

For Uplink scheduling and HARQ timing, the UE follows the reference uplink-downlink configuration based on the one provided in SIB1. For Downlink HARQ timing, the UE follows the reference uplink-downlink configuration provided through dedicated signalling.

Downlink subframes in the reference configuration provided in SIB1 remain unchanged whereas only a subset of uplink and special subframes may be reconfigured to downlink subframes. E-UTRAN sends a L1 signalling to the UE on PCell PDCCH to indicate which uplink-downlink configuration defined in TS 36.211 [4] is currently used for one or more serving cell(s). This uplink-downlink configuration provided by the L1 signalling applies for a RRC-configured number of radio frames.

The UE uses the L1-signalled uplink-downlink configuration for (E)PDCCH monitoring and CSI measurements.

The UE RRM/RLM measurements are not affected by the TDD eIMTA configuration.

For DL CSI measurements of each serving cell, two subframe sets may be configured via RRC signalling.

For PUSCH/SRS UL power control of each serving cell, two subframe sets with separate power control parameters may be configured via RRC signalling.

Subframe-set dependent overload indication and uplink-downlink configuration intended to be used by a cell may be exchanged between eNBs over the X2 interface to facilitate the TDD eIMTA operation.

23.6 RAN assisted WLAN interworking

This section describes the mechanisms to support traffic steering between E-UTRAN and WLAN.

23.6.1 General principles

This version of the specification supports E-UTRAN assisted UE based bi-directional traffic steering between E-UTRAN and WLAN for UEs in RRC_IDLE and RRC_CONNECTED.

E-UTRAN provides assistance parameters via broadcast and dedicated RRC signalling to the UE. The RAN assistance parameters may include E-UTRAN signal strength thresholds, WLAN channel utilization thresholds, WLAN backhaul data rate thresholds, WLAN signal strength thresholds and Offload Preference Indicator (OPI). E-UTRAN can also provide a list of WLAN identifiers to the UE via broadcast signalling. The UE uses the RAN assistance parameters in the evaluation of:

- Access network selection and traffic steering rules defined in TS 36.304 [11]; or
- ANDSF policies defined in TS 24.312 [58].

for traffic steering decisions between E-UTRAN and WLAN as specified in TS 23.402[19].

The OPI is only used in ANDSF policies as specified in TS 24.312 [58].

WLAN identifiers are only used in access network selection and traffic steering rules defined in TS 36.304 [11].

If the UE is provisioned with ANDSF policies it shall forward the received RAN assistance parameters to upper layers, otherwise it shall use them in the access network selection and traffic steering rules defined in section 23.6.2 and TS 36.304 [11]. The access network selection and traffic steering rules defined in section 23.6.2 and TS 36.304 [11] are applied only to the WLANs of which identifiers are provided by the E-UTRAN.

The UE in RRC_CONNECTED shall apply the parameters obtained via dedicated signalling if such have been received from the serving cell; otherwise, the UE shall apply the parameters obtained via broadcast signalling.

The UE in RRC_IDLE shall keep and apply the parameters obtained via dedicated signalling, until selection/reselection of another cell than the one where these parameters were received or a timer has expired since the UE entered RRC_IDLE upon which the UE shall apply the parameters obtained via broadcast signalling.

In the case of RAN sharing, each PLMN sharing the RAN can provide independent sets of RAN assistance parameters.

23.6.2 Access network selection and traffic steering rules

The UE indicates to upper layers when (and for which WLAN identifiers) access network selection and traffic steering rules defined in TS 36.304 [11] are fulfilled. The selection among WLANs that fulfil the access network selection and traffic steering rules is up to UE implementation.

When the UE applies the access network selection and traffic steering rules defined in TS 36.304 [11], it performs traffic steering between E-UTRAN and WLAN with APN granularity.

23.7 Support of Low Complexity UEs

Low complexity UEs are targeted to low-end (e.g. low average revenue per user, low data rate, delay tolerant) applications, e.g. some Machine-Type Communications.

A low complexity UE indicates UE Category 0 and has reduced Tx and Rx capabilities compared to other UE of different categories.

A low complexity UE may access a cell only if SIB1 indicates that access of low complexity UEs is supported. If the cell does not support low complexity UEs, a low complexity UE considers the cell as barred.

The eNB determines that a UE is a low complexity device based on the LCID for CCCH and the UE capability.

The S1 signalling has been extended to include the UE Radio Capability for Paging. This paging specific capability information is provided by the eNB to the MME, and the MME uses this information to indicate to the eNB that the paging request from the MME concerns a low complexity UE.

23.8 Support for Radio Interface based Synchronization

Radio-interface based synchronization (RIBS) enables an eNB to monitor the reference signals of another eNB for the purpose of over the air synchronization by means of network listening. This requires OAM to configure the eNBs with reference signal information, i.e. pattern, periodicity and offset, where the reference signals are available. The OAM should coordinate the reference signal information, for example via one to one mapping between stratum level and reference signal. To improve the hearability of reference signals, the listening eNB may request the interfering eNB(s) to enable subframe muting by means of network signalling.

23.9 Network-assisted interference cancellation/suppression

A UE that supports network assisted interference cancellation/suppression (NAICS) receiver functionality can mitigate PDSCH and CRS interference from aggressor cells in order to better receive a PDSCH from its serving cell.

The network may configure the UE with NAICS information of the aggressor cells in order to help the UE to mitigate the PDSCH and CRS interference of the aggressor cells. To support NAICS, an eNB may exchange NAICS information with its neighbour eNBs through X2 signalling.

23.10 Support for sidelink communication

23.10.1 General

Sidelink communication is a mode of communication whereby UEs can communicate with each other directly over the PC5 interface [62]. This communication mode is supported when the UE is served by E-UTRAN and when the UE is outside of E-UTRA coverage. Only those UEs authorised to be used for public safety operation can perform sidelink communication.

In order to perform synchronisation for out of coverage operation UE(s) may act as a synchronisation source by transmitting SBCCH and a synchronisation signal. SBCCH carries the most essential system information needed to receive other sidelink channels and signals. SBCCH along with a synchronisation signal is transmitted with a fixed periodicity of 40ms. When the UE is in network coverage, the contents of SBCCH are derived from the parameters signalled by the eNB. When the UE is out of coverage, if the UE selects another UE as a synchronisation reference, then the content of SBCCH is derived from the received SBCCH; otherwise UE uses pre-configured parameters. SIB18 provides the resource information for synchronisation signal and SBCCH transmission. There are two pre-configured subframes every 40ms for out of coverage operation. UE receives synchronisation signal and SBCCH in one subframe and transmit synchronisation signal and SBCCH on another subframe if UE becomes synchronisation source based on defined criterion [16].

UE performs sidelink communication on subframes defined over the duration of Sidelink Control period. The Sidelink Control period is the period over which resources allocated in a cell for sidelink control information and sidelink data transmissions occur. Within the Sidelink Control period the UE sends sidelink control information followed by sidelink data. Sidelink control information indicates a Layer 1 ID and characteristics of the transmissions (e.g. MCS, location of the resource(s) over the duration of Sidelink Control period, timing alignment).

The UE performs transmission and reception over Uu and PC5 with the following decreasing priority order:

- Uu transmission/reception (highest priority);
- PC5 sidelink communication transmission/reception;
- PC5 sidelink discovery announcement/monitoring (lowest priority).

23.10.2 Radio Protocol Architecture

In this subclause, the UE radio protocol architecture for sidelink communication is given for the user plane and the control plane.

23.10.2.1 User plane

Figure 23.10.2.1-1 shows the protocol stack for the user plane, where PDCP, RLC and MAC sublayers (terminate at the other UE) perform the functions listed for the user plane in subclause 6.

The Access Stratum protocol stack in the PC5 interface consists of PDCP, RLC, MAC and PHY as shown below in Figure 23.10.2.1-1.

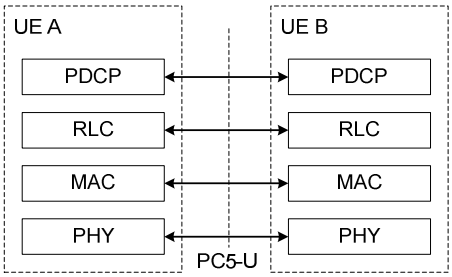


Figure 23.10.2.1-1: User-Plane protocol stack for sidelink communication

User plane details of sidelink communication:

- There is no HARQ feedback for sidelink communication;
- RLC UM is used for sidelink communication;
- A receiving UE needs to maintain at least one RLC UM entity per transmitting peer UE;
- A receiving RLC UM entity used for sidelink communication does not need to be configured prior to reception of the first RLC UMD PDU;
- ROHC Unidirectional Mode is used for header compression in PDCP for sidelink communication.

A UE may establish multiple logical channels. LCID included within the MAC subheader uniquely identifies a logical channel within the scope of one Source Layer-2 ID and ProSe Layer-2 Group ID combination. Parameters for logical channel prioritization are not configured.

23.10.2.2 Control plane

A UE does not establish and maintain a logical connection to receiving UEs prior to a sidelink communication.

The Access Stratum protocol stack for SBCCH in the PC5 interface consists of RRC, RLC, MAC and PHY as shown below in Figure 23.10.2.2-1.

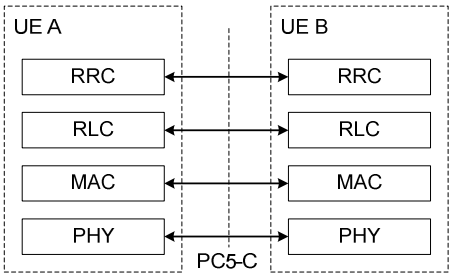


Figure 23.10.2.2-1: Control-Plane protocol stack for sidelink communication

23.10.3 Radio resource allocation

The UE supporting sidelink communication can operate in two modes for resource allocation:

- Scheduled resource allocation is characterized by:
  - The UE needs to be RRC_CONNECTED in order to transmit data;
  - The UE requests transmission resources from the eNB. The eNB schedules transmission resources for transmission of sidelink control information and data;
    - The UE sends a scheduling request (D-SR or Random Access) to the eNB followed by a Sidelink BSR. Based on the Sidelink BSR the eNB can determine that the UE has data for a sidelink communication transmission and estimate the resources needed for transmission. eNB can schedule transmission resources for sidelink communication using configured SL-RNTI.
- UE autonomous resource selection is characterized by:
  - A UE on its own selects resources from resource pools and performs transport format selection to transmit sidelink control information and data.

A UE in RRC_CONNECTED may send a Sidelink UE Information message to eNB when UE becomes interested in sidelink communication. In response eNB may configure the UE with a SL-RNTI.

A UE is considered in-coverage for sidelink communication whenever it detects a cell on a Public Safety ProSe Carrier as per criteria specified in [16]. The following rules apply for the UE:

- If the UE is out of coverage for sidelink communication it can only use UE autonomous resource selection;
- If the UE is in coverage for sidelink communication it may use scheduled resource allocation or UE autonomous resource selection as per eNB configuration;
- If the UE is in coverage for sidelink communication it shall use only the resource allocation mode indicated by eNB configuration unless one of the exceptional cases as specified in [16] occurs;
  - When an exceptional case occurs the UE is allowed to use UE autonomous resource selection temporarily even though it was configured to use scheduled resource allocation. Resource pool to be used during exceptional case may be provided by eNB.

A UE that is camped or connected on one carrier frequency but interested in sidelink communication operation on another carrier frequency (i.e. Public Safety ProSe Carrier) shall attempt to find cells on the Public Safety ProSe Carrier.

- An RRC_IDLE UE camped on a cell in another carrier frequency, but in the coverage area of an E-UTRA cell on Public Safety ProSe Carrier may consider the Public Safety ProSe carrier to be the highest priority; and reselects to the cell on the Public Safety ProSe Carrier. UE may consider a frequency (non-Public Safety ProSe carrier) to be the highest priority if it can perform sidelink communication only while camping on the frequency;
- An RRC_CONNECTED UE served by a cell in another carrier frequency may send a Sidelink UE Information message to its serving cell when it wants to perform sidelink communication. The indication contains the intended Public Safety ProSe Carrier;
  - The serving cell indicates with the presence of SIB18 whether the UE is allowed to send a ProSe UE Information indication;

  - The serving cell may configure an inter-frequency RRM measurement on the Public Safety ProSe Carrier;
  - Once the UE enters coverage of a cell on the Public Safety ProSe Carrier, based on measurement report the eNB performs inter-frequency mobility to the Public Safety ProSe Carrier;
  - If inter-frequency mobility is not performed by the serving cell (e.g. the serving cell does not broadcast SIB18 or if handover fails), the UE may still perform sidelink communication using UE autonomous resource selection from the resource pools, if any, broadcasted by the detected E-UTRA cell on the Public Safety ProSe Carrier.

- If the UE does not detect an E-UTRA cell on the Public Safety ProSe Carrier, the UE can use Public Safety ProSe Carrier resources preconfigured in the UICC or ME for out of coverage sidelink communication;
- If the UE detects an E-UTRA cell on the Public Safety ProSe Carrier, the UE stops using resources preconfigured in the UICC or ME. UE may use UE autonomous resource selection from the resource pools, if any, broadcasted by the detected E-UTRA cell on the Public Safety ProSe Carrier.

NOTE: For Rel-12 all ProSe communication (for a UE) is performed on a single preconfigured Public Safety ProSe Carrier, which is valid in the operating region. Higher layers check validity of the Public Safety ProSe Carrier in the operating region.

The cell on the Public Safety ProSe Carrier may select one of the following options:

- The cell on the Public Safety ProSe Carrier may provide a transmission resource pool for UE autonomous resource selection in SIB18;
  - UEs that are authorized for sidelink communication may use these resources for sidelink communication in RRC_IDLE in the cell on the same carrier (i.e. Public Safety ProSe Carrier).
  - UEs that are authorized for sidelink communication may use these resources for sidelink communication in RRC_IDLE or RRC_CONNECTED in a cell on another carrier.
- The cell on the Public Safety ProSe Carrier may indicate in SIB18 that it supports sidelink communication but does not provide transmission resources. UEs need to enter RRC_CONNECTED to perform sidelink communication transmission. In this case the cell on the Public Safety ProSe Carrier may provide in broadcast signalling an exceptional transmission resource pool for UE autonomous resource selection, to be used by the UE in exceptional cases, as specified in [16].
  - A UE in RRC_CONNECTED that is authorized to perform sidelink communication transmission indicates to the serving eNB that it wants to perform sidelink communication transmissions;
  - The eNB validates whether the UE is authorized for sidelink communication transmission using the UE context received from MME;
  - The eNB may configure a UE by dedicated signalling with a transmission resource pool for UE autonomous resource selection; that may be used without constraints while the UE is in RRC_CONNECTED. Alternatively, the eNB may configure a UE to use the exceptional transmission resource pool for UE autonomous resource selection which the UE is allowed to use only in exceptional cases, as specified in [16], and rely on scheduled resource allocation otherwise.

23.10.3.1 Resource Pool for sidelink control information

A set of resource pools for sidelink control informationwhen the UE is out of coverage for sidelink communication is pre-configured in the UE. The first pool in the list is used for both transmission and reception of sidelink control information while the other pools in the list are used for reception of sidelink control information.

The resource pools for sidelink control information when the UE is in coverage for sidelink communication are configured as below:

- The resource pools used for reception are configured by the eNB via RRC, in broadcast signalling;
- The resource pool used for transmission is configured by the eNB via RRC, in dedicated or broadcast signalling, if UE autonomous resource selection is used;
- The resource pool used for transmission is configured by the eNB via RRC, in dedicated signalling if scheduled resource allocation is used;

- The eNB schedules the specific resource(s) for sidelink control information transmission within the configured reception pools.

NOTE: In order to perform communication even when some UEs are in-coverage and some UEs are out of coverage, all UEs (i.e. both in and out of coverage) should be configured with resource pools for reception of sidelink control information which are the union of the resource pools used for transmission of sidelink control information from a) the serving cell, b) neighbour cells and c) out of coverage (i.e. pre-configured transmission resource pools).

23.10.3.2 Resource Pool for sidelink data

A set of resource pools for data when the UE is out of coverage for sidelink communication is pre-configured in the UE. The first pool in the list is used for transmission and reception of data while the other pools in the list are used for reception of data.

The resource pools for data when the UE is in coverage for sidelink communication are configured as below:

- The resource pools used for transmission and reception are configured by the eNB via RRC, in dedicated or broadcast signalling, if UE autonomous resource selection is used;

- There is no resource pool for transmission and reception if scheduled resource allocation is used.

23.11 Support for sidelink discovery

23.11.1 General

Sidelink discovery is defined as the procedure used by the UE supporting sidelink discovery to discover other UE(s) in its proximity, using E-UTRA direct radio signals via PC5. Sidelink discovery is supported only when the UE is served by E-UTRAN.

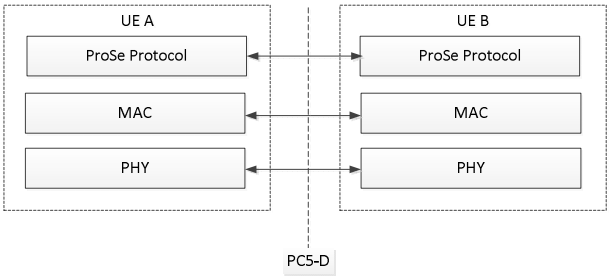


Figure 23.11.1-1: PC5 interface for sidelink discovery [62]

Upper layer handles authorization for announcement and monitoring of discovery message.

Content of discovery message is transparent to Access Stratum (AS) and no distinction in AS is made for sidelink discovery models and types of sidelink discovery [62].

NOTE: The ProSe Protocol ensures that only valid discovery messages are delivered to AS for announcement.

The UE can participate in announcing and monitoring of discovery message in both RRC_IDLE and RRC_CONNECTED states as per eNB configuration. The UE announces and monitors its discovery message subject to the half-duplex constraint.

The UE that participates in announcing and monitoring of discovery messages maintains the current UTC time. The UE that participates in announcing transmits the discovery message which is generated by the ProSe Protocol taking into account the UTC time upon transmission of the discovery message. In the monitoring UE the ProSe Protocol provides the message to be verified together with the UTC time upon reception of the message to the ProSe Function.

NOTE: UE may obtain UTC time from the RAN via SIB16 or from other sources such as NITZ, NTP, and GNSS depending on their availability.

In order to perform synchronisation UE(s) participating in announcing of discovery messages may act as a synchronisation source by transmitting a synchronisation signal based on the resource information for synchronisation signals provided in SIB19.

There are three range classes. Upper layer authorisation provides applicable range class of the UE. Maximum allowed transmission power for each range class is signalled in SIB19. UE uses the applicable maximum allowed transmission power corresponding to its authorised range class. This puts an upper limit on the determined transmit power based on open loop power control parameters.

23.11.2 Radio Protocol Architecture

The Access Stratum protocol stack for sidelink discovery consists of only MAC and PHY.

The AS layer performs the following functions:

- Interfaces with upper layer (ProSe Protocol): The MAC layer receives the discovery message from the upper layer (ProSe Protocol). The IP layer is not used for transmitting the discovery message;
- Scheduling: The MAC layer determines the radio resource to be used for announcing the discovery message received from upper layer;
- Discovery PDU generation: The MAC layer builds the MAC PDU carrying the discovery message and sends the MAC PDU to the physical layer for transmission in the determined radio resource. No MAC header is added.

23.11.3 Radio resource allocation

There are two types of resource allocation for discovery message announcement.

- UE autonomous resource selection: A resource allocation procedure where resources for announcing of discovery message are allocated on a non UE specific basis, further characterized by:
  - The eNB provides the UE(s) with the resource pool configuration used for announcing of discovery message. The configuration may be signalled in broadcast or dedicated signalling;
  - The UE autonomously selects radio resource(s) from the indicated resource pool and announces discovery message;
  - The UE can announce discovery message on a randomly selected discovery resource during each discovery period.
- Scheduled resource allocation: A resource allocation procedure where resources for announcing of discovery message are allocated on per UE specific basis, further characterized by:
  - The UE in RRC_CONNECTED may request resource(s) for announcing of discovery message from the eNB via RRC;
  - The eNB assigns resource(s) via RRC;
  - The resources are allocated within the resource pool that is configured in UEs for announcement.

For UEs in RRC_IDLE:

- The eNB may select one of the following options:
  - The eNB may provide a resource pool for UE autonomous resource selection based discovery message announcement in SIB19. UEs that are authorized for sidelink discovery use these resources for announcing discovery message in RRC_IDLE;
  - The eNB may indicate in SIB19 that it supports sidelink discovery but does not provide resources for discovery message announcement. UEs need to enter RRC_CONNECTED in order to request resources for discovery message announcement.

For UEs in RRC_CONNECTED:

- A UE authorized to perform sidelink discovery announcement indicates to the eNB that it wants to perform sidelink discovery announcement;

- The eNB validates whether the UE is authorized for sidelink discovery announcement using the UE context received from MME;
- The eNB may configure the UE with resource pool for UE autonomous resource selection for discovery message announcement via dedicated signalling;
- The eNB may configure resource pool along with dedicated resource in the form of time and frequency indices for discovery message announcement via dedicated RRC signalling;
- The resources allocated by the eNB via dedicated signalling are valid until;
  - The eNB re-configures the resource(s) by RRC signalling or;
  - The UE enters RRC_IDLE.

Authorised receiving UEs in RRC_IDLE and RRC_CONNECTED monitor resource pools used for UE autonomous resource selection and resource pools for scheduled resource allocation. The eNB provides the resource pool configuration used for discovery message monitoring in SIB19. The SIB19 may contain detailed sidelink discovery configuration used for announcing in neighbour cells of intra-frequency as well.

Synchronous and asynchronous deployments are supported. Discovery resources can be overlapping or non-overlapping across cells.

A UE if authorised by the NW can announce discovery message only on serving cell. The UE can monitor discovery resources in the same as well as other frequencies than the serving cell, in same or different PLMNs.

- The serving cell may provide in SIB19 a list of frequencies along with PLMN ID on which the UE may aim to monitor discovery message;
- The serving cell does not provide detailed sidelink discovery configuration for other carrier frequencies. The UE shall read SIB19 and other relevant SIBs on other carriers if it wants to perform discovery message monitoring on those carriers;
  - Obtaining sidelink discovery configuration by reading SIB19 (and other SIBs) of an inter-frequency and/or inter-PLMN cell shall not affect the UE's Uu reception on the serving cell(s);
- The UE performs intra-frequency sidelink discovery announcement in subframes in which a sidelink discovery resource pool is configured. The sidelink discovery announcement shall not affect Uu transmission and/or reception;
  - The UE shall not create autonomous gaps.
- Intra-frequency, inter-frequency and inter-PLMN sidelink discovery monitoring shall not affect Uu reception.
  - The UE uses DRX occasions in RRC_IDLE and RRC_CONNECTED or second RX chain if it is available, for intra- frequency, inter-frequency and inter-PLMN discovery message monitoring;
  - The UE shall not create autonomous gaps.
- An RRC_CONNECTED UE sends a Sidelink UE Information message to the serving cell if it is interested or no longer interested in intra-frequency, inter-frequency or inter-PLMN discovery message monitoring.

Annex A (informative): NAS Overview

This subclause provides for information an overview on services and functions provided by the NAS control protocol..

A.1 Services and Functions

The main services and functions of the NAS sublayer include:

- EPS Bearer control (see 3GPP TR 23.401 [17]);
- ECM-IDLE mobility handling;
- Paging origination;
- Configuration and control of Security.

A.2 NAS protocol states & state transitions

The NAS state model is based on a two-dimensional model which consists of EPS Mobility Management (EMM) states describing the mobility management states that result from the mobility management procedures e.g. Attach and Tracking Area Update procedures, and of EPS Connection Management (ECM) states describing the signalling connectivity between the UE and the EPC (see 3GPP TS 23.401 [17]).

NOTE: The ECM and EMM states are independent of each other and when the UE is in EMM-CONNECTED state this does not imply that the user plane (radio and S1 bearers) is established.

The relation between NAS and AS states is characterised by the following principles:

- EMM-DEREGISTERED & ECM-IDLE ⇒ RRC_IDLE:
  - Mobility: PLMN selection:
  - UE Position: not known by the network.
- EMM-REGISTERED & ECM-IDLE ⇒ RRC_IDLE:
  - Mobility: cell reselection;
  - UE Position: known by the network at tracking area level.
- EMM-REGISTERED & ECM-CONNECTED with radio bearers established ⇒ RRC_CONNECTED.
  - Mobility: handover;
  - UE Position: known by the network at cell level.

Annex B (informative): MAC and RRC Control

The E-UTRA supports control signalling in terms of MAC control signalling (PDCCH and MAC control PDU) and RRC control signalling (RRC message).

B.1 Difference between MAC and RRC control

The different characteristics of MAC and RRC control are summarized in the table below.

Table B.1-1: Summary of the difference between MAC and RRC control

	MAC control		RRC control
Control entity	**MAC**		**RRC**
Signalling	PDCCH	MAC control PDU	RRC message
Signalling reliability	~ 10^{-2} (no retransmission)	~ 10^{-3} (after HARQ)	~ 10^{-6} (after ARQ)
Control delay	Very short	Short	Longer
Extensibility	None or very limited	Limited	High
Security	No integrity protection No ciphering	No integrity protection No ciphering	Integrity protection Ciphering

The main difference between MAC and RRC control lies in the signalling reliability. Due to the signalling reliability, signalling involving state transitions and radio bearer configurations should be performed by RRC. Basically, all signalling performed by RRC in UTRA should also be performed by RRC also for E-UTRA.

B.2 Void

Annex C (informative):
Void

Annex D (informative):
Void

Annex E (informative):
Void

Annex F (informative):
Void

Annex G (informative): Guideline for E-UTRAN UE capabilities

Each radio access technology has defined specific "classes" of terminals in terms of radio capabilities. E.g. in GPRS the "multislot classes" are defined, in UMTS R'99 different dedicated bearer classes are defined and for HSDPA and HSUPA 12 respectively 6 physical layer categories are defined. The definition of UMTS R'99 UE classes lead to 7 DL classes and 7 UL classes for FDD out of which only 2 DL and 3 UL classes were commercially realized. Furthermore the lower end classes (e.g. 64 UL and 64 DL) disappeared from the market with commercialization of the UMTS networks quite soon. Besides these class definitions a huge number of possible parameter combinations (to achieve certain data rates) exist with UMTS R'99 which lead to the huge number of RAB and RB combinations defined. Further activities in the early phase of UMTS standardization aimed to reduce the number of possible combinations significantly.

For HSDPA two "simple" DL categories (11 & 12) with lowered complexity were defined with the intent to speed up commercialization of HSDPA. Originally those categories should have been removed for Rel-6. Out of the 12 defined categories only approx. 4 will be realized in commercial HSDPA platform products. A similar situation is likely for HSUPA as well as for the combinations of HSDPA/HSUPA.

Generally the aim to mandate certain essential functions/requirements can help to simplify the system definition as well as the realization options (e.g. mandating 20 MHz of DL reception as well as 20 MHz UL transmission bandwidth significantly reduced the E-UTRAN system complexity). Especially mandating certain terminal functions could be useful for the system design if a defined subset of parameter combinations are also supported by the systems, e.g. the eNB scheduler. However, there is also a risk that not all the defined E-UTRA features are deployed in the networks at the time when terminals are made commercially available on the market place. Some features are likely to be rather large and complex, which further increases the risk of interoperability problems unless these features have undergone sufficient interoperability testing (IOT) on real network equipment, and preferably with more than one network in order to improve the confidence of the UE implementation. Thus, avoiding unnecessary UE mandatory features but instead defining a limited set of UE radio classes allows simplification for the interoperability testing.

Given the discussion above, it seems beneficial for the introduction of E-UTRAN to limit the combination of radio capabilities to a clearly defined subset and ensure that a given set of parameters is supported by certain UE classes as well as networks for rapid E-UTRAN deployment. It seems unrealistic to mandate only one single UE class which always mandates the maximum capability.

In order to address the different market requirements (low end, medium and high end), the definition of the following UE classes are proposed:

Table G-1: E-UTRAN UE Classes

Class	UL	DL
A	[50] Mbps	[100] Mbps
B	[25] Mbps	[50] Mbps
C	[2] Mbps	[2] Mbps

NOTE: For simplification reasons, the table only depict the UE capabilities in terms of uplink and downlink peak data rates supported. However, it should be noted that further discussion on other features is expected once the work progresses.

It may require further discussion whether there be a need for an additional terminal class between 2 Mbps and 50 Mbps classes. It might make sense, since up to 5 MHz band allocations may be rather common in real deployments for several years. This would point to bit rate class of 25 Mbps in DL and 10 Mbps in UL.

The above given data rates are indicative and should be subject for further discussions in 3GPP RAN working groups. Depending on the different solutions to reach those data rates, the target should be to define [3..4] UE classes in different data rate ranges, and other parameters affecting device complexity and cost. The definition of the required parameters/features is for further study for each of the classes. For instance, half-duplex UEs form a specific category that may be frequency band specific.

NOTE: the support of half-duplex UEs is mandatory for the eNB where such a category is allowed in the frequency band supported by the eNB.

The aim is to ensure on the one hand that high end E-UTRAN UEs, supporting data rates representing state of the art level and competitive with other radio technologies are defined, while the medium and lower data rates aim to reduce implementation cost for chipset/terminal vendors and allow adoption of most cost efficient solutions for different market segments. It is expected that the support of the high end data rate terminals is ensured from the very beginning.

Another clear exception from this exercise is that on the low end very cheap product implementation is possible (e.g. for the machine-to-machine market or the voice and very low data rate only segment – to substitute GSM in the medium term) while top end performance is needed for data applications in notebooks, wireless gateways ("wireless DSL"), etc.

Another important aspect that must be ensured is that a higher capability UE can be treated in exactly the same way as for a lower capability UE, if the network wishes to do so, e.g., in case the network does not support some higher capability features. In HSDPA, there have been problems in this respect due to 2-stage rate matching in HARQ. Such problems should be avoided in E-UTRAN, and E-UTRAN UE capabilities should provide the compatibility to ease implementation and interoperability testing.

Annex H (informative): Void

Annex I (informative): SPID ranges and mapping of SPID values to cell reselection and inter-RAT/inter frequency handover priorities

This Annex defines two ranges of SPID (Subscriber Profile ID for RAT/Frequency Priority) values, respectively Operator Specific and Reference values. The mapping at eNB of Reference SPID values to cell reselection and inter-RAT/inter frequency handover priorities is defined.

I.1 SPID ranges

Values 1- 128 - Operator specific SPID values;

Values 129 - 256 - Reference values.

I.2 Reference SPID values

SPID = 256

Table I.2-1: eNB local configuration in idle and connected mode for SPID = 256

Configuration parameter	Value	Meaning
E-UTRAN carriers priority	high	The selection priorities for idle and connected mode of all E-UTRAN carriers are higher than the priorities for all UTRAN and GERAN carriers
UTRAN carriers priority	medium	The selection priorities for idle and connected mode of all UTRAN carriers are lower than the priorities for all E-UTRAN carriers and higher than the priorities for all GERAN carriers
GERAN carriers priority	low	The selection priorities for idle and connected mode of all GERAN carriers are lower than the priorities for all E-UTRAN and UTRAN carriers

SPID = 255

Table I.2-2: eNB local configuration in idle and connected mode for SPID = 255

Configuration parameter	Value	Meaning
UTRAN carriers priority	high	The selection priorities for idle and connected mode of all UTRAN carriers are higher than the priorities for all GERAN and E-UTRAN carriers
GERAN carriers priority	medium	The selection priorities for idle and connected mode of all GERAN carriers are lower than the priorities for all UTRAN carriers and higher than the priorities for all E-UTRAN carriers
E-UTRAN carriers priority	low	The selection priorities for idle and connected mode of all E-UTRAN carriers are lower than the priorities for all UTRAN and GERAN carriers

SPID = 254

Table I.2-3: eNB local configuration in idle and connected mode for SPID = 254

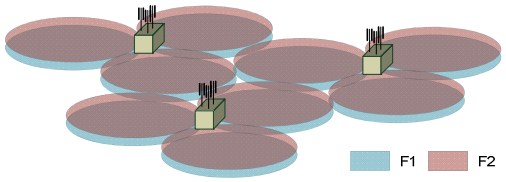
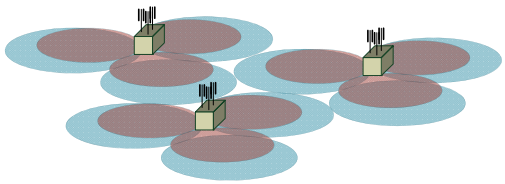
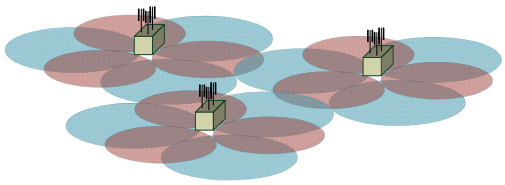
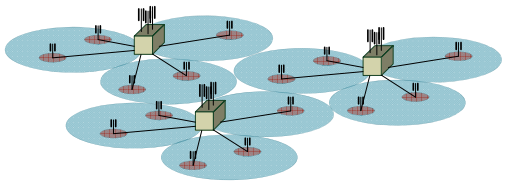
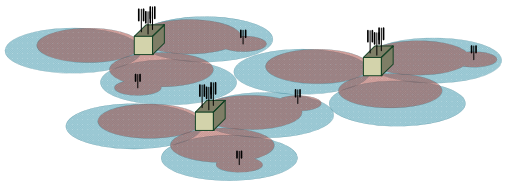
Configuration parameter	Value	Meaning
GERAN carriers priority	high	The selection priorities for idle and connected mode of all GERAN carriers are higher than the priorities for all UTRAN and E-UTRAN carriers
UTRAN carriers priority	medium	The selection priorities for idle and connected mode of all UTRAN carriers are lower than the priorities for all GERAN carriers and higher than the priorities for all E-UTRAN carriers
E-UTRAN carriers priority	low	The selection priorities for idle and connected mode of all E-UTRAN carriers are lower than the priorities for all GERAN and UTRAN carriers

Annex J (informative): Carrier Aggregation

J.1 Deployment Scenarios

Table J.1-1 shows some of the potential deployment scenarios for CA. In Rel-10, for the uplink, the focus is laid on the support of intra-band carrier aggregations (e.g. scenarios #1, as well as scenarios #2 and #3 when F1 and F2 are in the same band). Scenarios related to uplink inter-band CA are supported from Rel-11. For the downlink, all scenarios should be supported in Rel-10.

Table J.1-1: CA Deployment Scenarios (F2 > F1).

#	Description	Example
1	F1 and F2 cells are co-located and overlaid, providing nearly the same coverage. Both layers provide sufficient coverage and mobility can be supported on both layers. Likely scenario is when F1 and F2 are of the same band, e.g., 2 GHz, 800 MHz, etc. It is expected that aggregation is possible between overlaid F1 and F2 cells.	
2	F1 and F2 cells are co-located and overlaid, but F2 has smaller coverage due to larger path loss. Only F1 provides sufficient coverage and F2 is used to improve throughput. Mobility is performed based on F1 coverage. Likely scenario when F1 and F2 are of different bands, e.g., F1 = {800 MHz, 2 GHz} and F2 = {3.5 GHz}, etc. It is expected that aggregation is possible between overlaid F1 and F2 cells.	
3	F1 and F2 cells are co-located but F2 antennas are directed to the cell boundaries of F1 so that cell edge throughput is increased. F1 provides sufficient coverage but F2 potentially has holes, e.g., due to larger path loss. Mobility is based on F1 coverage. Likely scenario is when F1 and F2 are of different bands, e.g., F1 = {800 MHz, 2 GHz} and F2 = {3.5 GHz}, etc. It is expected that F1 and F2 cells of the same eNB can be aggregated where coverage overlaps.	
4	F1 provides macro coverage and on F2 Remote Radio Heads (RRHs) are used to improve throughput at hot spots. Mobility is performed based on F1 coverage. Likely scenarios are both when F1 and F2 are DL non-contiguous carrier on the same band, e.g., 1.7 GHz, etc. and F1 and F2 are of different bands, e.g., F1 = {800 MHz, 2 GHz} and F2 = {3.5 GHz}, etc. It is expected that F2 RRHs cells can be aggregated with the underlying F1 macro cells.	
5	Similar to scenario #2, but frequency selective repeaters are deployed so that coverage is extended for one of the carrier frequencies. It is expected that F1 and F2 cells of the same eNB can be aggregated where coverage overlaps.	

The reception timing difference at the physical layer of DL assignments and UL grants for the same TTI but from different serving cells (e.g. depending on number of control symbols, propagation and deployment scenario) does not affect MAC operation. A UE should cope with a relative propagation delay difference up to 30 μs among the component carriers to be aggregated in both intra-band non-contiguous and inter-band non-contiguous CA. This implies that a UE should cope with a delay spread of up to 30.26 μs among the component carriers monitored at the receiver, since the BS time alignment is specified to be up to 0.26 μs. This also implies that the UE should cope with a maximum uplink transmission timing difference between TAGs of 32.47μs for inter-band carrier aggregation with multiple TAGs.

When CA is deployed frame timing and SFN are aligned across cells that can be aggregated.

J.2 Void

J.3 Void

J.4 Void

J.5 Void

J.6 Void

Annex K (informative): Time domain ICIC

This Annex reflects the agreements reached on time domain ICIC that may not necessarily fit in the core of the specification but which needs to be captured in the absence of corresponding details in Stage 3 specifications.

K.1 Deployment scenarios

Two scenarios have been identified where conventional ICIC techniques are insufficient to overcome co-channel interference, the CSG scenario and the Pico scenario. The identified scenarios are examples of network configurations that are intended to depict the basic concept of time domain ICIC and it should be understood that other network deployment scenarios are also possible.

K.1.1 CSG scenario

Dominant interference condition may happen when non-member users are in close proximity of a CSG cell. Depending on network deployment and strategy, it may not be possible to divert the users suffering from inter-cell interference to another E-UTRA carrier or other RAT. Time domain ICIC may be used to allow such non-member UEs to remain served by the macro cell on the same frequency layer.

Such interference may be mitigated by the CSG cell utilizing Almost Blank Subframes to protect the corresponding macro cell's subframes from the interference. A non-member UE may be signalled to utilize the protected resources for cell measurements (RRM), radio link monitoring (RLM) and CSI measurements for the serving macro cell, allowing the UE to continue to be served by the macro cell under strong interference from the CSG cell.

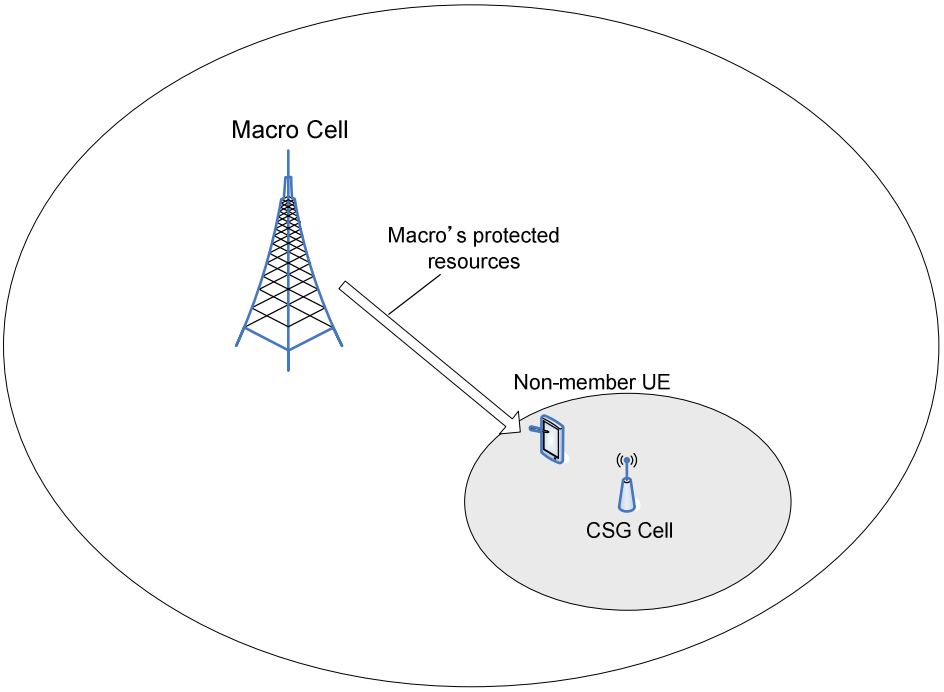


Figure K.1.1-1: Time domain ICIC: CSG scenario

In RRC_CONNECTED, the network can find out that the UE is subject to dominant interference from a CSG cell which the UE is not a member of through the existing measurement events (defined in release-8/9), at which point the network may choose to configure the RRM/RLM/CSI measurement resource restriction for the UE. The network may also configure RRM measurement resource restriction for neighbour cells in order to facilitate mobility from the serving macro cell. The network may release the RRM/RLM/CSI measurement resource restriction when it detects that the UE is no longer severely interfered by the CSG cell.

K.1.2 Pico scenario

Time domain ICIC may be utilized for pico users who served in the edge of the serving pico cell, e.g. for traffic off-loading from a macro cell to a pico cell. Time domain ICIC may be utilized to allow such UEs to remain served by the pico cell on the same frequency layer.

Such interference may be mitigated by the macro cell(s) utilizing Almost Blank Subframes to protect the corresponding pico cell's subframes from the interference. A UE served by a pico cell uses the protected resources for cell measurements (RRM), radio link monitoring (RLM) and CSI measurements for the serving pico cell.

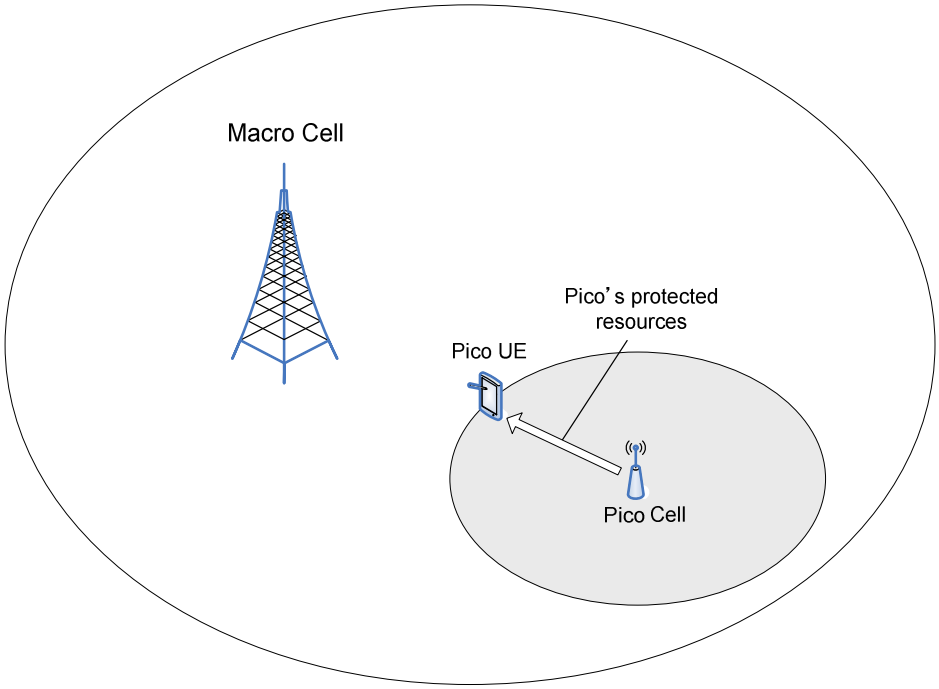


Figure K.1.2-1: Time domain ICIC: Pico scenario

For a UE served by a pico cell, the RRM/RLM/CSI measurement resource restriction may allow more accurate measurement of pico cell under strong interference from the macro cell(s). The pico cell may selectively configure the RRM/RLM/CSI measurement resource restriction only for those UEs subject to strong interference from the macro cell(s). Also, for a UE served by a macro cell, the network may configure RRM measurement resource restriction for neighbour cells in order to facilitate mobility from the macro cell to a pico cell.

Annex L (informative): Void

Annex M (informative): Dual Connectivity

M.1 Dual Connectivity operation

For Dual Connectivity, the UE is configured with two cell groups (CGs). A CG may only include cells that are associated to the same eNB and those cells are synchronized at the eNB level similar as for carrier aggregation. Two operations are defined: synchronous and asynchronous DC. In synchronous DC operation, the UE can cope with a maximum reception timing difference up to at least 33μs between CGs. In asynchronous DC operation, the UE can cope with a maximum reception timing difference up to 500μs between CGs.

When DC is deployed, frame timing and SFN are aligned among the component carriers to be aggregated within a CG, and may or may not be aligned between different CGs.

M.2 Operation Overview

Table M.2-1 below gives a network overview of the DC operations.

Table M.2-1: Dual Connectivity Operations

#	Network Action	Corresponding subclause	Remarks
1	Intra-PCell Handover	10.1.2.8.2.1 Intra-MeNB handover involving SCG change	Causes also intra-PSCell Change or Intra-SeNB Change. Also used for KeNB refresh. Done via Handover like in Rel-8; SCG can be retained during the Handover.
2	Intra-PSCell SCG Change	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	Also used for S-KeNB refresh. Does not require intra-PCell Handover.
3	Intra-MeNB Handover	10.1.2.8.2.1 Intra-MeNB handover involving SCG change	Causes also intra-PSCell Change or Intra-SeNB Change. Done via Handover like in Rel-8; SCG can be retained during the Change.
4	Intra-SeNB SCG Change	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	Requires SCG change but does not require intra-PCell Handover.
5	Inter-MeNB Handover	10.1.2.8.5 MeNB to eNB Change	Done via Handover like in Rel-8; SCG is also released.
6	Inter-SeNB SCG Change	10.1.2.8.4 Change of SeNB	Requires SCG change. Only supported when the MeNB does not change at the same time.
7	SCG addition by MeNB	10.1.2.8.1 SeNB Addition	Only the MeNB can request an SCG to be added.
8	SCG SCell addition by MeNB	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification)	Only the MeNB can request to add SCells to the SCG.If the SeNB wants to use the new SCell as PSCell it needs to initiate an SeNB modification.
9	Non-last SCG SCell release by MeNB	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification)	For requesting the release of the last SCG SCell i.e. PSCell, the MeNB has to request SCG release instead.
10	Non-last SCG SCell release by SeNB	10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	For requesting the release of the last SCG SCell i.e. PSCell, the SeNB has to request SCG release instead. The SeNB can request to release the PSCell only if it also chooses a new PSCell.
11	SCG release by MeNB	10.1.2.8.3 SeNB Release (MeNB initiated SeNB Release)	The MeNB can always request the release of the SCG and the SeNB has to comply.
12	SCG release by SeNB	10.1.2.8.3 SeNB Release (SeNB initiated SeNB Release)	The SeNB can always request the release of the SCG and the MeNB has to comply
13	SCG bearer addition by MeNB	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) (10.1.2.8.1 MeNB initiated SeNB Addition)	If this is the first bearer to be added in the SeNB, SCG addition is used instead.
14	SCG bearer release	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	Allowed for both the MeNB and the SeNB, but the SeNB cannot request to release the last SCG bearer if that would result in no bearers in SeNB - SCG release should be used instead. The SeNB cannot initiate the release of an SCG bearer and make changes to *SCG-Config* at the same time e.g. change the configuration of the physical layer.
15	Split bearer addition by MeNB	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification)	
16	Split bearer release	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification	Allowed for both the MeNB and the SeNB, but the SeNB cannot request to release the last split bearer if that would result in no bearers in

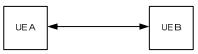
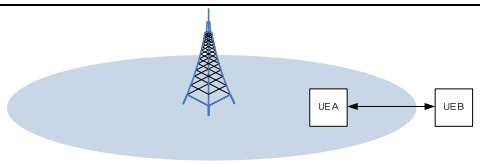
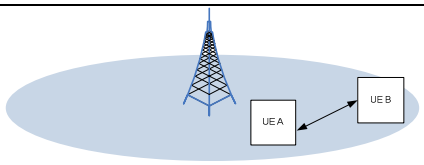
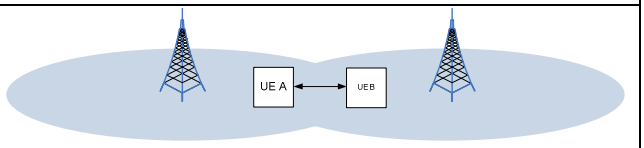
		(SeNB initiated SeNB Modification)	SeNB - SCG release should be used instead. The SeNB cannot initiate the release of an SCG bearer and make changes to *SCG-Config* at the same time e.g. change the configuration of the physical layer.
17	MCG to SCG bearer type change (and vice versa)	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	Either the MeNB or the SeNB can request to release an SCG bearer. Done via SCG change, i.e. L2 reset is required for the UE. The SeNB can only request change from SCG to MCG by requesting release of SCG bearer. The MeNB makes the decision on whether to release the DRB entirely or change it to MCG bearer.
18	MCG to Split Bearer Change (and vice versa)	10.1.2.8.2 SeNB Modification (MeNB initiated SeNB Modification) 10.1.2.8.2 SeNB Modification (SeNB initiated SeNB Modification)	The SeNB can always request to release the SCG part of a split bearer. Done via SCG change, i.e. L2 reset is required for the UE. MeNB makes the decision on whether to release the DRB entirely or change it to MCG bearer.

Annex N (informative): Sidelink communication

N.1 Deployment Scenarios

Table N.1-1shows scenarios for sidelink communication where UE A and UE B are located in-coverage /out-of-coverage of a cell. When UE A has a role as transmitter, UE A sends message and UE B receives it. UE A and UE B can change their transmission and reception role. The transmission from UE A can be received by one or more UEs like UE B.

Table N.1-1: sidelink communication Scenarios

#	Description	UE A	UE B	Example
1A	Out-of-Coverage	Out-of-Coverage	Out-of-Coverage	
1B	Partial-Coverage	In-Coverage	Out-of-Coverage	
1C	In-Coverage-Single-Cell	In-Coverage	In-Coverage	
1D	In-Coverage-Multi-Cell	In-Coverage	In-Coverage	

Annex O (informative): Change history

Change history (before approval)							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2006-06	RAN2 Ad.	R2-062020			First version.		0.0.0
2006-06	RAN2 Ad.	R2-062026			RLC operation clarified; High priority and low priority SRBs listed in RRC; New section on RRC procedures; Organisation of paging groups explained; New section on Support for self-configuration and self-optimisation.	0.0.0	0.0.1
2006-06	RAN2 Ad.	R2-062036			Four possible types of allocation added to section 11; New section for the support for real time IMS services.	0.0.1	0.0.2
2006-08	RAN2#54	R2-062206			Annex B on RRC and MAC control added. Minor editorial clarifications.	0.0.2	0.0.3
2006-09	RAN#34	RP-060603			Section 4 on "Overall Architecture" reorganised; Details on RLC operation included (segmentation, PDU size); Overview of System Information and RACH procedure added.	0.0.3	0.0.4
2006-10	RAN2#55	R2-063012			Ciphering for RRC signalling required in eNB as agreed in SA3; Agreements on RLC operation included: concatenation, discard, polling and status reports; Agreed text proposal in R3-061428 on Self Configuration added to section 19; Context transfer of header compression at UPE relocation listed as FFS. Outline of the RACH procedure described.	0.0.4	0.0.5
2006-10	RAN2#55	R2-063039			Miscellaneous editorial corrections; Agreed text proposal R3-061606 on Current status of E-UTRAN Architecture description added to section 4; Agreed text proposal in R3-061613 on Support for self-configuration and self-optimisation added to section 19. Agreed Physical layer model R2-063031 added to section 5	0.0.5	0.1.0
2006-11	RAN2#56	R2-063656			Annex C on system information classification added (R2-063064); Integrity protection for the control plane only (SA3 agreement); Agreements on PDCP and RLC PDU structure/handling reflected; Decisions on mobility aspects such as load balancing, handover, radio link failure and random access procedure added; Agreed MBMS deployment scenarios listed together with MBMS transmissions and principles from 25.813; Agreed text proposal R3-061936 on Radio Resource Management added to section 15; Agreed text proposal R3-061940 on RAN Sharing added to section 10; Agreed text proposal R3-061943 on Roaming/Area Restrictions in SAE/LTE added to section 10; Agreed text proposal R3-062008 on S1 C-Plane Functions and procedures added to section 18; Agreed text proposal R3-062011 on X2 interface added to section 19.	0.1.0	0.2.0
2006-11	RAN2#56	R2-063680			Incorporation of RAN1 agreement regarding the mandatory support of 20Mhz DL bandwidth for UEs i.e. removal of sub-clause 16.1; Editorial corrections.	0.2.0	0.3.0
2006-11	RAN2#56	R2-063681			Removal of the SA3 agreement on integrity protection for the user plane; Addition of Annex D on MBMS Transmission; Editorial corrections.	0.3.0	0.3.1
2006-11	RAN#34	RP-060806			Clean version	0.3.1	0.3.1
2007-01	RAN2#56 bis	R2-070403			SA3 agreement on integrity protection for the user plane included (R2-070016); Annex E on drivers for mobility control added (R2-070276); Agreements on the details of the random access procedure added in section 10.1.5 (R2-070365); New section on UL rate control included (R2-070410); RRC security principles listed in section 13.1 (R2-070044); Agreement on MAC security added to section 13 (R2-062100); Basis for DL scheduling put in section 11.1; Assumptions on neighbour cell list included in section 10.	0.3.1	0.4.0
2007-02	RAN2#57	R2-070451			Number of bits for RACH in TDD clarified; Miscellaneous editorial corrections.	0.4.0	0.5.0
2007-02	RAN2#57	R2-071073			Architecture updated according to R3-070397;	0.5.0	0.6.0

					Agreements from R2-070802.		
2007-02	RAN2#57	R2-071120			RACH model for initial access described; Mapping of the BCCH and System Information principles added; Agreements on DRX included in section 12.	0.6.0	0.7.0
2007-02	RAN2#57	R2-071122			Miscellaneous clarifications	0.7.0	0.7.1
2007-02	RAN2#57	R2-071123			CCCH in DL listed as FFS; SAE Gateway ID removed from section 8.2; PDCP for the control plane listed as FFS in section 4.3.2; Agreements on intra-E-UTRAN handover procedure included in section 10.1.2 (R3-062020).	0.7.1	0.8.0
2007-03	RAN2#57	R2-071124			Agreement on Radio Access Network Sharing (R2-070551) added to section 10.1.7; Overview of the physical layer (R1-071251) included to section 5; Agreed text proposals on *S1 interface* included in Section 19 (R3-070289, R3-070402); Agreed text proposal R3-070409 on *network sharing* included in section 10.1.7; Agreed text proposal R3-070411 on *Area Restrictions* included in section 10.4; Agreed text proposal R3-070448 on *Assembly of Intra-E-UTRAN handover command* included in section 10.1.2.1.1; Agreed text proposal R3-070451 on *inter RAT HO principles* included in section 10.2.2; Agreed text proposal R3-070472 on *Addressing on S1-C and X2-C* added to sections 19.2 and 20.2; Agreed text proposal R3-070494 on *Initial Context Setup Function and Procedure* added to section 19; Agreed text proposal R3-070495 on *S1 Paging function and procedure* added to section 19 Figures for mapping between channels split into Uplink and Downlink parts in section 5.3.1 and 6.1.3.	0.8.0	0.9.0
2007-03	RAN#35	RP-070136			S1-U and S1-MME used throughout the document; aGW replaced by EPC when still used; Clean version for information	0.9.0	1.0.0

Change history (after approval)							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2007-03	RP-35	RP-070136	-		Approved at TSG-RAN #35 and placed under Change Control	1.0.0	8.0.0
2007-06	RP-36	RP-070399	0001	1	Changes to management-, handover-, paging- and NAS functions, node- synchronization, X2 UP protocol stack, X2 inter cell load management, IP fragmentation, intra-LTE HO, and TA relation to cells in eNB	8.0.0	8.1.0
	RP-36	RP-070494	0002	1	Update on Mobility, Security, Random Access Procedure, etc…	8.0.0	8.1.0
	RP-36	RP-070399	0003	-	Update on MBMS	8.0.0	8.1.0
2007-09	RP-37	RP-070637	0004	1	Update on Security, System Information, Mobility, MBMS and DRX	8.1.0	8.2.0
	RP-37	RP-070637	0005	1	Correction of synchronization, handover, trace, eMBMS architecture, and S1 common functions and procedures	8.1.0	8.2.0
2007-12	RP-38	RP-070913	0006	1	Clean up and update on security, scheduling, mobility, MBMS and DRX	8.2.0	8.3.0
	RP-38	RP-070913	0007	-	Mobility management	8.2.0	8.3.0
	RP-38	RP-070913	0008	-	Correction of eMBMS functions and NAS handling during X2 handover	8.2.0	8.3.0
	RP-38	RP-071048	0009	-	Update of Stage 2 to incorporate Interworking with cdma2000	8.2.0	8.3.0
2008-03	RP-39	RP-080192	0010	-	CR to 36.300 on NAS States, Persistent Scheduling, C-RNTI Allocation at Handover…	8.3.0	8.4.0
	RP-39	RP-080192	0011	-	RAN3 corrections to 36.300 (CR0011)	8.3.0	8.4.0
2008-05	RP-40	RP-080406	0012	1	Introduction of optimized FS2 for TDD	8.4.0	8.5.0
	RP-40	RP-080406	0013	1	System Information, Mobilty, QoS and miscellaneous updates	8.4.0	8.5.0
	RP-40	RP-080406	0014	-	Updates to Stage 2 based on Stage 3 progress on CDMA inter-working	8.4.0	8.5.0
	RP-40	RP-080406	0016	1	CR 0016r1 to 36.300 on CSG mobility performance guidelines	8.4.0	8.5.0
	RP-40	RP-080406	0017	-	CR to 36.300 on AS-NAS interaction	8.4.0	8.5.0
	RP-40	RP-080420	0018	1	RAN3 agreed changes to TS 36.300	8.4.0	8.5.0
	RP-40	RP-080463	0019	-	Network Interface for ETWS support based on CBS solution	8.4.0	8.5.0
2008-09	RP-41	RP-080688	0020	-	Correction for Rename of L1/L2 control channel	8.5.0	8.6.0
	RP-41	RP-080688	0021	-	CR to 36.300 on Paging Channel Description	8.5.0	8.6.0
	RP-41	RP-080688	0022	-	Proposed updates to Stage 2 for CDMA2000 handover	8.5.0	8.6.0
	RP-41	RP-080688	0023	-	CR to 36.300 on Semi-Persistent Scheduling	8.5.0	8.6.0
	RP-41	RP-080688	0024	-	CR to 36.300 on System Information	8.5.0	8.6.0
	RP-41	RP-080688	0026	-	Clarification of PDCCH description	8.5.0	8.6.0
	RP-41	RP-080688	0027	-	Removal of DRX interval threshold in 36.300	8.5.0	8.6.0

	RP-41	RP-080688	0028	-	CR on Randon Access procedure	8.5.0	8.6.0
	RP-41	RP-080688	0032	1	Transport of NAS messages by AS during Handover	8.5.0	8.6.0
	RP-41	RP-080688	0034	-	CR to 36.300 capturing home eNB conclusions of RAN2 #63	8.5.0	8.6.0
	RP-41	RP-080688	0035	-	Changes to TS36.300 agreed in RAN3#61	8.5.0	8.6.0
2008-12	RP-42	RP-081016	0036	-	CR0036 to 36.300 [Rel-8] on Contention Resolution	8.6.0	8.7.0
	RP-42	RP-081016	0037	-	CR0037 to 36.300 [Rel-8] on ETWS SIB	8.6.0	8.7.0
	RP-42	RP-081016	0038	-	Alignment of 36.300 with stage 3 on 1xRTT CSfallback	8.6.0	8.7.0
	RP-42	RP-081016	0039	1	Data handling in UE during Inter-RAT mobility	8.6.0	8.7.0
	RP-42	RP-081016	0040	-	Removing of end time for dedicated preamble	8.6.0	8.7.0
	RP-42	RP-081016	0041	-	Remove the Note about RA preamble for FS2	8.6.0	8.7.0
	RP-42	RP-081016	0042	-	Clarification of AS-NAS concatenation - Stage 2	8.6.0	8.7.0
	RP-42	RP-081016	0044	-	CR 0044 to 36.300 on Miscellaneous corrections	8.6.0	8.7.0
	RP-42	RP-081016	0046	1	Proposed CR to 36.300 [Rel-8] on Security Overview	8.6.0	8.7.0
	RP-42	RP-081016	0047	-	Proposed CR to 36.300 [Rel-8] on MBMS	8.6.0	8.7.0
	RP-42	RP-081016	0050	-	PDCP reordering function removal	8.6.0	8.7.0
	RP-42	RP-081016	0052	-	Align Number of Cell Identities	8.6.0	8.7.0
	RP-42	RP-081016	0055	2	Periodic Updates In Connected Mode DRX	8.6.0	8.7.0
	RP-42	RP-081016	0056	-	Cleaning of the figure w.r.t Handover Control Plane - CR to TS 36.300	8.6.0	8.7.0
	RP-42	RP-081016	0057	-	CR to 36.300 to capture measurement model for EUTRAN	8.6.0	8.7.0
	RP-42	RP-081016	0058	2	CSG Mobility Updates from RAN2 #63bis and RAN2 #64	8.6.0	8.7.0
	RP-42	RP-081016	0059	-	CR to 36.300 on Correction of the Description of FS2	8.6.0	8.7.0
	RP-42	RP-081016	0060	-	Changes to TS36.300 agreed in RAN3#61bis and RAN3#62	8.6.0	8.7.0
2009-03	RP-43	RP-090123	0061	1	CR to 36.300 - Clarification on RAPreambles	8.7.0	8.8.0
	RP-43	RP-090123	0062	-	CR to 36.300 on E-UTRAN Identities	8.7.0	8.8.0
	RP-43	RP-090123	0063	1	CR to 36.300 - MME in temporary UE identity	8.7.0	8.8.0
	RP-43	RP-090123	0064	-	UE with SIM in EUTRA	8.7.0	8.8.0
	RP-43	RP-090123	0065	-	Collected 36.300 corrections	8.7.0	8.8.0
	RP-43	RP-090123	0066	-	CR for 36.300 on Local NACK feature	8.7.0	8.8.0
	RP-43	RP-090123	0067	-	CR for allowed CSG list	8.7.0	8.8.0
	RP-43	RP-090123	0068	3	UE capability transfer upon handover to E-UTRA	8.7.0	8.8.0
	RP-43	RP-090123	0069	1	Inter-RAT ANR Function for CDMA2000	8.7.0	8.8.0
	RP-43	RP-090123	0070	-	Corrections to Handover Scenario	8.7.0	8.8.0
	RP-43	RP-090123	0071	-	Corrections to Security for alignment with 33.401	8.7.0	8.8.0
	RP-43	RP-090134	0072	-	Establishment of X2 Interface to HeNB GW	8.7.0	8.8.0
	RP-43	RP-090134	0073	-	Clarification of PLMN id to be used in E-CGI and Global eNB ID	8.7.0	8.8.0
	RP-43	RP-090134	0074	-	Specification of UL PDUs handling	8.7.0	8.8.0
	RP-43	RP-090134	0075	-	Update of AMBR Concept with UE-AMBR and APN-AMBR	8.7.0	8.8.0
	RP-43	RP-090134	0076	-	Aligning E-RAB release request procedure with E-RAB release indication in 36.413	8.7.0	8.8.0
	RP-43	RP-090134	0077	-	Stage 2 CR on S1 CDMA2000 Tunnelling Function	8.7.0	8.8.0
	RP-43	RP-090134	0078	-	Finalisation of dynamic configuration of the X2 and S1 interfaces	8.7.0	8.8.0
	RP-43	RP-090134	0079	-	Addition and correction of X2 procedures in stage 2 specification	8.7.0	8.8.0
	RP-43	RP-090134	0080	-	NNSF Description	8.7.0	8.8.0
	RP-43	RP-090134	0081	-	Collection of minor corrections to 36.300 agreed by RAN3	8.7.0	8.8.0
	RP-43	RP-090134	0082	-	Data Forwarding Resource Release	8.7.0	8.8.0
	RP-43	RP-090134	0083	-	Support of Paging Optimisation for CSG cells	8.7.0	8.8.0
	RP-43	RP-090134	0084	-	Handling of trace session and location reporting during UE context release	8.7.0	8.8.0
2009-06	RP-44	RP-090507	0085	-	Proposed CR to 36.300 on RLC status report triggers	8.8.0	8.9.0
	RP-44	RP-090507	0086	2	Updates on UE capability transfer and container handling for E-UTRA	8.8.0	8.9.0
	RP-44	RP-090507	0089	-	Proposed CR to 36.300 Rel-8 on FFS and outdated statements	8.8.0	8.9.0
	RP-44	RP-090508	0096	-	Removal of no longer necessary notes	8.8.0	8.9.0
	RP-44	RP-090508	0097	-	Introduction of support for Cell traffic trace	8.8.0	8.9.0
	RP-44	RP-090508	0098	-	Correction the text about the UE History Information	8.8.0	8.9.0
	RP-44	RP-090538	0102	-	Configuration transfer	8.8.0	8.9.0
2009-06	RP-44	-	-	-	TS 36.300 v9.0.0 was created based on TS 36.300 v8.9.0	8.9.0	9.0.0
	RP-44	RP-090523	0087	1	MBMS baseline for Rel-9 LTE	8.8.0	9.0.0
	RP-44	RP-090524	0088	-	Idle mode requirements to support Hybrid Cells	8.8.0	9.0.0
	RP-44	RP-090523	0099	-	eMBMS Stage 2 description	8.8.0	9.0.0
	RP-44	RP-090523	0100	-	CR for eMBMS Deployment Alternatives in 36.300	8.8.0	9.0.0
	RP-44	RP-090534	0101	1	QoS support for Hybrid CSG cells	8.8.0	9.0.0
	RP-44	RP-090537	0103	-	TAI based handover routing for HeNBs	8.8.0	9.0.0
2009-09	RP-45	RP-090906	0106	1	Correction regarding SRVCC	9.0.0	9.1.0
	RP-45	RP-090906	0108	-	Clarification on UE behaviour in case of L2 buffer overflow	9.0.0	9.1.0
	RP-45	RP-090926	0112	1	IMS Emergency Call	9.0.0	9.1.0
	RP-45	RP-090927	0113	-	Introduction of position cause for dedicated PRACH allocation	9.0.0	9.1.0
	RP-45	RP-090929	0114	-	Adding Support for Explicit Congestion Notification	9.0.0	9.1.0
	RP-45	RP-090930	0115	2	Agreements on inbound mobility to CSG	9.0.0	9.1.0

	RP-45	RP-090934	0116	-	Alignment to the stage3 specification	9.0.0	9.1.0
	RP-45	RP-090928	0117	2	MBMS agreements RAN2#66bis and RAN2#67	9.0.0	9.1.0
	RP-45	RP-090934	0123	-	CR to 36.300 for Stage 2 alignment of Enhanced CSFB to 1xRTT	9.0.0	9.1.0
	RP-45	RP-090906	0129	-	Corrections to ECGI Specification	9.0.0	9.1.0
	RP-45	RP-090932	0130	-	Support for Mobility Robustness Optimization SON Function	9.0.0	9.1.0
	RP-45	RP-090919	0132	-	Addition of missing Resource Status Reporting procedures	9.0.0	9.1.0
	RP-45	RP-090931	0133	-	HeNB Access Mode Sginalling	9.0.0	9.1.0
	RP-45	RP-090931	0134	-	QoS principles in Hybrid access cell	9.0.0	9.1.0
	RP-45	RP-090933	0136	-	Introduction of PWS (which includes ETWS and CMAS) delivery function	9.0.0	9.1.0
	RP-45	RP-090928	0137	1	Dynamic service multiplexing	9.0.0	9.1.0
	RP-45	RP-090928	0138	-	MBMS SYNC configuration	9.0.0	9.1.0
	RP-45	RP-090932	0140	-	Adding Mobility Load Balancing (MLB) use case to the SON section	9.0.0	9.1.0
	RP-45	RP-090919	0141	-	Handling of Radio Link Failure and S1 UE Context Release Request	9.0.0	9.1.0
	RP-45	RP-090919	0142	-	Introduction of informative text on Initial Context Setup failure	9.0.0	9.1.0
	RP-45	RP-090931	0143	-	Support for paging optimization with CSG membership changes	9.0.0	9.1.0
2009-12	RP-46	RP-091314	0145	-	CR on the usage of Transparent Mode MAC	9.1.0	9.2.0
	RP-46	RP-091343	0146	2	Capturing HeNB inbound mobility agreements	9.1.0	9.2.0
	RP-46	RP-091331	0148	1	ETWS correction to 36.300	9.1.0	9.2.0
	RP-46	RP-091314	0150	-	Inclusion of INTER RAT HANDOVER INFO at HO from UTRAN to GERAN	9.1.0	9.2.0
	RP-46	RP-091341	0151	1	MBMS Agreements	9.1.0	9.2.0
	RP-46	RP-091346	0152	-	Measurement Overview	9.1.0	9.2.0
	RP-46	RP-091345	0153	1	High level feature description of CMAS	9.1.0	9.2.0
	RP-46	RP-091344	0154	1	RACH optimization in 36.300	9.1.0	9.2.0
	RP-46	RP-091314	0156	1	Correction on the precondition for cell reselection to HRPD	9.1.0	9.2.0
	RP-46	RP-091346	0158	1	Miscellaneous corrections to 36.300 (Rel-9)	9.1.0	9.2.0
	RP-46	RP-091343	0162	-	Renaming Allowed CSG List (36.300, Rel-9)	9.1.0	9.2.0
	RP-46	RP-091344	0165	-	The scope and method for HO negotiations	9.1.0	9.2.0
	RP-46	RP-091151	0166	1	Access control for handover procedures to LTE CSG/hybrid cells	9.1.0	9.2.0
	RP-46	RP-091341	0167	-	Admission Control in MCE	9.1.0	9.2.0
	RP-46	RP-091341	0168	-	Clarification on SFN Synchronization	9.1.0	9.2.0
	RP-46	RP-091341	0169	1	BMSC-MCE signaling synchronization in session start message	9.1.0	9.2.0
	RP-46	RP-091341	0170	-	CR on multiplexing decision and DSP length	9.1.0	9.2.0
	RP-46	RP-091237	0171	1	M3AP stage 2	9.1.0	9.2.0
	RP-46	RP-091150	0172	1	M2AP stage 2	9.1.0	9.2.0
	RP-46	RP-091340	0173	-	CR for Transportation support for LPPa	9.1.0	9.2.0
	RP-46	RP-091341	0174	-	Introduction of MBMS for LTE: C- and U-Plane synchronisation principles	9.1.0	9.2.0
	RP-46	RP-091341	0175	-	CR on Mechanism for Consecutive Packet Loss in 36.300	9.1.0	9.2.0
	RP-46	RP-091332	0177	-	Overload reduction	9.1.0	9.2.0
	RP-46	RP-091344	0178	-	The scope and method for HO negotiations	9.1.0	9.2.0
	RP-46	RP-091344	0179	-	Introduction of MRO procedures in stage 2	9.1.0	9.2.0
	RP-46	RP-091341	0180	1	MCE to MME session start response	9.1.0	9.2.0
	RP-46	RP-091332	0182	-	In order delivery of the multiple NAS PDUs	9.1.0	9.2.0
2010-03	RP-47	RP-100305	0183	-	Correction regarding support of multiple MBSFN areas	9.2.0	9.3.0
	RP-47	RP-100305	0184	1	Correction to MBMS terminology	9.2.0	9.3.0
	RP-47	RP-100305	0185	-	Corrections on eNB muting MBSFN transmission	9.2.0	9.3.0
	RP-47	RP-100305	0186	-	Corrections to TS 36.300 on MBMS	9.2.0	9.3.0
	RP-47	RP-100306	0187	-	CR capturing HeNB inbound mobility agreeements	9.2.0	9.3.0
	RP-47	RP-100308	0188	-	Remove FFSs from RAN2 specifications	9.2.0	9.3.0
	RP-47	RP-100296	0189	-	SIM based access for Emergency calls in LTE	9.2.0	9.3.0
	RP-47	RP-100304	0191	-	RA for Positioning	9.2.0	9.3.0
	RP-47	RP-100305	0192	-	Corrections to TS36.300 on MBMS	9.2.0	9.3.0
	RP-47	RP-100308	0196	1	Stage 2 update for Full Configuration Handover for handling earlier eNB releases	9.2.0	9.3.0
	RP-47	RP-100296	0197	-	Handling Kasme mismatch for IMS Emergency calls	9.2.0	9.3.0
	RP-47	RP-100308	0199	-	Correction to MTU endpoint	9.2.0	9.3.0
	RP-47	RP-100307	0200	-	Stage 2 correction of Load Reporting for MLB	9.2.0	9.3.0
	RP-47	RP-100307	0201	-	CR for Allowed Range in Negotiation	9.2.0	9.3.0
	RP-47	RP-100307	0202	-	Clarification of definitions of HO failure cases	9.2.0	9.3.0
	RP-47	RP-100307	0203	-	Clarification on the usage of the mechanism to transfer IRAT MLB information	9.2.0	9.3.0
	RP-47	RP-100305	0204	-	MBMS Session Update in M3AP stage 2	9.2.0	9.3.0
	RP-47	RP-100305	0205	-	Correction on radio bearer configuration	9.2.0	9.3.0
	RP-47	RP-100305	0206	-	Correction to the MSAP occasion implied by SYNC timestamp	9.2.0	9.3.0
	RP-47	RP-100305	0207	-	MCCH related BCCH content	9.2.0	9.3.0

	RP-47	RP-100305	0208	-	MCCH update synchronization	9.2.0	9.3.0
	RP-47	RP-100305	0209	-	MBMS Session Update in M2AP stage 2	9.2.0	9.3.0
	RP-47	RP-100305	0210	-	CR for MBMS User Data flow synchronisation in 36.300	9.2.0	9.3.0
	RP-47	RP-100305	0211	-	MBMS User Data flow synchronisation	9.2.0	9.3.0
	RP-47	RP-100305	0212	-	Packet dropping	9.2.0	9.3.0
	RP-47	RP-100305	0213	-	SYNC sequence duration configuration in MCE	9.2.0	9.3.0
	RP-47	RP-100305	0214	-	Adding the description of simultaneously change of SIB13 and MCCH	9.2.0	9.3.0
	RP-47	RP-100305	0215	-	Addition u-plane protocol stack for M1	9.2.0	9.3.0
	RP-47	RP-100295	0217	-	Queue concurrent NAS messages if necessary for in seq delivery	9.2.0	9.3.0
	RP-47	RP-100295	0219	-	Support of X2 Inter-PLMN HO	9.2.0	9.3.0
	RP-47	RP-100300	0220	-	Clarifications on CSG process definition and mobility procedures	9.2.0	9.3.0
	RP-47	RP-100300	0221	-	Corrections of HeNB	9.2.0	9.3.0
	RP-47	RP-100300	0222	-	CSG expiry Handling	9.2.0	9.3.0
	RP-47	RP-100295	0224	-	eNB/MME Status Transfer procedure	9.2.0	9.3.0
	RP-47	RP-100308	0225	-	SPID implementation guidelines	9.2.0	9.3.0
	RP-47	RP-100308	0226	-	Handling of handover restriction for emergency call	9.2.0	9.3.0
	RP-47	RP-100300	0227	-	Some corrections for HeNB	9.2.0	9.3.0
2010-06	RP-48	RP-100556	0228	-	CR to 36.300 for CSFB to 1xRTT	9.3.0	9.4.0
	RP-48	RP-100554	0229	1	Proposed CR to 36.322 on RLC re-establishment for MBMS	9.3.0	9.4.0
	RP-48	RP-100551	0231	-	Stage2 correction for HeNB inbound handover	9.3.0	9.4.0
	RP-48	RP-100554	0235	-	CR to 36.300 on MBMS terminology	9.3.0	9.4.0
	RP-48	RP-100570	0238	1	Add MOBILITY SETTINGS CHANGE Procedure to X2-CP Procedure section	9.3.0	9.4.0
	RP-48	RP-100556	0239	-	Introduction of trace functions and procedures in S1 sections of 36.300 (contact: Motorola)	9.3.0	9.4.0
	RP-48	RP-100554	0240	-	Correction of Synchronization Sequence (contact: Alcatel-Lucent Shanghai Bell, Alcatel-Lucent)	9.3.0	9.4.0
	RP-48	RP-100552	0241	-	Clarification of CSG / Hybrid cell definitions (contact: Ericsson)	9.3.0	9.4.0
	RP-48	RP-100555	0242	-	SON stage 2 clean up (contact: Samsung, Nokia Siemens Networks)	9.3.0	9.4.0
	RP-48	RP-100555	0243	-	Updating Stage-2 on R9 Automatic Neighbour Relation Function (contact: ETRI, Samsung)	9.3.0	9.4.0
	RP-48	RP-100554	0244	1	Adding of description in EUTRAN for IP Multicast (contact: NEC)	9.3.0	9.4.0
	RP-48	RP-100556	0245	-	Correction of trace failure description in Stage 2 (contact: NEC, Motorola, Huawei)	9.3.0	9.4.0
	RP-48	RP-100554	0246	-	Correction of packet dropping (contact: Alcatel-Lucent Shanghai Bell, Alcatel-Lucent)	9.3.0	9.4.0
	RP-48	RP-100552	0247	-	Clarification of paging optimization (contact: Qualcomm)	9.3.0	9.4.0
2010-06	RP-48	-	-	-	TS 36.300 v10.0.0 was created based on TS 36.300 v9.4.0	9.4.0	10.0.0
	RP-48	RP-100561	0230	3	Stage 2 description of Carrier Aggregation	9.3.0	10.0.0
	RP-48	RP-100562	0232	1	Stage-2 description of relaying into 36.300	9.3.0	10.0.0
2010-09	RP-49	RP-100865	0248	4	Corrections and new Agreements on Carrier Aggregation	10.0.0	10.1.0
	RP-49	RP-100866	0249	1	36.300 CR for stage 2 RAN #70bis and #71 agreements of relaying	10.0.0	10.1.0
	RP-49	RP-100866	0255	-	Start-up procedure for relays	10.0.0	10.1.0
	RP-49	RP-100851	0257	-	Keeping neighbouring eNBs up-to-date with complete list of served cells (contact: NSN)	10.0.0	10.1.0
	RP-49	RP-100851	0259	-	Description of Energy Saving mechanisms (contact: Ericsson)	10.0.0	10.1.0
	RP-49	RP-100866	0260	-	Handover request routing toward RN (contact: Huawei)	10.0.0	10.1.0
	RP-49	RP-100853	0262	-	MBMS Session Update procedure (contact: Motorola)	10.0.0	10.1.0
	RP-49	RP-100860	0264	-	CS Fallback Indication and Handover Restriction List (contact: NEC)	10.0.0	10.1.0
	RP-49	RP-100866	0265	-	X2-AP non UE dedicated messages handling (contact: Huawei)	10.0.0	10.1.0
	RP-49	RP-100866	0266	-	Detach procedure for relays (contact: NTT DOCOMO)	10.0.0	10.1.0
	RP-49	RP-100866	0267	1	RN and DeNB OAMs should be able to exchange info (contact: Ericsson)	10.0.0	10.1.0
	RP-49	RP-100882	0268	-	CSFB summary	10.0.0	10.1.0
2010-12	RP-50	RP-101226	0269	2	Corrections and new agreements on Carrier Aggregation	10.1.0	10.2.0
	RP-50	RP-101206	0271	-	36300_CRxxx_Handover for Hybrid Cells	10.1.0	10.2.0
	RP-50	RP-101208	0273	-	Correction on MAC padding on MCH	10.1.0	10.2.0
	RP-50	RP-101228	0274	3	Additions and corrections to relaying description	10.1.0	10.2.0
	RP-50	RP-101231	0275	1	LTE - Stage 2 agreements on MBMS enhancement	10.1.0	10.2.0
	RP-50	RP-101214	0276	1	CR to 36.300 adding e1xCSFB support for dual Rx/Tx UE	10.1.0	10.2.0
	RP-50	RP-101214	0277	-	Editorial Clean-Up	10.1.0	10.2.0
	RP-50	RP-101229	0278	1	Introduction of enhanced ICIC	10.1.0	10.2.0
	RP-50	RP-101214	0285	2	Setting of Maximum Bit Rate (MBR) to be greater than the Guaranteed Bit Rate (GBR) over E-UTRA: MBR enforcement at eNB side.	10.1.0	10.2.0
	RP-50	RP-101214	0286	-	CR for Description of Energy Saving	10.1.0	10.2.0

	RP-50	RP-101228	0287	-	S1 non UE associated message handling	10.1.0	10.2.0
	RP-50	RP-101214	0288	-	Clarification to ANR Operation	10.1.0	10.2.0
	RP-50	RP-101228	0289	-	P-GW function embedded in DeNB and addressing requirements	10.1.0	10.2.0
	RP-50	RP-101228	0290	-	eNB Configuration Update procedure in RN startup and detach procedure	10.1.0	10.2.0
	RP-50	RP-101231	0291	-	Introduction of MCE initiated MBMS Session Start Request	10.1.0	10.2.0
	RP-50	RP-101228	0292	-	No NNSF function in RN	10.1.0	10.2.0
	RP-50	RP-101228	0293	-	S1 handover routing toward RN	10.1.0	10.2.0
	RP-50	RP-101228	0294	-	TNL address Handling	10.1.0	10.2.0
	RP-50	RP-101214	0295	-	Correction on SPID Transfer	10.1.0	10.2.0
	RP-50	RP-101231	0296	-	Support of ARP Pre-emption	10.1.0	10.2.0
	RP-50	RP-101231	0297	-	Support of MBMS Service Counting Report procedure	10.1.0	10.2.0
	RP-50	RP-101222	0298	-	Stage 2 for the X2 based mobility enhancement between HeNBs	10.1.0	10.2.0
	RP-50	RP-101230	0299	-	Introduction of event-triggered inter-RAT cell load reporting	10.1.0	10.2.0
	RP-50	RP-101216	0300	-	Introduction of LIPA function	10.1.0	10.2.0
	RP-50	RP-101228	0301	-	OAM requirements for QCI to DSCP mapping config for relays	10.1.0	10.2.0
	RP-50	RP-101228	0302	-	Non UE associated message handling	10.1.0	10.2.0
	RP-50	RP-101224	0303	-	Introduction of MTC Overload Support	10.1.0	10.2.0
	RP-50	RP-101228	0304	-	Relay Node Un Signalling Transport Support	10.1.0	10.2.0
	RP-50	RP-101214	0305	-	Complete S1 Interface Signalling Procedures	10.1.0	10.2.0
	RP-50	RP-101229	0306	1	X2 procedure and OAM requirements to support eICIC	10.1.0	10.2.0
	RP-50	RP-101228	0307	-	Stage-2 updates to RN initial attachment	10.1.0	10.2.0
	RP-50	RP-101230	0308	-	Functionality of SON MRO defined for Rel.10	10.1.0	10.2.0
2011-03	RP-51	RP-110280	0309	-	Enforcing uplink MBR in the eNodeB	10.2.0	10.3.0
	RP-51	RP-110291	0310	-	Implementation Updates on Non-UE associated S1X2 message Handling	10.2.0	10.3.0
	RP-51	RP-110292	0311	-	Introduction of 2 subsets for pattern 3	10.2.0	10.3.0
	RP-51	RP-110280	0312	-	MBR management for uplink grant	10.2.0	10.3.0
	RP-51	RP-110289	0313	-	Measurements in CA	10.2.0	10.3.0
	RP-51	RP-110289	0314	1	Annex J Clean Up	10.2.0	10.3.0
	RP-51	RP-110291	0317	-	Stage-2 relay updates	10.2.0	10.3.0
	RP-51	RP-110291	0320	2	stage-2 clarification on relay security	10.2.0	10.3.0
	RP-51	RP-110280	0321	-	stage-2 Clarification on handover and system information description	10.2.0	10.3.0
	RP-51	RP-110280	0324	-	CR to 36.300 adding UE capability indicator for dual Rx/Tx e1xCSFB	10.2.0	10.3.0
	RP-51	RP-110292	0328	1	Update of Inter-cell Interference Coordination Feature Description	10.2.0	10.3.0
	RP-51	RP-110292	0330	1	CR on ABS definition	10.2.0	10.3.0
	RP-51	RP-110280	0331	-	Fix incorrect name for CT4 GTP message in HO Procedure	10.2.0	10.3.0
	RP-51	RP-110280	0332	-	CR for MBMS User Data flow synchronisation	10.2.0	10.3.0
	RP-51	RP-110294	0333	-	Remove Procedure Lists for MBMS	10.2.0	10.3.0
	RP-51	RP-110283	0334	-	Routing functionality for X2 handover between HeNB	10.2.0	10.3.0
	RP-51	RP-110291	0335	-	Update to OAM Traffic QoS requirements	10.2.0	10.3.0
	RP-51	RP-110278	0336	-	Completion of LIPA feature	10.2.0	10.3.0
	RP-51	RP-110293	0337	-	Editorial update for inter-RAT load reporting	10.2.0	10.3.0
	RP-51	RP-110280	0338	-	Correction of MBMS Deployment consideration	10.2.0	10.3.0
	RP-51	RP-110292	0339	-	OAM requirement for time domain eICIC for macro-pico scenario	10.2.0	10.3.0
	RP-51	RP-110293	0340	-	Cleanup of MRO	10.2.0	10.3.0
	RP-51	RP-110291	0341	-	Stage-2 Updates of Relaying	10.2.0	10.3.0
	RP-51	RP-110278	0342	-	Clean up of LIPA	10.2.0	10.3.0
	RP-51	RP-110272	0344	-	Correction to usage of Handover Report for MRO	10.2.0	10.3.0
	RP-51	RP-110291	0345	-	Clarification of the RN authorisation	10.2.0	10.3.0
	RP-51	RP-110293	0346	-	Requirements for OAM control of MRO	10.2.0	10.3.0
	RP-51	RP-110278	0347	-	LIPA packets reordering in downlink	10.2.0	10.3.0
	RP-51	RP-110282	0348	-	Support for MDT	10.2.0	10.3.0
	RP-51	RP-110280	0349	-	Introduction of a Stepwise Load Reduction Indication for the Overload procedure in Stage 2	10.2.0	10.3.0
	RP-51	RP-110294	0350	-	Remove FFS on Differentiating the Receiving or Interested UEs	10.2.0	10.3.0
	RP-51	RP-110223	0352	-	Correction on MBMS Reset procedure	10.2.0	10.3.0
	RP-51	RP-110291	0353	-	Clarification of RN Architecture and Startup	10.2.0	10.3.0
	RP-51	RP-110291	0354	-	Miscellaneous small corrections to TS 36.300 on Relay	10.2.0	10.3.0
	RP-51	RP-110294	0355	-	Suspension and Resume function	10.2.0	10.3.0
	RP-51	RP-110280	0356	-	Correction on physical layer part on TS36.300	10.2.0	10.3.0
	RP-51	RP-110405	0358	3	CSFB to GERAN	10.2.0	10.3.0
2011-06	RP-52	RP-110839	0359	-	clarification on redirection in 36.300	10.3.0	10.4.0
	RP-52	RP-110850	0360	-	CR to 36.300 for eICIC updates	10.3.0	10.4.0
	RP-52	RP-110836	0361	-	Update of the MCCH Structure description for CountingRequest message	10.3.0	10.4.0

	RP-52	RP-110839	0362	-	Miscellaneous corrections to 36.300	10.3.0	10.4.0
	RP-52	RP-110850	0363	1	Correctoin on eICIC description	10.3.0	10.4.0
	RP-52	RP-110839	0365	2	Some small corrections to 36.300	10.3.0	10.4.0
	RP-52	RP-110846	0369	-	UE receiver window for Inter-band non-contiguous CA	10.3.0	10.4.0
	RP-52	RP-110843	0370	1	Capture the stage2 RLF agreement	10.3.0	10.4.0
	RP-52	RP-110839	0372	-	Clarification on MME selection	10.3.0	10.4.0
	RP-52	RP-110839	0373	-	Correction on the Release of Supporting SRVCC	10.3.0	10.4.0
	RP-52	RP-110839	0374	-	Correction of the area restrictions description	10.3.0	10.4.0
	RP-52	RP-110839	0375	-	Correcting the Note regarding the usage of the GUMMEI	10.3.0	10.4.0
	RP-52	RP-110836	0376	-	Correction of Counting Function	10.3.0	10.4.0
	RP-52	RP-110836	0377	-	Correction of MBMS Service Suspension and Resumption Function	10.3.0	10.4.0
	RP-52	RP-110849	0378	-	Relaying Stage 2 Corrections	10.3.0	10.4.0
	RP-52	RP-110839	0379	-	Correction of Reset	10.3.0	10.4.0
	RP-52	RP-110839	0380	-	Cleanup general topics before Rel-10 closure	10.3.0	10.4.0
	RP-52	RP-110839	0381	-	Cleanup of HeNB related topics before Rel-10 closure	10.3.0	10.4.0
	RP-52	RP-110713	0382	-	Clarification to detection of unnecessary IRAT handover	10.3.0	10.4.0
	RP-52	RP-110714	0383	-	Release the UE context in the source HeNB-GW after HeNB-HeNB X2 HO	10.3.0	10.4.0
	RP-52	RP-110851	0384	-	Corrections of MRO	10.3.0	10.4.0
2011-09	RP-53	RP-111280	0388	-	RLC/MAC synchronization for MBSFN	10.4.0	10.5.0
	RP-53	RP-111297	0390	-	Miscellaneous correction to 36.300 on Security Overview	10.4.0	10.5.0
	RP-53	RP-111297	0391	-	Corrections to 1xRTT CS Fallback	10.4.0	10.5.0
	RP-53	RP-111287	0392	-	Corrections on MCCH and MBMS counting	10.4.0	10.5.0
	RP-53	RP-111297	0393	-	Correction on the MME Direct Information Transfer procedure	10.4.0	10.5.0
	RP-53	RP-111290	0394	-	Security Mechanism for H(e)NB "no-IPsec" usage option	10.4.0	10.5.0
	RP-53	RP-111287	0395	-	Correction of MBMS Suspension Function	10.4.0	10.5.0
	RP-53	RP-111288	0396	-	Cleanup of editor's notes for relay	10.4.0	10.5.0
	RP-53	RP-111292	0397	-	Correction on LIPA PDN Deactivation for X2 HO	10.4.0	10.5.0
	RP-53	RP-111290	0398	-	Correction of Release Indication	10.4.0	10.5.0
	RP-53	RP-111297	0399	-	Correction of Trace Function	10.4.0	10.5.0
	RP-53	RP-111288	0400	-	RN security correction	10.4.0	10.5.0
	RP-53	RP-111297	0401	-	Correction of Emergency Call	10.4.0	10.5.0
	RP-53	RP-111290	0402	-	Overload Handling by HeNB GW	10.4.0	10.5.0
	RP-53	RP-111287	0403	-	Synchronisation of MBMS Service Resumption	10.4.0	10.5.0
	RP-53	RP-111287	0404	-	Miscellaneous Correction for MBMS	10.4.0	10.5.0
	RP-53	RP-111291	0405	1	Small correction on unnecessary IRAT HO	10.4.0	10.5.0
	RP-53	RP-111297	0406	-	Clarification of TAI handling between MME and HeNB(-GW)	10.4.0	10.5.0
2011-12	RP-54	RP-111714	0411	-	Correction on RN security	10.5.0	10.6.0
	RP-54	RP-111711	0413	-	HeNB Architecture Clarification	10.5.0	10.6.0
	RP-54	RP-111604	0414	1	Correction of Support for RACH optimization	10.5.0	10.6.0
	RP-54	RP-111711	0415	-	Correction of inbound mobility	10.5.0	10.6.0
	RP-54	RP-111714	0416	-	Correction of MBMS Resumption Function	10.5.0	10.6.0
	RP-54	RP-111711	0418	-	Routing of MME Direct Information Transfer message	10.5.0	10.6.0
	RP-54	RP-111714	0419	-	Correction of support for Mobility Robustness Optimisation	10.5.0	10.6.0
	RP-54	RP-111714	0420	-	Clarification of MRO Unnecessary Handover	10.5.0	10.6.0
	RP-54	RP-111716	0421	-	Correction of the MRO stage-2 description	10.5.0	10.6.0
2011-12	RP-54	-	-	-	TS 36.300 v11.0.0 was created based on TS 36.300 v10.6.0	10.6.0	11.0.0
	RP-54	RP-111644	0417	1	MME behavior in case of broken SCTP connection	10.5.0	11.0.0
	RP-54	RP-111721	0422	-	Addition of M3 Setup	10.5.0	11.0.0
	RP-54	RP-111721	0423	-	Correction of MCCH Update Synchronization mechanism	10.5.0	11.0.0
2012-03	RP-55	RP-120327	0425	-	Correction to the handling of RRC container during the inter-RAT handover	11.0.0	11.1.0
	RP-55	RP-120329	0431	-	Correction on MME/eNB behaviour in case of broken SCTP connection	11.0.0	11.1.0
	RP-55	RP-120329	0432	-	Correction of Emergency Call	11.0.0	11.1.0
	RP-55	RP-120232	0434	-	Correction on unnecessary HO	11.0.0	11.1.0
	RP-55	RP-120326	0435	-	CR for clarification of eMBMS architecture description	11.0.0	11.1.0
	RP-55	RP-120326	0437	-	Restriction on Rel-10 X2-based handover between HeNBs	11.0.0	11.1.0
2012-06	RP-56	RP-120821	0439	3	Introduction of service continuity improvements for MBMS on LTE	11.1.0	11.2.0
	RP-56	RP-120807	0441	-	Clarification on networking sharing for MBMS	11.1.0	11.2.0
	RP-56	RP-120812	0444	-	Correction to Measurement Restriction Description of eICIC in 36.300	11.1.0	11.2.0
	RP-56	RP-120817	0445	-	Introduction of Absolute Priority Based Cell Reselection to CELL_FACH in 36.300	11.1.0	11.2.0
	RP-56	RP-120823	0446	1	Stage-2 CR on signalling and procedure for interference avoidance for IDC	11.1.0	11.2.0
	RP-56	RP-120822	0450	3	Stage 2 CR on eDDA UE assistance information	11.1.0	11.2.0

	RP-56	RP-120813	0452	1	Korean Public Alert System (KPAS) and EU-Alert in relation to CMAS	11.1.0	11.2.0
	RP-56	RP-120819	0453	1	Introduction of MDT enhancements - multi-PLMN RLF Report	11.1.0	11.2.0
	RP-56	RP-120811	0456	-	Correction on Session Start and Session Stop procedure	11.1.0	11.2.0
	RP-56	RP-120812	0457	-	Correction of the MRO definitions	11.1.0	11.2.0
	RP-56	RP-120812	0459	-	Clarification on MME's support for inter-PLMN handover to CSG and hybrid cells	11.1.0	11.2.0
	RP-56	RP-120811	0461	-	GUMMEI handling by RN and HeNB	11.1.0	11.2.0
	RP-56	RP-120811	0462	-	Clarification on TAC in X2 Setup	11.1.0	11.2.0
	RP-56	RP-120811	0463	-	Correction of Session Update	11.1.0	11.2.0
	RP-56	RP-120824	0464	-	Addition of Energy Saving function for Inter-RAT scenario	11.1.0	11.2.0
	RP-56	RP-120807	0465	-	MCE and MBSFN role for distributed MCE architecture	11.1.0	11.2.0
	RP-56	RP-120881	0470	1	PCI range note on RAN sharing	11.1.0	11.2.0
2012-09	RP-57	RP-121371	0472	-	Introduction of EAB	11.2.0	11.3.0
	RP-57	RP-121395	0475	-	Corrections to physical channels of RN and the number of measurement types	11.2.0	11.3.0
	RP-57	RP-121374	0476	1	Network Based Positioning Support	11.2.0	11.3.0
	RP-57	RP-121379	0481	-	36300_CR on the addition of the stage-2 agreements on IDC	11.2.0	11.3.0
	RP-57	RP-121377	0483	1	Introduction of Carrier aggregation enhancements	11.2.0	11.3.0
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	RP-57	RP-121382	0495	-	Verification of HeNB Identity	11.2.0	11.3.0
	RP-57	RP-121140	0496	-	Introduction of UE Radio Capability Match procedure	11.2.0	11.3.0
	RP-57	RP-121372	0497	-	Support for inter-RAT MRO	11.2.0	11.3.0
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	RP-57	RP-121372	0499	-	Description of the failure information retrieval function for SON MRO purposes	11.2.0	11.3.0
	RP-57	RP-121372	0500	-	Description of the inter-RAT ping-pong problem	11.2.0	11.3.0
	RP-57	RP-121138	0501	-	Addition of UE measurements solution for Inter-RAT energy saving scenario	11.2.0	11.3.0
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	RP-58	RP-121959	0505	-	CR to 36.300 on introducing ROHC context continue for intra-ENB handover	11.3.0	11.4.0
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	RP-58	RP-121948	0534	-	UE context release in source HeNB GW after X2 handover from HeNB to eNB	11.3.0	11.4.0
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2015-09	RP-69	RP-151441	0786	1	Sidelink terminology alignment in TS 36.300	12.6.0	12.7.0
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Protocol specification
(Release 12)





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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and E-UTRAN as well as for the radio interface between RN and E-UTRAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source eNB and target eNB upon inter eNB handover;
- the radio related information transported in a transparent container between a source or target eNB and another system upon inter RAT handover.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] Void.

[3] 3GPP TS 36.302: "Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer ".

[4] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); UE Procedures in Idle Mode".

[5] 3GPP TS 36.306 "Evolved Universal Terrestrial Radio Access (E-UTRA); UE Radio Access Capabilities".

[6] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".

[7] 3GPP TS 36.322:"Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification".

[8] 3GPP TS 36.323: "Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) Specification".

[9] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRAN); Overall description; Stage 2".

[10] 3GPP TS 22.011: "Service accessibility".

[11] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[12] 3GPP2 C.S0002-F v1.0: "Physical Layer Standard for cdma2000 Spread Spectrum Systems".

[13] ITU-T Recommendation X.680 (07/2002) "Information Technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation" (Same as the ISO/IEC International Standard 8824-1).

[14] ITU-T Recommendation X.681 (07/2002) "Information Technology - Abstract Syntax Notation One (ASN.1): Information object specification" (Same as the ISO/IEC International Standard 8824-2).

[15] ITU-T Recommendation X.691 (07/2002) "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).

[16] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[17] 3GPP TS 25.101: "Universal Terrestrial Radio Access (UTRA); User Equipment (UE) radio transmission and reception (FDD)".

[18] 3GPP TS 25.102: "Universal Terrestrial Radio Access (UTRA); User Equipment (UE) radio transmission and reception (TDD)".

[19] 3GPP TS 25.331:"Universal Terrestrial Radio Access (UTRA); Radio Resource Control (RRC); Protocol specification".

[20] 3GPP TS 45.005: "Radio transmission and reception".

[21] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[22] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[23] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[24] 3GPP2 C.S0057-E v1.0: "Band Class Specification for cdma2000 Spread Spectrum Systems".

[25] 3GPP2 C.S0005-F v1.0: "Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems".

[26] 3GPP2 C.S0024-C v2.0: "cdma2000 High Rate Packet Data Air Interface Specification".

[27] 3GPP TS 23.003: "Numbering, addressing and identification".

[28] 3GPP TS 45.008: "Radio subsystem link control".

[29] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[30] 3GPP TS 25.123: "Requirements for Support of Radio Resource Management (TDD)".

[31] 3GPP TS 36.401: "Evolved Universal Terrestrial Radio Access (E-UTRA); Architecture description".

[32] 3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security architecture".

[33] 3GPP2 A.S0008-C v4.0: "Interoperability Specification (IOS) for High Rate Packet Data (HRPD) Radio Access Network Interfaces with Session Control in the Access Network"

[34] 3GPP2 C.S0004-F v1.0: "Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems"

[35] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[36] 3GPP TS 44.060: "General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol".

[37] 3GPP TS 23.041: "Technical realization of Cell Broadcast Service (CBS)".

[38] 3GPP TS 23.038: "Alphabets and Language".

[39] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access (E-UTRAN); S1 Application Protocol (S1 AP)".

[40] 3GPP TS 25.304: "Universal Terrestrial Radio Access (UTRAN); User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode".

[41] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[42] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[43] 3GPP TS 44.005: "Data Link (DL) Layer General Aspects".

[44] 3GPP2 C.S0087-A v2.0: "E-UTRAN - cdma2000 HRPD Connectivity and Interworking Air Interface Specification"

[45] 3GPP TS 44.018: "Mobile radio interface layer 3 specification; Radio Resource Control (RRC) protocol".

[46] 3GPP TS 25.223: "Spreading and modulation (TDD)".

[47] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".

[48] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer - Measurements".

[49] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core network protocols; Stage 3".

[50] 3GPP TS 45.010:"Radio subsystem synchronization".

[51] 3GPP TS 23.272: "Circuit Switched Fallback in Evolved Packet System; Stage 2".

[52] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN)".

[53] 3GPP2 C.S0097-0 v3.0: "E-UTRAN - cdma2000 1x Connectivity and Interworking Air Interface Specification".

[54] 3GPP TS 36.355: "LTE Positioning Protocol (LPP)".

[55] 3GPP TS 36.216: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer for relaying operation".

[56] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".

[57] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".

[58] 3GPP TS 32.422: "Telecommunication management; Subsriber and equipment trace; Trace control and confiuration management".

[59] 3GPP TS 22.368: "Service Requirements for Machine Type Communications; Stage 1".

[60] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

[61] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); Stage 2".

[62] 3GPP TS 22.146: "Multimedia Broadcast/Multicast Service (MBMS); Stage 1".

[63] 3GPP TR 36.816: "Evolved Universal Terrestrial Radio Access (E-UTRA); Study on signalling and procedure for interference avoidance for in-device coexistence".

[64] IS-GPS-200F: "Navstar GPS Space Segment/Navigation User Segment Interfaces".

[65] 3GPP TS 25.307: "Requirement on User Equipments (UEs) supporting a release-independent frequency band".

[66] 3GPP TS 24.312: "Access Network Discovery and Selection Function (ANDSF) Management Object (MO)".

[67] IEEE 802.11-2012, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, IEEE Std.

[68] 3GPP TS 23.303: "Proximity-based services (ProSe); Stage 2".

[69] 3GPP TS 24.334: "Proximity-services (ProSe) User Equipment (UE) to ProSe function protocol aspects; Stage 3".

[70] 3GPP TS 24.333: "Proximity-services (ProSe) Management Objects (MO)".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Commercial Mobile Alert System: Public Warning System that delivers *Warning Notifications* provided by *Warning Notification Providers* to CMAS capable UEs.

Common access barring parameters: The common access barring parameters refer to the access class barring parameters that are broadcast in *SystemInformationBlockType2* outside the list of PLMN specific parameters (i.e. in *ac-BarringPerPLMN-List*).

CSG member cell: A cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN and for which the CSG whitelist of the UE includes an entry comprising cell's CSG ID and the respective PLMN identity.

Dual Connectivity: A UE in RRC_CONNECTED is configured with Dual Connectivity when configured with a Master and a Secondary Cell Group.

EU-Alert: Public Warning System that delivers Warning Notifications provided by Warning Notification Providers using the same AS mechanisms as defined for CMAS.

Field: The individual contents of an information element are referred as fields.

Floor: Mathematical function used to 'round down' i.e. to the nearest integer having a lower or equal value.

Information element: A structural element containing a single or multiple fields is referred as information element.

Korean Public Alert System (KPAS): Public Warning System that delivers Warning Notifications provided by Warning Notification Providers using the same AS mechanisms as defined for CMAS.

Master Cell Group: For a UE not configured with DC, the MCG comprises all serving cells. For a UE configured with DC, the MCG concerns a subset of the serving cells comprising of the PCell and zero or more secondary cells.

MBMS service: MBMS bearer service as defined in TS 23.246 [56] (i.e. provided via an MRB).

Primary Cell: The cell, operating on the primary frequency, in which the UE either performs the initial connection establishment procedure or initiates the connection re-establishment procedure, or the cell indicated as the primary cell in the handover procedure.

Primary Secondary Cell: The SCG cell in which the UE is instructed to perform random access when performing the SCG change procedure.

Primary Timing Advance Group: Timing Advance Group containing the PCell or the PSCell.

Secondary Cell: A cell, operating on a secondary frequency, which may be configured once an RRC connection is established and which may be used to provide additional radio resources.

Secondary Cell Group: For a UE configured with DC, the subset of serving cells not part of the MCG, i.e. comprising of the PSCell and zero or more other secondary cells.

Secondary Timing Advance Group: Timing Advance Group neither containing the PCell nor the PSCell. A secondary timing advance group contains at least one cell with configured uplink.

Serving Cell: For a UE in RRC_CONNECTED not configured with CA/ DC there is only one serving cell comprising of the primary cell. For a UE in RRC_CONNECTED configured with CA/ DC the term 'serving cells' is used to denote the set of one or more cells comprising of the primary cell and all secondary cells.

Sidelink: UE to UE interface for sidelink communication and sidelink discovery. The sidelink corresponds to the PC5 interface as defined in TS 23.303 [68].

Sidelink communication: AS functionality enabling ProSe Direct Communication as defined in TS 23.303 [68], between two or more nearby UEs, using E-UTRA technology but not traversing any network node.

Sidelink discovery: AS functionality enabling ProSe Direct Discovery as defined in TS 23.303 [68], using E-UTRA technology but not traversing any network node.

Timing Advance Group: A group of serving cells that is configured by RRC and that, for the cells with an UL configured, use the same timing reference cell and the same Timing Advance value. A Timing Advance Group only includes cells of the same cell group i.e. it either includes MCG cells or SCG cells.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

1xRTT	CDMA2000 1x Radio Transmission Technology
ACK	Acknowledgement
AM	Acknowledged Mode
ANDSF	Access Network Discovery and Selection Function
ARQ	Automatic Repeat Request
AS	Access Stratum
ASN.1	Abstract Syntax Notation One
BCCH	Broadcast Control Channel
BCD	Binary Coded Decimal
BCH	Broadcast Channel
BLER	Block Error Rate
CA	Carrier Aggregation
CCCH	Common Control Channel
CCO	Cell Change Order
CG	Cell Group
CMAS	Commercial Mobile Alert Service
CP	Control Plane
C-RNTI	Cell RNTI
CRS	Cell-specific Reference Signal
CSFB	CS fallback
CSG	Closed Subscriber Group
CSI	Channel State Information
DC	Dual Connectivity
DCCH	Dedicated Control Channel
DCI	Downlink Control Information
DFN	Direct Frame Number
DL	Downlink
DL-SCH	Downlink Shared Channel
DRB	(user) Data Radio Bearer
DRX	Discontinuous Reception

DTCH	Dedicated Traffic Channel
EAB	Extended Access Barring
EHPLMN	Equivalent Home Public Land Mobile Network
eIMTA	Enhanced Interference Management and Traffic Adaptation
ENB	Evolved Node B
EPC	Evolved Packet Core
EPDCCH	Enhanced Physical Downlink Control Channel
EPS	Evolved Packet System
ETWS	Earthquake and Tsunami Warning System
E-UTRA	Evolved Universal Terrestrial Radio Access
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
FDD	Frequency Division Duplex
FFS	For Further Study
GERAN	GSM/EDGE Radio Access Network
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communications
HARQ	Hybrid Automatic Repeat Request
HFN	Hyper Frame Number
HPLMN	Home Public Land Mobile Network
HRPD	CDMA2000 High Rate Packet Data
IDC	In-Device Coexistence
IE	Information element
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
ISM	Industrial, Scientific and Medical
kB	Kilobyte (1000 bytes)
L1	Layer 1
L2	Layer 2
L3	Layer 3
MAC	Medium Access Control
MBMS	Multimedia Broadcast Multicast Service
MBSFN	Multimedia Broadcast multicast service Single Frequency Network
MCG	Master Cell Group
MDT	Minimization of Drive Tests
MIB	Master Information Block
MO	Mobile Originating
MRB	MBMS Point to Multipoint Radio Bearer
MRO	Mobility Robustness Optimisation
MSI	MCH Scheduling Information
MT	Mobile Terminating
N/A	Not Applicable
NACC	Network Assisted Cell Change
NAICS	Network Assisted Interference Cancellation/Suppression
NAS	Non Access Stratum
PCCH	Paging Control Channel
PCell	Primary Cell
PDCCH	Physical Downlink Control Channel
PDCP	Packet Data Convergence Protocol
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
ProSe	Proximity based Services
PSCell	Primary Secondary Cell
PTAG	Primary Timing Advance Group
PUCCH	Physical Uplink Control Channel
QoS	Quality of Service
RACH	Random Access CHannel
RAT	Radio Access Technology
RB	Radio Bearer
RLC	Radio Link Control
RN	Relay Node
RNTI	Radio Network Temporary Identifier
ROHC	RObust Header Compression

RPLMN	Registered Public Land Mobile Network
RRC	Radio Resource Control
RSCP	Received Signal Code Power
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
SAE	System Architecture Evolution
SAP	Service Access Point
SC	Sidelink Control
SCell	Secondary Cell
SCG	Secondary Cell Group
SFN	System Frame Number
SI	System Information
SIB	System Information Block
SI-RNTI	System Information RNTI
SL	Sidelink
SLSS	Sidelink Synchronisation Signal
SMC	Security Mode Control
SPS	Semi-Persistent Scheduling
SR	Scheduling Request
SRB	Signalling Radio Bearer
SSAC	Service Specific Access Control
STAG	Secondary Timing Advance Group
S-TMSI	SAE Temporary Mobile Station Identifier
TA	Tracking Area
TAG	Timing Advance Group
TDD	Time Division Duplex
TDM	Time Division Multiplexing
TM	Transparent Mode
TPC-RNTI	Transmit Power Control RNTI
T-RPT	Time Resource Pattern of Transmission
TTT	Time To Trigger
UE	User Equipment
UICC	Universal Integrated Circuit Card
UL	Uplink
UL-SCH	Uplink Shared Channel
UM	Unacknowledged Mode
UP	User Plane
UTC	Coordinated Universal Time
UTRAN	Universal Terrestrial Radio Access Network
VoLTE	Voice over Long Term Evolution
WLAN	Wireless Local Area Network

In the ASN.1, lower case may be used for some (parts) of the above abbreviations e.g. c-RNTI

4 General

4.1 Introduction

In this specification, (parts of) procedures and messages specified for the UE equally apply to the RN for functionality necessary for the RN. There are also (parts of) procedures and messages which are only applicable to the RN in its communication with the E-UTRAN, in which case the specification denotes the RN instead of the UE. Such RN-specific aspects are not applicable to the UE.

This specification is organised as follows:

- sub-clause 4.2 describes the RRC protocol model;
- sub-clause 4.3 specifies the services provided to upper layers as well as the services expected from lower layers;
- sub-clause 4.4 lists the RRC functions;

- clause 5 specifies RRC procedures, including UE state transitions;
- clause 6 specifies the RRC message in a mixed format (i.e. tabular & ASN.1 together);
- clause 7 specifies the variables (including protocol timers and constants) and counters to be used by the UE;
- clause 8 specifies the encoding of the RRC messages;
- clause 9 specifies the specified and default radio configurations;
- clause 10 specifies the RRC messages transferred across network nodes;
- clause 11 specifies the UE capability related constraints and performance requirements.

4.2 Architecture

4.2.1 UE states and state transitions including inter RAT

A UE is in RRC_CONNECTED when an RRC connection has been established. If this is not the case, i.e. no RRC connection is established, the UE is in RRC_IDLE state. The RRC states can further be characterised as follows:

- **RRC_IDLE**:
  - A UE specific DRX may be configured by upper layers.
  - UE controlled mobility;
  - The UE:
    - Monitors a Paging channel to detect incoming calls, system information change, for ETWS capable UEs, ETWS notification, and for CMAS capable UEs, CMAS notification;
    - Performs neighbouring cell measurements and cell (re-)selection;
    - Acquires system information.
    - Performs logging of available measurements together with location and time for logged measurement configured UEs.
- **RRC_CONNECTED**:
  - Transfer of unicast data to/from UE.
  - At lower layers, the UE may be configured with a UE specific DRX.
  - For UEs supporting CA, use of one or more SCells, aggregated with the PCell, for increased bandwidth;
  - For UEs supporting DC, use of one SCG, aggregated with the MCG, for increased bandwidth;
  - Network controlled mobility, i.e. handover and cell change order with optional network assistance (NACC) to GERAN;
  - The UE:
    - Monitors a Paging channel and/ or System Information Block Type 1 contents to detect system information change, for ETWS capable UEs, ETWS notification, and for CMAS capable UEs, CMAS notification;
    - Monitors control channels associated with the shared data channel to determine if data is scheduled for it;
    - Provides channel quality and feedback information;
    - Performs neighbouring cell measurements and measurement reporting;
    - Acquires system information.

The following figure not only provides an overview of the RRC states in E-UTRA, but also illustrates the mobility support between E-UTRAN, UTRAN and GERAN.

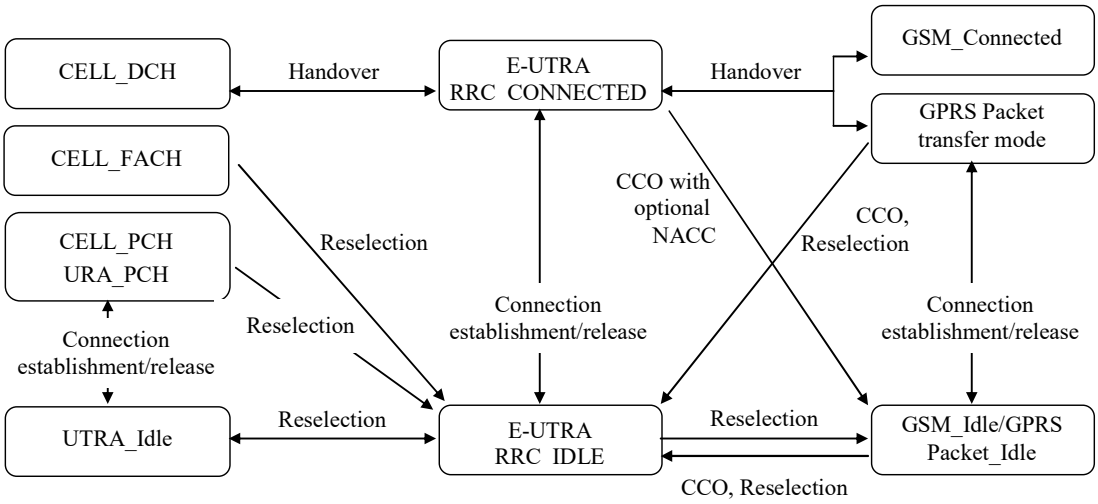


Figure 4.2.1-1: E-UTRA states and inter RAT mobility procedures, 3GPP

The following figure illustrates the mobility support between E-UTRAN, CDMA2000 1xRTT and CDMA2000 HRPD. The details of the CDMA2000 state models are out of the scope of this specification.

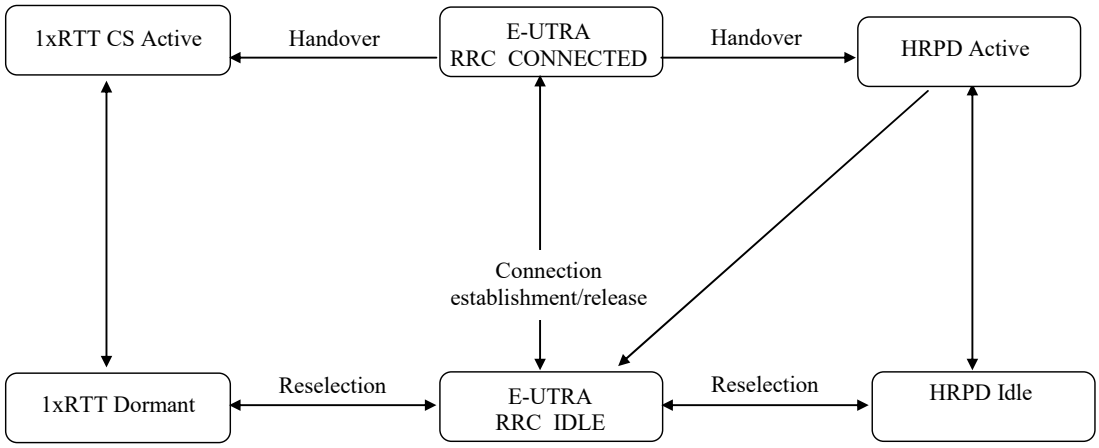


Figure 4.2.1-2: Mobility procedures between E-UTRA and CDMA2000

The inter-RAT handover procedure(s) supports the case of signalling, conversational services, non-conversational services and combinations of these.

In addition to the state transitions shown in Figure 4.2.1-1 and Figure 4.2.1-2, there is support for connection release with redirection information from E-UTRA RRC_CONNECTED to GERAN, UTRAN and CDMA2000 (HRPD Idle/ 1xRTT Dormant mode).

4.2.2 Signalling radio bearers

"Signalling Radio Bearers" (SRBs) are defined as Radio Bearers (RB) that are used only for the transmission of RRC and NAS messages. More specifically, the following three SRBs are defined:

- SRB0 is for RRC messages using the CCCH logical channel;
- SRB1 is for RRC messages (which may include a piggybacked NAS message) as well as for NAS messages prior to the establishment of SRB2, all using DCCH logical channel;
- SRB2 is for RRC messages which include logged measurement information as well as for NAS messages, all using DCCH logical channel. SRB2 has a lower-priority than SRB1 and is always configured by E-UTRAN after security activation.

In downlink piggybacking of NAS messages is used only for one dependant (i.e. with joint success/ failure) procedure: bearer establishment/ modification/ release. In uplink NAS message piggybacking is used only for transferring the initial NAS message during connection setup.

NOTE: The NAS messages transferred via SRB2 are also contained in RRC messages, which however do not include any RRC protocol control information.

Once security is activated, all RRC messages on SRB1 and SRB2, including those containing NAS or non-3GPP messages, are integrity protected and ciphered by PDCP. NAS independently applies integrity protection and ciphering to the NAS messages.

For a UE configured with DC, all RRC messages, regardless of the SRB used and both in downlink and uplink, are transferred via the MCG.

4.3 Services

4.3.1 Services provided to upper layers

The RRC protocol offers the following services to upper layers:

- Broadcast of common control information;
- Notification of UEs in RRC_IDLE, e.g. about a terminating call, for ETWS, for CMAS;
- Transfer of dedicated control information, i.e. information for one specific UE.

4.3.2 Services expected from lower layers

In brief, the following are the main services that RRC expects from lower layers:

- PDCP: integrity protection and ciphering;
- RLC: reliable and in-sequence transfer of information, without introducing duplicates and with support for segmentation and concatenation.

Further details about the services provided by Packet Data Convergence Protocol layer (e.g. integrity and ciphering) are provided in TS 36.323 [8]. The services provided by Radio Link Control layer (e.g. the RLC modes) are specified in TS 36.322 [7]. Further details about the services provided by Medium Access Control layer (e.g. the logical channels) are provided in TS 36.321 [6]. The services provided by physical layer (e.g. the transport channels) are specified in TS 36.302 [3].

4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:
  - Including NAS common information;
  - Information applicable for UEs in RRC_IDLE, e.g. cell (re-)selection parameters, neighbouring cell information and information (also) applicable for UEs in RRC_CONNECTED, e.g. common channel configuration information.

  - Including ETWS notification, CMAS notification;

- RRC connection control:

  - Paging;

  - Establishment/ modification/ release of RRC connection, including e.g. assignment/ modification of UE identity (C-RNTI), establishment/ modification/ release of SRB1 and SRB2, access class barring;

  - Initial security activation, i.e. initial configuration of AS integrity protection (SRBs) and AS ciphering (SRBs, DRBs);

  - For RNs, configuration of AS integrity protection for DRBs;

  - RRC connection mobility including e.g. intra-frequency and inter-frequency handover, associated security handling, i.e. key/ algorithm change, specification of RRC context information transferred between network nodes;

  - Establishment/ modification/ release of RBs carrying user data (DRBs);

  - Radio configuration control including e.g. assignment/ modification of ARQ configuration, HARQ configuration, DRX configuration;

  - For RNs, RN-specific radio configuration control for the radio interface between RN and E-UTRAN;

  - In case of CA, cell management including e.g. change of PCell, addition/ modification/ release of SCell(s) and addition/modification/release of STAG(s);

  - In case of DC, cell management including e.g. change of PSCell, addition/ modification/ release of SCG cell(s) and addition/modification/release of SCG TAG(s).

  - QoS control including assignment/ modification of semi-persistent scheduling (SPS) configuration information for DL and UL, assignment/ modification of parameters for UL rate control in the UE, i.e. allocation of a priority and a prioritised bit rate (PBR) for each RB;

  - Recovery from radio link failure;

- Inter-RAT mobility including e.g. security activation, transfer of RRC context information;

- Measurement configuration and reporting:

  - Establishment/ modification/ release of measurements (e.g. intra-frequency, inter-frequency and inter- RAT measurements);

  - Setup and release of measurement gaps;

  - Measurement reporting;

- Other functions including e.g. transfer of dedicated NAS information and non-3GPP dedicated information, transfer of UE radio access capability information, support for E-UTRAN sharing (multiple PLMN identities);

- Generic protocol error handling;

- Support of self-configuration and self-optimisation;

- Support of measurement logging and reporting for network performance optimisation [60];

NOTE: Random access is specified entirely in the MAC including initial transmission power estimation.

5 Procedures

5.1 General

5.1.1 Introduction

The procedural requirements are structured according to the main functional areas: system information (5.2), connection control (5.3), inter-RAT mobility (5.4) and measurements (5.5). In addition sub-clause 5.6 covers other aspects e.g. NAS dedicated information transfer, UE capability transfer, sub-clause 5.7 specifies the generic error handling, sub-clause 5.8 covers MBMS, sub-clause 5.9 covers RN-specific procedures and sub-clause 5.10 covers sidelink.

5.1.2 General requirements

The UE shall:

1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;

NOTE 1: E-UTRAN may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.

1> within a sub-clause execute the steps according to the order specified in the procedural description;

1> consider the term 'radio bearer' (RB) to cover SRBs and DRBs but not MRBs unless explicitly stated otherwise;

1> set the *rrc-TransactionIdentifier* in the response message, if included, to the same value as included in the message received from E-UTRAN that triggered the response message;

1> upon receiving a choice value set to *setup*:

2> apply the corresponding received configuration and start using the associated resources, unless explicitly specified otherwise;

1> upon receiving a choice value set to *release*:

2> clear the corresponding configuration and stop using the associated resources;

1> upon handover to E-UTRA; or

1> upon receiving an *RRCConnectionReconfiguration* message including the *fullConfig*:

2> apply the Conditions in the ASN.1 for inclusion of the fields for the DRB/PDCP/RLC setup during the reconfiguration of the DRBs included in the *drb-ToAddModList*;

NOTE 2: At each point in time, the UE keeps a single value for each field except for during handover when the UE temporarily stores the previous configuration so it can revert back upon handover failure. In other words: when the UE reconfigures a field, the existing value is released except for during handover.

NOTE 3: Although not explicitly stated, the UE initially considers all functionality to be deactivated/ released until it is explicitly stated that the functionality is setup/ activated. Correspondingly, the UE initially considers lists to be empty e.g. the list of radio bearers, the list of measurements.

1> upon receiving an extension field comprising the entries in addition to the ones carried by the original field (regardless of whether E-UTRAN may signal more entries in total); apply the following generic behaviour if explicitly stated to be applicable:

2> create a combined list by concatenating the additional entries included in the extension field to the original field while maintaining the order among both the original and the additional entries;

2> for the combined list, created according to the previous, apply the same behaviour as defined for the original field;

NOTE 4: A field comprising a list of entries normally includes 'list' in the field name. The typical way to extend (the size of) such a list is to introduce a field comprising the additional entries, which should include 'listExt' in the name of the field/ IE. E.g. *field1List-RAT*, *field1ListExt-RAT*.

5.2 System information

5.2.1 Introduction

5.2.1.1 General

System information is divided into the *MasterInformationBlock* (MIB) and a number of *SystemInformationBlocks* (SIBs). The MIB includes a limited number of most essential and most frequently transmitted parameters that are needed to acquire other information from the cell, and is transmitted on BCH. SIBs other than *SystemInformationBlockType1* are carried in *SystemInformation* (SI) messages and mapping of SIBs to SI messages is flexibly configurable by *schedulingInfoList* included in *SystemInformationBlockType1*, with restrictions that: each SIB is contained only in a single SI message, and at most once in that message; only SIBs having the same scheduling requirement (periodicity) can be mapped to the same SI message; *SystemInformationBlockType2* is always mapped to the SI message that corresponds to the first entry in the list of SI messages in *schedulingInfoList*. There may be multiple SI messages transmitted with the same periodicity. *SystemInformationBlockType1* and all SI messages are transmitted on DL-SCH.

NOTE 1: The physical layer imposes a limit to the maximum size a SIB can take. When DCI format 1C is used the maximum allowed by the physical layer is 1736 bits (217 bytes) while for format 1A the limit is 2216 bits (277 bytes), see TS 36.212 [22] and TS 36.213 [23].

In addition to broadcasting, E-UTRAN may provide *SystemInformationBlockType1*, including the same parameter values, via dedicated signalling i.e., within an *RRCConnectionReconfiguration* message.

The UE applies the system information acquisition and change monitoring procedures for the PCell. For an SCell, E-UTRAN provides, via dedicated signalling, all system information relevant for operation in RRC_CONNECTED when adding the SCell. However, a UE that is configured with DC shall aquire the *MasterInformationBlock* of the PSCell but use it only to determine the SFN timing of the SCG, which may be different from the MCG. Upon change of the relevant system information of a configured SCell, E-UTRAN releases and subsequently adds the concerned SCell, which may be done with a single *RRCConnectionReconfiguration* message. If the UE is receiving or interested to receive an MBMS service in a cell, the UE shall apply the system information acquisition and change monitoring procedure to acquire parameters relevant for MBMS operation and apply the parameters acquired from system information only for MBMS operation for this cell.

NOTE 2: E-UTRAN may configure via dedicated signalling different parameter values than the ones broadcast in the concerned SCell.

An RN configured with an RN subframe configuration does not need to apply the system information acquisition and change monitoring procedures. Upon change of any system information relevant to an RN, E-UTRAN provides the system information blocks containing the relevant system information to an RN configured with an RN subframe configuration via dedicated signalling using the *RNReconfiguration* message. For RNs configured with an RN subframe configuration, the system information contained in this dedicated signalling replaces any corresponding stored system information and takes precedence over any corresponding system information acquired through the system information acquisition procedure. The dedicated system information remains valid until overridden.

NOTE 3: E-UTRAN may configure an RN, via dedicated signalling, with different parameter values than the ones broadcast in the concerned cell.

5.2.1.2 Scheduling

The MIB uses a fixed schedule with a periodicity of 40 ms and repetitions made within 40 ms. The first transmission of the MIB is scheduled in subframe #0 of radio frames for which the SFN mod 4 = 0, and repetitions are scheduled in subframe #0 of all other radio frames.

The *SystemInformationBlockType1* uses a fixed schedule with a periodicity of 80 ms and repetitions made within 80 ms. The first transmission of *SystemInformationBlockType1* is scheduled in subframe #5 of radio frames for which the SFN mod 8 = 0, and repetitions are scheduled in subframe #5 of all other radio frames for which SFN mod 2 = 0.

The SI messages are transmitted within periodically occurring time domain windows (referred to as SI-windows) using dynamic scheduling. Each SI message is associated with a SI-window and the SI-windows of different SI messages do not overlap. That is, within one SI-window only the corresponding SI is transmitted. The length of the SI-window is common for all SI messages, and is configurable. Within the SI-window, the corresponding SI message can be transmitted a number of times in any subframe other than MBSFN subframes, uplink subframes in TDD, and subframe #5 of radio frames for which SFN mod 2 = 0. The UE acquires the detailed time-domain scheduling (and other information, e.g. frequency-domain scheduling, used transport format) from decoding SI-RNTI on PDCCH (see TS 36.321 [6]).

A single SI-RNTI is used to address *SystemInformationBlockType1* as well as all SI messages.

SystemInformationBlockType1 configures the SI-window length and the transmission periodicity for the SI messages.

5.2.1.3 System information validity and notification of changes

Change of system information (other than for ETWS, CMAS and EAB parameters) only occurs at specific radio frames, i.e. the concept of a modification period is used. System information may be transmitted a number of times with the same content within a modification period, as defined by its scheduling. The modification period boundaries are defined by SFN values for which SFN mod m= 0, where m is the number of radio frames comprising the modification period. The modification period is configured by system information.

When the network changes (some of the) system information, it first notifies the UEs about this change, i.e. this may be done throughout a modification period. In the next modification period, the network transmits the updated system information. These general principles are illustrated in figure 5.2.1.3-1, in which different colours indicate different system information. Upon receiving a change notification, the UE acquires the new system information immediately from the start of the next modification period. The UE applies the previously acquired system information until the UE acquires the new system information.

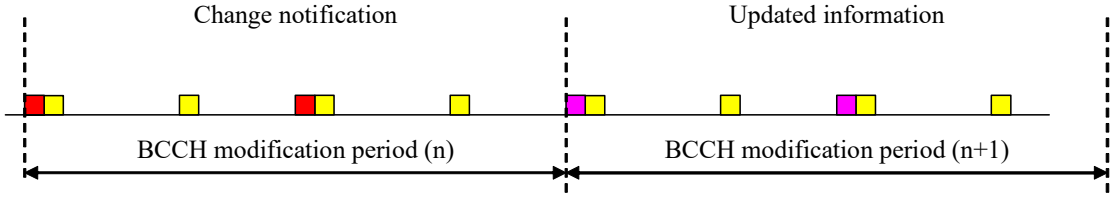


Figure 5.2.1.3-1: Change of system Information

The *Paging* message is used to inform UEs in RRC_IDLE and UEs in RRC_CONNECTED about a system information change. If the UE receives a *Paging* message including the *systemInfoModification*, it knows that the system information will change at the next modification period boundary. Although the UE may be informed about changes in system information, no further details are provided e.g. regarding which system information will change.

SystemInformationBlockType1 includes a value tag, *systemInfoValueTag*, that indicates if a change has occurred in the SI messages. UEs may use *systemInfoValueTag*, e.g. upon return from out of coverage, to verify if the previously stored SI messages are still valid. Additionally, the UE considers stored system information to be invalid after 3 hours from the moment it was successfully confirmed as valid, unless specified otherwise.

E-UTRAN may not update *systemInfoValueTag* upon change of some system information e.g. ETWS information, CMAS information, regularly changing parameters like time information (*SystemInformationBlockType8*, *SystemInformationBlockType16*), EAB parameters. Similarly, E-UTRAN may not include the *systemInfoModification* within the *Paging* message upon change of some system information.

The UE verifies that stored system information remains valid by either checking *systemInfoValueTag* in *SystemInformationBlockType1* after the modification period boundary, or attempting to find the *systemInfoModification* indication at least *modificationPeriodCoeff* times during the modification period in case no paging is received, in every modification period. If no paging message is received by the UE during a modification period, the UE may assume that no change of system information will occur at the next modification period boundary. If UE in RRC_CONNECTED, during a modification period, receives one paging message, it may deduce from the presence/ absence of *systemInfoModification* whether a change of system information other than ETWS information, CMAS information and EAB parameters will occur in the next modification period or not.

ETWS and/or CMAS capable UEs in RRC_CONNECTED shall attempt to read paging at least once every *defaultPagingCycle* to check whether ETWS and/or CMAS notification is present or not.

5.2.1.4 Indication of ETWS notification

ETWS primary notification and/ or ETWS secondary notification can occur at any point in time. The *Paging* message is used to inform ETWS capable UEs in RRC_IDLE and UEs in RRC_CONNECTED about presence of an ETWS primary notification and/ or ETWS secondary notification. If the UE receives a *Paging* message including the *etws-Indication*, it shall start receiving the ETWS primary notification and/ or ETWS secondary notification according to *schedulingInfoList* contained in *SystemInformationBlockType1*. If the UE receives *Paging* message including the *etws-Indication* while it is acquiring ETWS notification(s), the UE shall continue acquiring ETWS notification(s) based on the previously acquired *schedulingInfoList* until it re-acquires *schedulingInfoList* in *SystemInformationBlockType1*.

NOTE: The UE is not required to periodically check *schedulingInfoList* contained in *SystemInformationBlockType1*, but *Paging* message including the *etws-Indication* triggers the UE to re-acquire *schedulingInfoList* contained in *SystemInformationBlockType1* for scheduling changes for *SystemInformationBlockType10* and *SystemInformationBlockType11*. The UE may or may not receive a *Paging* message including the *etws-Indication* and/or *systemInfoModification* when ETWS is no longer scheduled.

ETWS primary notification is contained in *SystemInformationBlockType10* and ETWS secondary notification is contained in *SystemInformationBlockType11*. Segmentation can be applied for the delivery of a secondary notification. The segmentation is fixed for transmission of a given secondary notification within a cell (i.e. the same segment size for a given segment with the same *messageIdentifier*, *serialNumber* and *warningMessageSegmentNumber*). An ETWS secondary notification corresponds to a single *CB data* IE as defined according to TS 23.041 [37].

5.2.1.5 Indication of CMAS notification

CMAS notification can occur at any point in time. The *Paging* message is used to inform CMAS capable UEs in RRC_IDLE and UEs in RRC_CONNECTED about presence of one or more CMAS notifications. If the UE receives a *Paging* message including the *cmas-Indication*, it shall start receiving the CMAS notifications according to *schedulingInfoList* contained in *SystemInformationBlockType1*. If the UE receives *Paging* message including the *cmas-Indication* while it is acquiring CMAS notification(s), the UE shall continue acquiring CMAS notification(s) based on the previously acquired *schedulingInfoList* until it re-acquires *schedulingInfoList* in *SystemInformationBlockType1*.

NOTE: The UE is not required to periodically check *schedulingInfoList* contained in *SystemInformationBlockType1*, but *Paging* message including the *cmas-Indication* triggers the UE to re-acquire *schedulingInfoList* contained in *SystemInformationBlockType1* for scheduling changes for *SystemInformationBlockType12*. The UE may or may not receive a *Paging* message including the *cmas-Indication* and/or *systemInfoModification* when *SystemInformationBlockType12* is no longer scheduled.

CMAS notification is contained in *SystemInformationBlockType12*. Segmentation can be applied for the delivery of a CMAS notification. The segmentation is fixed for transmission of a given CMAS notification within a cell (i.e. the same segment size for a given segment with the same *messageIdentifier*, *serialNumber* and *warningMessageSegmentNumber*). E-UTRAN does not interleave transmissions of CMAS notifications, i.e. all segments of a given CMAS notification transmission are transmitted prior to those of another CMAS notification. A CMAS notification corresponds to a single *CB data* IE as defined according to TS 23.041 [37].

5.2.1.6 Notification of EAB parameters change

Change of EAB parameters can occur at any point in time. The EAB parameters are contained in *SystemInformationBlockType14*. The *Paging* message is used to inform EAB capable UEs in RRC_IDLE about a change of EAB parameters or that *SystemInformationBlockType14* is no longer scheduled. If the UE receives a *Paging* message including the *eab-ParamModification*, it shall acquire *SystemInformationBlockType14* according to *schedulingInfoList* contained in *SystemInformationBlockType1*. If the UE receives a *Paging* message including the *eab-ParamModification* while it is acquiring *SystemInformationBlockType14*, the UE shall continue acquiring *SystemInformationBlockType14* based on the previously acquired *schedulingInfoList* until it re-acquires *schedulingInfoList* in *SystemInformationBlockType1*.

NOTE: The EAB capable UE is not expected to periodically check *schedulingInfoList* contained in *SystemInformationBlockType1*.

5.2.2 System information acquisition

5.2.2.1 General

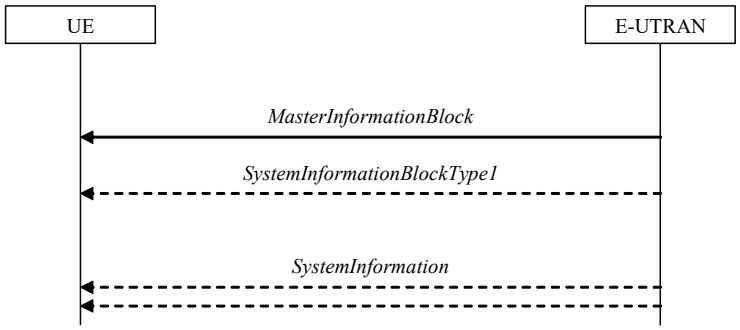


Figure 5.2.2.1-1: System information acquisition, normal

The UE applies the system information acquisition procedure to acquire the AS- and NAS- system information that is broadcasted by the E-UTRAN. The procedure applies to UEs in RRC_IDLE and UEs in RRC_CONNECTED.

5.2.2.2 Initiation

The UE shall apply the system information acquisition procedure upon selecting (e.g. upon power on) and upon re-selecting a cell, after handover completion, after entering E-UTRA from another RAT, upon return from out of coverage, upon receiving a notification that the system information has changed, upon receiving an indication about the presence of an ETWS notification, upon receiving an indication about the presence of a CMAS notification, upon receiving a notification that the EAB parameters have changed, upon receiving a request from CDMA2000 upper layers and upon exceeding the maximum validity duration. Unless explicitly stated otherwise in the procedural specification, the system information acquisition procedure overwrites any stored system information, i.e. delta configuration is not applicable for system information and the UE discontinues using a field if it is absent in system information unless explicitly specified otherwise.

5.2.2.3 System information required by the UE

The UE shall:

1> ensure having a valid version, as defined below, of (at least) the following system information, also referred to as the 'required' system information:

2> if in RRC_IDLE:

3> the *MasterInformationBlock* and *SystemInformationBlockType1* as well as *SystemInformationBlockType2* through *SystemInformationBlockType8* (depending on support of the concerned RATs), *SystemInformationBlockType17* (depending on support of RAN-assisted WLAN interworking);

2> if in RRC_CONNECTED:

3> the *MasterInformationBlock*, *SystemInformationBlockType1* and *SystemInformationBlockType2* as well as *SystemInformationBlockType8* (depending on support of CDMA2000), *SystemInformationBlockType17* (depending on support of RAN-assisted WLAN interworking);

1> delete any stored system information after 3 hours from the moment it was confirmed to be valid as defined in 5.2.1.3, unless specified otherwise;

1> consider any stored system information except *SystemInformationBlockType10, SystemInformationBlockType11, systemInformationBlockType12* and *systemInformationBlockType14* to be invalid if *systemInfoValueTag* included in the *SystemInformationBlockType1* is different from the one of the stored system information;

5.2.2.4 System information acquisition by the UE

The UE shall:

1> apply the specified BCCH configuration defined in 9.1.1.1;

1> if the procedure is triggered by a system information change notification:

2> start acquiring the required system information, as defined in 5.2.2.3, from the beginning of the modification period following the one in which the change notification was received;

NOTE 1: The UE continues using the previously received system information until the new system information has been acquired.

1> if the UE is in RRC_IDLE and enters a cell for which the UE does not have stored a valid version of the system information required in RRC_IDLE, as defined in 5.2.2.3:

2> acquire, using the system information acquisition procedure as defined in 5.2.3, the system information required in RRC_IDLE, as defined in 5.2.2.3;

1> following successful handover completion to a PCell for which the UE does not have stored a valid version of the system information required in RRC_CONNECTED, as defined in 5.2.2.3:

2> acquire, using the system information acquisition procedure as defined in 5.2.3, the system information required in RRC_CONNECTED, as defined in 5.2.2.3;

2> upon acquiring the concerned system information:

3> discard the corresponding radio resource configuration information included in the *radioResourceConfigCommon* previously received in a dedicated message, if any;

1> following a request from CDMA2000 upper layers:

2> acquire *SystemInformationBlockType8*, as defined in 5.2.3;

1> neither initiate the RRC connection establishment procedure nor initiate transmission of the *RRCConnectionReestablishmentRequest* message until the UE has a valid version of the *MasterInformationBlock* and *SystemInformationBlockType1* messages as well as *SystemInformationBlockType2* ;

1> not initiate the RRC connection establishment subject to EAB until the UE has a valid version of *SystemInformationBlockType14*, if broadcast;

1> if the UE is ETWS capable:

2> upon entering a cell during RRC_IDLE, following successful handover or upon connection re-establishment:

3> discard any previously buffered *warningMessageSegment*;

3> clear, if any, the current values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*;

2> when the UE acquires *SystemInformationBlockType1* following ETWS indication, upon entering a cell during RRC_IDLE, following successful handover or upon connection re-establishment:

3> if *schedulingInfoList* indicates that *SystemInformationBlockType10* is present:

4> start acquiring *SystemInformationBlockType10* immediately;

3> if *schedulingInfoList* indicates that *SystemInformationBlockType11* is present:

4> start acquiring *SystemInformationBlockType11* immediately;

NOTE 2: UEs shall start acquiring *SystemInformationBlockType10* and *SystemInformationBlockType11* as described above even when *systemInfoValueTag* in *SystemInformationBlockType1* has not changed.

1> if the UE is CMAS capable:

2> upon entering a cell during RRC_IDLE, following successful handover or upon connection re-establishment:

3> discard any previously buffered *warningMessageSegment*;

3> clear, if any, stored values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType12* associated with the discarded *warningMessageSegment*;

2> when the UE acquires *SystemInformationBlockType1* following CMAS indication, upon entering a cell during RRC_IDLE, following successful handover and upon connection re-establishment:

3> if *schedulingInfoList* indicates that *SystemInformationBlockType12* is present:

4> acquire *SystemInformationBlockType12*;

NOTE 3: UEs shall start acquiring *SystemInformationBlockType12* as described above even when *systemInfoValueTag* in *SystemInformationBlockType1* has not changed.

1> if the UE is interested to receive MBMS services:

2> if *schedulingInfoList* indicates that *SystemInformationBlockType13* is present and the UE does not have stored a valid version of this system information block:

3> acquire *SystemInformationBlockType13*;

2> if the UE is capable of MBMS Service Continuity:

3> if *schedulingInfoList* indicates that *SystemInformationBlockType15* is present and the UE does not have stored a valid version of this system information block:

4> acquire SystemInformationBlockType15;

1> if the UE is EAB capable:

2> when the UE does not have stored a valid version of *SystemInformationBlockType14* upon entering RRC_IDLE, or when the UE acquires *SystemInformationBlockType1* following EAB parameters change notification or upon entering a cell during RRC_IDLE:

3> if *schedulingInfoList* indicates that *SystemInformationBlockType14* is present:

4> start acquiring *SystemInformationBlockType14* immediately;

3> else:

4> discard *SystemInformationBlockType14*, if previously received;

NOTE 4: EAB capable UEs start acquiring *SystemInformationBlockType14* as described above even when *systemInfoValueTag* in *SystemInformationBlockType1* has not changed.

NOTE 5: EAB capable UEs maintain an up to date *SystemInformationBlockType14* in RRC_IDLE.

1> if the UE is capable of sidelink communication and is configured by upper layers to receive or transmit sidelink communication:

2> if the cell used for sidelink communication meets the S-criteria as defined in TS 36.304 [4]; and

2> if *schedulingInfoList* indicates that *SystemInformationBlockType18* is present and the UE does not have stored a valid version of this system information block:

3> acquire *SystemInformationBlockType18*;

1> if the UE is capable of sidelink discovery and is configured by upper layers to receive or transmit sidelink discovery announcements on the primary frequency:

2> if *schedulingInfoList* indicates that *SystemInformationBlockType19* is present and the UE does not have stored a valid version of this system information block:

3> acquire *SystemInformationBlockType19*;

2> for each of the one or more frequencies included in *discInterFreqList*, if included in *SystemInformationBlockType19* and for which the UE is configured by upper layers to receive sidelink discovery announcements on:

3> if *schedulingInfoList* indicates that *SystemInformationBlockType19* is present and the UE does not have stored a valid version of this system information block:

4> acquire *SystemInformationBlockType19*;

The UE may apply the received SIBs immediately, i.e. the UE does not need to delay using a SIB until all SI messages have been received. The UE may delay applying the received SIBs until completing lower layer procedures associated with a received or a UE originated RRC message, e.g. an ongoing random access procedure.

NOTE 6: While attempting to acquire a particular SIB, if the UE detects from *schedulingInfoList* that it is no longer present, the UE should stop trying to acquire the particular SIB.

5.2.2.5 Essential system information missing

The UE shall:

1> if in RRC_IDLE or in RRC_CONNECTED while T311 is running:

2> if the UE is unable to acquire the *MasterInformationBlock* or the *SystemInformationBlockType1*:

3> consider the cell as barred in accordance with TS 36.304 [4]; and

3> perform barring as if *intraFreqReselection* is set to *allowed*, and as if the *csg-Indication* is set to *FALSE*;

2> else if the UE is unable to acquire the *SystemInformationBlockType2*:

3> treat the cell as barred in accordance with TS 36.304 [4];

5.2.2.6 Actions upon reception of the *MasterInformationBlock* message

Upon receiving the *MasterInformationBlock* message the UE shall:

1> apply the radio resource configuration included in the *phich-Config*;

1> if the UE is in RRC_IDLE or if the UE is in RRC_CONNECTED while T311 is running:

2> if the UE has no valid system information stored according to 5.2.2.3 for the concerned cell:

3> apply the received value of *dl-Bandwidth* to the *ul-Bandwidth* until *SystemInformationBlockType2* is received;

5.2.2.7 Actions upon reception of the *SystemInformationBlockType1* message

Upon receiving the *SystemInformationBlockType1* either via broadcast or via dedicated signalling, the UE shall:

1> if in RRC_IDLE or in RRC_CONNECTED while T311 is running; and

1> if the UE is a category 0 UE according to TS 36.306 [5]; and

1> if *category0Allowed* is not included in *SystemInformationBlockType1*:

2> consider the cell as barred in accordance with TS 36.304 [4];

1> if in RRC_CONNECTED while T311 is not running, and the UE supports multi-band cells as defined by bit 31 in *featureGroupIndicators*:

2> disregard the *freqBandIndicator* and *multiBandInfoList*, if received, while in RRC_CONNECTED;

2> forward the *cellIdentity* to upper layers;

2> forward the *trackingAreaCode* to upper layers;

1> else:

2> if the frequency band indicated in the *freqBandIndicator* is part of the frequency bands supported by the UE and it is not a downlink only band; or

2> if the UE supports *multiBandInfoList,* and if one or more of the frequency bands indicated in the *multiBandInfoList* are part of the frequency bands supported by the UE and they are not downlink only bands:

3> forward the *cellIdentity* to upper layers;

3> forward the *trackingAreaCode* to upper layers;

3> if, for the frequency band selected by the UE (from *freqBandIndicator* or *multiBandInfoList*), the *freqBandInfo* or the *multiBandInfoList-v10j0* is present and the UE capable of *multiNS-Pmax* supports at least one *additionalSpectrumEmission* in the *NS-PmaxList* within the *freqBandInfo* or *multiBandInfoList-v10j0*:

4> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NS-PmaxList* within *freqBandInfo* or *multiBandInfolist-v10j0*;

4> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NS-PmaxList*:

5> apply the *additionalPmax*;

4> else:

5> apply the *p-Max*;

3> else:

4> apply the *additionalSpectrumEmission* in *SystemInformationBlockType2* and the *p-Max*;

2> else:

3> consider the cell as barred in accordance with TS 36.304 [4]; and

3> perform barring as if *intraFreqReselection* is set to *notAllowed*, and as if the *csg-Indication* is set to *FALSE*;

5.2.2.8 Actions upon reception of *SystemInformation* messages

No UE requirements related to the contents of the *SystemInformation* messages apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.9 Actions upon reception of *SystemInformationBlockType2*

Upon receiving *SystemInformationBlockType2*, the UE shall:

1> apply the configuration included in the *radioResourceConfigCommon*;

1> if upper layers indicate that a (UE specific) paging cycle is configured:

2> apply the shortest of the (UE specific) paging cycle and the *defaultPagingCycle* included in the *radioResourceConfigCommon*;

1> if the *mbsfn-SubframeConfigList* is included:

2> consider that DL assignments may occur in the MBSFN subframes indicated in the *mbsfn-SubframeConfigList* under the conditions specified in [23, 7.1];

1> apply the specified PCCH configuration defined in 9.1.1.3;

1> not apply the *timeAlignmentTimerCommon*;

1> if in RRC_CONNECTED and UE is configured with RLF timers and constants values received within *rlf-TimersAndConstants*:

2> not update its values of the timers and constants in *ue-TimersAndConstants* except for the value of timer T300;

1> if in RRC_CONNECTED while T311 is not running; and the UE supports multi-band cells as defined by bit 31 in *featureGroupIndicators* or *multipleNS-Pmax*:

2> disregard the *additionalSpectrumEmission* and *ul-CarrierFreq*, if received, while in RRC_CONNECTED;

5.2.2.10 Actions upon reception of *SystemInformationBlockType3*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.11 Actions upon reception of *SystemInformationBlockType4*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.12 Actions upon reception of *SystemInformationBlockType5*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.13 Actions upon reception of *SystemInformationBlockType6*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.14 Actions upon reception of *SystemInformationBlockType7*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.15 Actions upon reception of *SystemInformationBlockType8*

Upon receiving *SystemInformationBlockType8*, the UE shall:

1> if *sib8-PerPLMN-List* is included and the UE is capable of network sharing for CDMA2000:

2> apply the CDMA2000 parameters below corresponding to the RPLMN;

1> if the *systemTimeInfo* is included:

2> forward the *systemTimeInfo* to CDMA2000 upper layers;

1> if the UE is in RRC_IDLE and if *searchWindowSize* is included:

2> forward the *searchWindowSize* to CDMA2000 upper layers;

1> if *parametersHRPD* is included:

2> forward the *preRegistrationInfoHRPD* to CDMA2000 upper layers only if the UE has not received the *preRegistrationInfoHRPD* within an *RRCConnectionReconfiguration* message after entering this cell;

2> if the *cellReselectionParametersHRPD* is included:

3> forward the *neighCellList* to the CDMA2000 upper layers;

1> if the *parameters1XRTT* is included:

2> if the *csfb-RegistrationParam1XRTT* is included:

3> forward the *csfb-RegistrationParam1XRTT* to the CDMA2000 upper layers which will use this information to determine if a CS registration/re-registration towards CDMA2000 1xRTT in the EUTRA cell is required;

2> else:

3> indicate to CDMA2000 upper layers that CSFB Registration to CDMA2000 1xRTT is not allowed;

2> if the *longCodeState1XRTT* is included:

3> forward the *longCodeState1XRTT* to CDMA2000 upper layers;

2> if the *cellReselectionParameters1XRTT* is included:

3> forward the *neighCellList* to the CDMA2000 upper layers;

2> if the *csfb-SupportForDualRxUEs* is included:

3> forward *csfb-SupportForDualRxUEs* to the CDMA2000 upper layers;

2> else:

3> forward *csfb-SupportForDualRxUEs*, with its value set to *FALSE*, to the CDMA2000 upper layers;

2> if *ac-BarringConfig1XRTT* is included:

3> forward *ac-BarringConfig1XRTT* to the CDMA2000 upper layers;

2> if the *csfb-DualRxTxSupport* is included:

3> forward *csfb-DualRxTxSupport* to the CDMA2000 upper layers;

2> else:

3> forward *csfb-DualRxTxSupport*, with its value set to *FALSE*, to the CDMA2000 upper layers;

5.2.2.16 Actions upon reception of *SystemInformationBlockType9*

Upon receiving *SystemInformationBlockType9*, the UE shall:

1> if *hnb-Name* is included, forward the *hnb-Name* to upper layers;

5.2.2.17 Actions upon reception of *SystemInformationBlockType10*

Upon receiving *SystemInformationBlockType10*, the UE shall:

1> forward the received *warningType*, *messageIdentifier* and *serialNumber* to upper layers;

5.2.2.18 Actions upon reception of *SystemInformationBlockType11*

Upon receiving *SystemInformationBlockType11*, the UE shall:

1> if there is no current value for *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*; or

1> if either the received value of *messageIdentifier* or of s*erialNumber* or of both are different from the current values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*:

2> use the received values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11* as the current values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*;

2> discard any previously buffered *warningMessageSegment*;

2> if all segments of a warning message have been received:

3> assemble the warning message from the received *warningMessageSegment*;

3> forward the received warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;

3> stop reception of *SystemInformationBlockType11*;

3> discard the current values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*;

2> else:

3> store the received *warningMessageSegment*;

3> continue reception of *SystemInformationBlockType11*;

1> else if all segments of a warning message have been received:

2> assemble the warning message from the received *warningMessageSegment*;

2> forward the received complete warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;

2> stop reception of *SystemInformationBlockType11*;

2> discard the current values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11*;

1> else:

2> store the received *warningMessageSegment*;

2> continue reception of *SystemInformationBlockType11*;

The UE should discard any stored *warningMessageSegment* and the current value of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType11* if the complete warning message has not been assembled within a period of 3 hours.

5.2.2.19 Actions upon reception of *SystemInformationBlockType12*

Upon receiving *SystemInformationBlockType12*, the UE shall:

1> if the *SystemInformationBlockType12* contains a complete warning message:

2> forward the received warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;

2> continue reception of *SystemInformationBlockType12*;

1> else:

2> if the received values of *messageIdentifier* and *serialNumber* are the same (each value is the same) as a pair for which a warning message is currently being assembled:

3> store the received *warningMessageSegment*;

3> if all segments of a warning message have been received:

4> assemble the warning message from the received *warningMessageSegment*;

4> forward the received warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;

4> stop assembling a warning message for this *messageIdentifier* and *serialNumber* and delete all stored information held for it;

3> continue reception of *SystemInformationBlockType12*;

2> else if the received values of *messageIdentifier* and/or *serialNumber* are not the same as any of the pairs for which a warning message is currently being assembled:

3> start assembling a warning message for this *messageIdentifier* and *serialNumber* pair;

3> store the received *warningMessageSegment*;

3> continue reception of *SystemInformationBlockType12*;

The UE should discard *warningMessageSegment* and the associated values of *messageIdentifier* and *serialNumber* for *SystemInformationBlockType12* if the complete warning message has not been assembled within a period of 3 hours.

NOTE: The number of warning messages that a UE can re-assemble simultaneously is a function of UE implementation.

5.2.2.20 Actions upon reception of *SystemInformationBlockType13*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.21 Actions upon reception of *SystemInformationBlockType14*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.22 Actions upon reception of *SystemInformationBlockType15*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.23 Actions upon reception of *SystemInformationBlockType16*

No UE requirements related to the contents of this *SystemInformationBlock* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

5.2.2.24 Actions upon reception of *SystemInformationBlockType17*

Upon receiving *SystemInformationBlockType17*, the UE shall:

1> if *wlan-OffloadConfigCommon* corresponding to the RPLMN is included:

2> apply the *wlan-Id-List* corresponding to the RPLMN;

2> if not configured with the *wlan-OffloadConfigDedicated*;

3> apply the *wlan-OffloadConfigCommon* corresponding to the RPLMN;

5.2.2.25 Actions upon reception of *SystemInformationBlockType18*

Upon receiving *SystemInformationBlockType18*, the UE shall:

1> if *SystemInformationBlockType18* message includes the *commConfig*:

2> if configured to receive sidelink communication:

3> from the next SC period, as defined by *sc-Period*, use the resource pool indicated by *commRxPool* for sidelink communication monitoring, as specified in 5.10.3;

2> if configured to transmit sidelink communication:

3> from the next SC period, as defined by *sc-Period*, use the resource pool indicated by *commTxPoolNormalCommon* or by *commTxPoolExceptional* for sidelink communication transmission, as specified in 5.10.4;

5.2.2.26 Actions upon reception of *SystemInformationBlockType19*

Upon receiving *SystemInformationBlockType19*, the UE shall:

1> if *SystemInformationBlockType19* message includes the *discConfig*:

2> from the next discovery period, as defined by *discPeriod*, use the resources indicated by *discRxPool* for sidelink discovery monitoring, as specified in 5.10.5;

2> if *SystemInformationBlockType19* message includes the *discTxPoolCommon*; and the UE is in RRC_IDLE:

3> from the next discovery period, as defined by *discPeriod*, use the resources indicated by *discTxPoolCommon* for sidelink discovery announcement, as specified in 5.10.6;

2> if the *SystemInformationBlockType19* message includes the *discTxPowerInfo*:

3> use the power information included in *discTxPowerInfo* for sidelink discovery transmission, as specified in TS 36.213 [23];

5.2.3 Acquisition of an SI message

When acquiring an SI message, the UE shall:

1> determine the start of the SI-window for the concerned SI message as follows:

2> for the concerned SI message, determine the number *n* which corresponds to the order of entry in the list of SI messages configured by *schedulingInfoList* in *SystemInformationBlockType1*;

2> determine the integer value $x = (n - 1)*w$, where w is the *si-WindowLength*;

2> the SI-window starts at the subframe #*a*, where $a = x \bmod 10$, in the radio frame for which SFN mod T = FLOOR(x/10), where T is the *si-Periodicity* of the concerned SI message;

NOTE: E-UTRAN should configure an SI-window of 1 ms only if all SIs are scheduled before subframe #5 in radio frames for which SFN mod 2 = 0.

1> receive DL-SCH using the SI-RNTI from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by *si-WindowLength*, or until the SI message was received, excluding the following subframes:

2> subframe #5 in radio frames for which SFN mod 2 = 0;

2> any MBSFN subframes;

2> any uplink subframes in TDD;

1> if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message;

5.3 Connection control

5.3.1 Introduction

5.3.1.1 RRC connection control

RRC connection establishment involves the establishment of SRB1. E-UTRAN completes RRC connection establishment prior to completing the establishment of the S1 connection, i.e. prior to receiving the UE context information from the EPC. Consequently, AS security is not activated during the initial phase of the RRC connection. During this initial phase of the RRC connection, the E-UTRAN may configure the UE to perform measurement reporting, but the UE only sends the corresponding measurement reports after successful security activation. However, the UE only accepts a handover message when security has been activated.

NOTE: In case the serving frequency broadcasts multiple overlapping bands, E-UTRAN can only configure measurements after having obtained the UE capabilities, as the measurement configuration needs to be set according to the band selected by the UE.

Upon receiving the UE context from the EPC, E-UTRAN activates security (both ciphering and integrity protection) using the initial security activation procedure. The RRC messages to activate security (command and successful response) are integrity protected, while ciphering is started only after completion of the procedure. That is, the response to the message used to activate security is not ciphered, while the subsequent messages (e.g. used to establish SRB2 and DRBs) are both integrity protected and ciphered.

After having initiated the initial security activation procedure, E-UTRAN initiates the establishment of SRB2 and DRBs, i.e. E-UTRAN may do this prior to receiving the confirmation of the initial security activation from the UE. In any case, E-UTRAN will apply both ciphering and integrity protection for the RRC connection reconfiguration messages used to establish SRB2 and DRBs. E-UTRAN should release the RRC connection if the initial security activation and/ or the radio bearer establishment fails (i.e. security activation and DRB establishment are triggered by a joint S1-procedure, which does not support partial success).

For SRB2 and DRBs, security is always activated from the start, i.e. the E-UTRAN does not establish these bearers prior to activating security.

For some radio configuration fields, a critical extension has been defined. A switch from the original version of the field to the critically extended version is allowed using any connection reconfiguration. The UE reverts to the original version of some critically extended fields upon handover and re-establishment as specified elsewhere in this specification. Otherwise, switching a field from the critically extended version to the original version is only possible using the handover or re-establishment procedure with the full configuration option. This also applies for fields that are critically extended within a release (i.e. original and extended version defined in same release).

After having initiated the initial security activation procedure, E-UTRAN may configure a UE that supports CA, with one or more SCells in addition to the PCell that was initially configured during connection establishment. The PCell is used to provide the security inputs and upper layer system information (i.e. the NAS mobility information e.g. TAI). SCells are used to provide additional downlink and optionally uplink radio resources. When not configured with DC all SCells the UE is configured with, if any, are part of the MCG. When configured with DC however, some of the SCells are part of a SCG. In this case, user data carried by a DRB may either be transferred via MCG (i.e. MCG-DRB), via SCG (SCG-DRB) or via both MCG and SCG in DL while E-UTRAN configures the CG used in UL (split DRB). An RRC connection reconfiguration message may be used to change the DRB type from MCG-DRB to SCG-DRB or to split DRB, as well as from SCG-DRB or split DRB to MCG-DRB.

SCG change is a synchronous SCG reconfiguration procedure (i.e. involving RA to the PSCell) including reset/ re-establishment of layer 2 and, if SCG DRBs are configured, refresh of security. The procedure is used in a number of different scenarios e.g. SCG establishment, PSCell change, Key refresh, change of DRB type. The UE performs the SCG change related actions upon receiving an *RRCConnectionReconfiguration* message including *mobilityControlInfoSCG*, see 5.3.10.10.

The release of the RRC connection normally is initiated by E-UTRAN. The procedure may be used to re-direct the UE to an E-UTRA frequency or an inter-RAT carrier frequency. Only in exceptional cases, as specified within this specification, TS 36.300 [9], TS 36.304 [4] or TS 24.301 [35], may the UE abort the RRC connection, i.e. move to RRC_IDLE without notifying E-UTRAN.

5.3.1.2 Security

AS security comprises of the integrity protection of RRC signalling (SRBs) as well as the ciphering of RRC signalling (SRBs) and user data (DRBs).

RRC handles the configuration of the security parameters which are part of the AS configuration: the integrity protection algorithm, the ciphering algorithm and two parameters, namely the *keyChangeIndicator* and the *nextHopChainingCount,* which are used by the UE to determine the AS security keys upon handover and/ or connection re-establishment.

The integrity protection algorithm is common for signalling radio bearers SRB1 and SRB2. The ciphering algorithm is common for all radio bearers (i.e. SRB1, SRB2 and DRBs). Neither integrity protection nor ciphering applies for SRB0.

RRC integrity and ciphering are always activated together, i.e. in one message/ procedure. RRC integrity and ciphering are never de-activated. However, it is possible to switch to a 'NULL' ciphering algorithm (eea0).

The 'NULL' integrity protection algorithm (eia0) is used only for the UE in limited service mode [32, TS33.401]. In case the 'NULL' integrity protection algorithm is used, 'NULL' ciphering algorithm is also used.

NOTE 1: Lower layers discard RRC messages for which the integrity check has failed and indicate the integrity verification check failure to RRC.

The AS applies three different security keys: one for the integrity protection of RRC signalling (K_{RRCint}), one for the ciphering of RRC signalling (K_{RRCenc}) and one for the ciphering of user data (K_{UPenc}). All three AS keys are derived from the K_{eNB} key. The K_{eNB} is based on the K_{ASME} key, which is handled by upper layers.

Upon connection establishment new AS keys are derived. No AS-parameters are exchanged to serve as inputs for the derivation of the new AS keys at connection establishment.

The integrity and ciphering of the RRC message used to perform handover is based on the security configuration used prior to the handover and is performed by the source eNB.

The integrity and ciphering algorithms can only be changed upon handover. The four AS keys ($K_{eNB,}$ K_{RRCint}, K_{RRCenc} and K_{UPenc}) change upon every handover and connection re-establishment. The *keyChangeIndicator* is used upon handover and indicates whether the UE should use the keys associated with the K_{ASME} key taken into use with the latest successful NAS SMC procedure. The *nextHopChainingCount* parameter is used upon handover and connection re-establishment by the UE when deriving the new K_{eNB} that is used to generate K_{RRCint}, K_{RRCenc} and K_{UPenc} (see TS 33.401 [32]). An intra cell handover procedure may be used to change the keys in RRC_CONNECTED.

For each radio bearer an independent counter (COUNT, as specified in TS 36.323 [8]) is maintained for each direction. For each DRB, the COUNT is used as input for ciphering. For each SRB, the COUNT is used as input for both ciphering and integrity protection. It is not allowed to use the same COUNT value more than once for a given security key. In order to limit the signalling overhead, individual messages/ packets include a short sequence number (PDCP SN, as specified in TS 36.323 [8]). In addition, an overflow counter mechanism is used: the hyper frame number (TX_HFN and RX_HFN, as specified in TS 36.323 [8]). The HFN needs to be synchronized between the UE and the eNB. The eNB is responsible for avoiding reuse of the COUNT with the same RB identity and with the same K_{eNB}, e.g. due to the transfer of large volumes of data, release and establishment of new RBs. In order to avoid such re-use, the eNB may e.g. use different RB identities for successive RB establishments, trigger an intra cell handover or an RRC_CONNECTED to RRC_IDLE to RRC_CONNECTED transition.

For each SRB, the value provided by RRC to lower layers to derive the 5-bit BEARER parameter used as input for ciphering and for integrity protection is the value of the corresponding *srb-Identity* with the MSBs padded with zeroes.

In case of DC, a separate K_{eNB} is used for SCG-DRBs (S-K_{eNB}). This key is derived from the key used for the MCG (K_{eNB}) and an SCG counter that is used to ensure freshness. To refresh the S-K_{eNB} e.g. when the COUNT will wrap around, E-UTRAN employs an SCG change, i.e. an *RRCConnectionReconfiguration* message including *mobilityControlInfoSCG*. When performing handover, while at least one SCG-DRB remains configured, both K_{eNB} and S-K_{eNB} are refreshed. In such case E-UTRAN performs handover with SCG change i.e. an *RRCConnectionReconfiguration* message including both *mobilityControlInfo* and *mobilityControlInfoSCG*. The ciphering algorithm is common for all radio bearers within a CG but may be different between MCG and SCG. The ciphering algorithm for SCG DRBs can only be changed upon SCG change.

5.3.1.2a RN security

For RNs, AS security follows the procedures in 5.3.1.2. Furthermore, E-UTRAN may configure per DRB whether or not integrity protection is used. The use of integrity protection may be configured only upon DRB establishment and reconfigured only upon handover or upon the first reconfiguration following RRC connection re-establishment.

To provide integrity protection on DRBs between the RN and the E-UTRAN, the K_{UPint} key is derived from the K_{eNB} key as described in TS33.401 [32]. The same integrity protection algorithm used for SRBs also applies to the DRBs. The K_{UPint} changes at every handover and RRC connection re-establishment and is based on an updated K_{eNB} which is derived by taking into account the *nextHopChainingCount.* The COUNT value maintained for DRB ciphering is also used for integrity protection, if the integrity protection is configured for the DRB.

5.3.1.3 Connected mode mobility

In RRC_CONNECTED, the network controls UE mobility, i.e. the network decides when the UE shall connect to which E-UTRA cell(s), or inter-RAT cell. For network controlled mobility in RRC_CONNECTED, the PCell can be changed using an *RRCConnectionReconfiguration* message including the *mobilityControlInfo* (handover), whereas the

SCell(s) can be changed using the *RRCConnectionReconfiguration* message either with or without the *mobilityControlInfo*.

An SCG can only be established by using an *RRCConnectionReconfiguration* message without the *mobilityControlInfo*, while reconfiguration or release of the SCG can be done using an *RRCConnectionReconfiguration* message with or without the *mobilityControlInfo*. In case Random Access to the PSCell is required upon SCG reconfiguration, E-UTRAN employs the SCG change procedure (i.e. an *RRCConnectionReconfiguration* message including the *mobilityControlInfoSCG*). The PSCell can only be changed using the SCG change procedure.

The network triggers the handover procedure e.g. based on radio conditions, load. To facilitate this, the network may configure the UE to perform measurement reporting (possibly including the configuration of measurement gaps). The network may also initiate handover blindly, i.e. without having received measurement reports from the UE.

Before sending the handover message to the UE, the source eNB prepares one or more target cells. The source eNB selects the target PCell. The source eNB may also provide the target eNB with a list of best cells on each frequency for which measurement information is available, in order of decreasing RSRP. The source eNB may also include available measurement information for the cells provided in the list. The target eNB decides which SCells are configured for use after handover, which may include cells other than the ones indicated by the source eNB. Handover involves either SCG release or SCG change. The latter option is only supported in case of intra-eNB handover. In case the UE was configured with DC, the target eNB indicates in the handover message that the UE shall release the entire SCG configuration. Upon connection re-establishment, the UE releases the entire SCG configuration except for the DRB configuration, while E-UTRAN in the first reconfiguration message following the re-establishment either releases the DRB(s) or reconfigures the DRB(s) to MCG DRB(s).

The target eNB generates the message used to perform the handover, i.e. the message including the AS-configuration to be used in the target cell(s). The source eNB transparently (i.e. does not alter values/ content) forwards the handover message/ information received from the target to the UE. When appropriate, the source eNB may initiate data forwarding for (a subset of) the DRBs.

After receiving the handover message, the UE attempts to access the target PCell at the first available RACH occasion according to Random Access resource selection defined in TS 36.321 [6], i.e. the handover is asynchronous. Consequently, when allocating a dedicated preamble for the random access in the target PCell, E-UTRA shall ensure it is available from the first RACH occasion the UE may use. Upon successful completion of the handover, the UE sends a message used to confirm the handover.

If the target eNB does not support the release of RRC protocol which the source eNB used to configure the UE, the target eNB may be unable to comprehend the UE configuration provided by the source eNB. In this case, the target eNB should use the full configuration option to reconfigure the UE for Handover and Re-establishment. Full configuration option includes an initialization of the radio configuration, which makes the procedure independent of the configuration used in the source cell(s) with the exception that the security algorithms are continued for the RRC re-establishment.

After the successful completion of handover, PDCP SDUs may be re-transmitted in the target cell(s). This only applies for DRBs using RLC-AM mode and for handovers not involving full configuration option. The further details are specified in TS 36.323 [8]. After the successful completion of handover not involving full configuration option, the SN and the HFN are reset except for the DRBs using RLC-AM mode (for which both SN and HFN continue). For reconfigurations involving the full configuration option, the PDCP entities are newly established (SN and HFN do not continue) for all DRBs irrespective of the RLC mode. The further details are specified in TS 36.323 [8].

One UE behaviour to be performed upon handover is specified, i.e. this is regardless of the handover procedures used within the network (e.g. whether the handover includes X2 or S1 signalling procedures).

The source eNB should, for some time, maintain a context to enable the UE to return in case of handover failure. After having detected handover failure, the UE attempts to resume the RRC connection either in the source PCell or in another cell using the RRC re-establishment procedure. This connection resumption succeeds only if the accessed cell is prepared, i.e. concerns a cell of the source eNB or of another eNB towards which handover preparation has been performed. The cell in which the re-establishment procedure succeeds becomes the PCell while SCells and STAGs, if configured, are released.

Normal measurement and mobility procedures are used to support handover to cells broadcasting a CSG identity. In addition, E-UTRAN may configure the UE to report that it is entering or leaving the proximity of cell(s) included in its CSG whitelist. Furthermore, E-UTRAN may request the UE to provide additional information broadcast by the handover candidate cell e.g. global cell identity, CSG identity, CSG membership status.

NOTE: E-UTRAN may use the 'proximity report' to configure measurements as well as to decide whether or not to request additional information broadcast by the handover candidate cell. The additional information is used to verify whether or not the UE is authorised to access the target PCell and may also be needed to identify handover candidate cell (*PCI confusion* i.e. when the physical layer identity that is included in the measurement report does not uniquely identify the cell).

5.3.2 Paging

5.3.2.1 General



Figure 5.3.2.1-1: Paging

The purpose of this procedure is:

- to transmit paging information to a UE in RRC_IDLE and/ or;
- to inform UEs in RRC_IDLE and UEs in RRC_CONNECTED about a system information change and/ or;
- to inform about an ETWS primary notification and/ or ETWS secondary notification and/ or;
- to inform about a CMAS notification and/ or;
- to inform UEs in RRC_IDLE about an EAB parameters modification.

The paging information is provided to upper layers, which in response may initiate RRC connection establishment, e.g. to receive an incoming call.

5.3.2.2 Initiation

E-UTRAN initiates the paging procedure by transmitting the *Paging* message at the UE's paging occasion as specified in TS 36.304 [4]. E-UTRAN may address multiple UEs within a *Paging* message by including one *PagingRecord* for each UE. E-UTRAN may also indicate a change of system information, and/ or provide an ETWS notification or a CMAS notification in the *Paging* message.

5.3.2.3 Reception of the *Paging* message by the UE

Upon receiving the *Paging* message, the UE shall:

1> if in RRC_IDLE, for each of the *PagingRecord*, if any, included in the *Paging* message:

2> if the *ue-Identity* included in the *PagingRecord* matches one of the UE identities allocated by upper layers:

3> forward the *ue-Identity* and the *cn-Domain* to the upper layers;

1> if the *systemInfoModification* is included:

2> re-acquire the required system information using the system information acquisition procedure as specified in 5.2.2.

1> if the *etws-Indication* is included and the UE is ETWS capable:

2> re-acquire *SystemInformationBlockType1* immediately, i.e., without waiting until the next system information modification period boundary;

2> if the *schedulingInfoList* indicates that *SystemInformationBlockType10* is present:

3> acquire *SystemInformationBlockType10*;

2> if the *schedulingInfoList* indicates that *SystemInformationBlockType11* is present:

3> acquire *SystemInformationBlockType11*;

1> if the *cmas-Indication* is included and the UE is CMAS capable:

2> re-acquire *SystemInformationBlockType1* immediately, i.e., without waiting until the next system information modification period boundary as specified in 5.2.1.5;

2> if the *schedulingInfoList* indicates that *SystemInformationBlockType12* is present:

3> acquire *SystemInformationBlockType12*;

1> if in RRC_IDLE, the *eab-ParamModification* is included and the UE is EAB capable:

2> consider previously stored SystemInformationBlockType14 as invalid;

2> re-acquire *SystemInformationBlockType1* immediately, i.e., without waiting until the next system information modification period boundary as specified in 5.2.1.6;

2> re-acquire *SystemInformationBlockType14* using the system information acquisition procedure as specified in 5.2.2.4;

5.3.3 RRC connection establishment

5.3.3.1 General

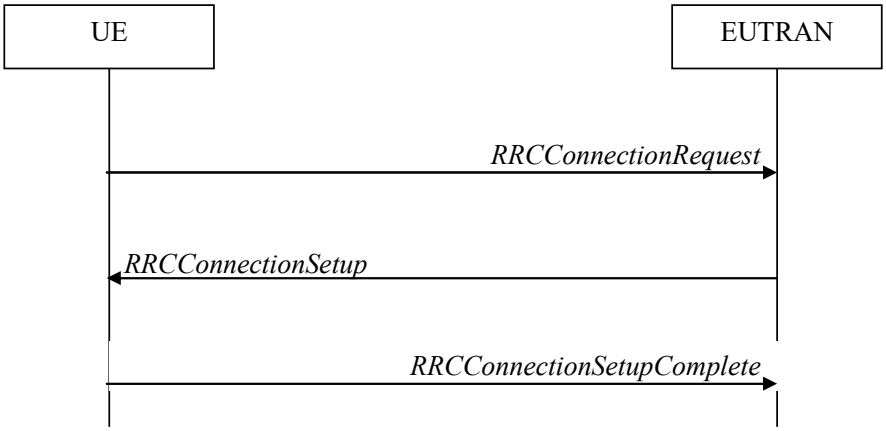


Figure 5.3.3.1-1: RRC connection establishment, successful

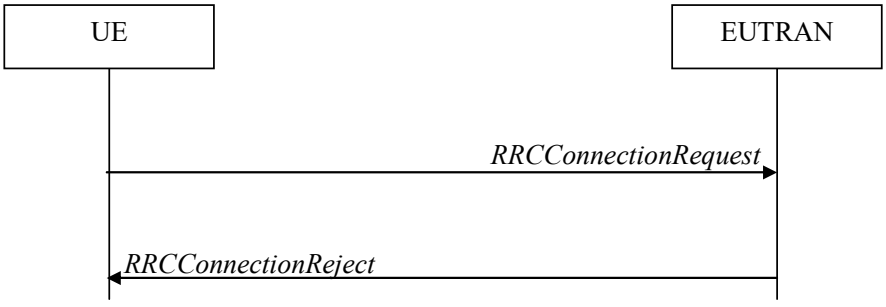


Figure 5.3.3.1-2: RRC connection establishment, network reject

The purpose of this procedure is to establish an RRC connection. RRC connection establishment involves SRB1 establishment. The procedure is also used to transfer the initial NAS dedicated information/ message from the UE to E-UTRAN.

E-UTRAN applies the procedure as follows:

- to establish SRB1 only.

5.3.3.1a Conditions for establishing RRC Connection for sidelink communication/ discovery

For sidelink communication an RRC connection is initiated only in the following case:

1> if configured by upper layers to transmit sidelink communication and related data is available for transmission:

2> if *SystemInformationBlockType18* is broadcast by the cell on which the UE camps; and if the valid version of *SystemInformationBlockType18* does not include *commTxPoolNormalCommon*;

For sidelink discovery an RRC connection is initiated only in the following case:

1> if configured by upper layers to transmit sidelink discovery announcements:

2> if *SystemInformationBlockType19* is broadcast by the cell on which the UE camps: and if the valid version of *SystemInformationBlockType19* does not include *discTxPoolCommon*;

NOTE: Upper layers initiate an RRC connection. The interaction with NAS is left to UE implementation.

5.3.3.2 Initiation

The UE initiates the procedure when upper layers request establishment of an RRC connection while the UE is in RRC_IDLE.

Upon initiation of the procedure, the UE shall:

1> if *SystemInformationBlockType2* includes *ac-BarringPerPLMN-List* and the *ac-BarringPerPLMN-List* contains an *AC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers (see TS 23.122 [11], TS 24.301 [35]):

2> select the *AC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers;

2> in the remainder of this procedure, use the selected *AC-BarringPerPLMN* entry (i.e. presence or absence of access barring parameters in this entry) irrespective of the common access barring parameters included in *SystemInformationBlockType2;*

1> else

2> in the remainder of this procedure use the common access barring parameters (i.e. presence or absence of these parameters) included in *SystemInformationBlockType2;*

1> if upper layers indicate that the RRC connection is subject to EAB (see TS 24.301 [35]):

2> if the result of the EAB check, as specified in 5.3.3.12, is that access to the cell is barred:

3> inform upper layers about the failure to establish the RRC connection and that EAB is applicable, upon which the procedure ends;

1> if the UE is establishing the RRC connection for mobile terminating calls:

2> if timer T302 is running:

3> inform upper layers about the failure to establish the RRC connection and that access barring for mobile terminating calls is applicable, upon which the procedure ends;

1> else if the UE is establishing the RRC connection for emergency calls:

2> if *SystemInformationBlockType2* includes the *ac-BarringInfo*:

3> if the *ac-BarringForEmergency* is set to *TRUE*:

4> if the UE has one or more Access Classes, as stored on the USIM, with a value in the range 11..15, which is valid for the UE to use according to TS 22.011 [10] and TS 23.122 [11]:

NOTE 1: ACs 12, 13, 14 are only valid for use in the home country and ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN.

5> if the *ac-BarringInfo* includes *ac-BarringForMO-Data*, and for all of these valid Access Classes for the UE, the corresponding bit in the *ac-BarringForSpecialAC* contained in *ac-BarringForMO-Data* is set to *one*:

6> consider access to the cell as barred;

4> else:

5> consider access to the cell as barred;

2> if access to the cell is barred:

3> inform upper layers about the failure to establish the RRC connection, upon which the procedure ends;

1> else if the UE is establishing the RRC connection for mobile originating calls:

2> perform access barring check as specified in 5.3.3.11, using T303 as "Tbarring" and *ac-BarringForMO-Data* as "AC barring parameter";

2> if access to the cell is barred:

3> if *SystemInformationBlockType2* includes *ac-BarringForCSFB* or the UE does not support CS fallback:

4> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating calls is applicable, upon which the procedure ends;

3> else (*SystemInformationBlockType2* does not include *ac-BarringForCSFB* and the UE supports CS fallback):

4> if timer T306 is not running, start T306 with the timer value of T303;

4> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating calls and mobile originating CS fallback is applicable, upon which the procedure ends;

1> else if the UE is establishing the RRC connection for mobile originating signalling:

2> perform access barring check as specified in 5.3.3.11, using T305 as "Tbarring" and *ac-BarringForMO-Signalling* as "AC barring parameter";

2> if access to the cell is barred:

3> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating signalling is applicable, upon which the procedure ends;

1> else if the UE is establishing the RRC connection for mobile originating CS fallback:

2> if *SystemInformationBlockType2* includes *ac-BarringForCSFB*:

3> perform access barring check as specified in 5.3.3.11, using T306 as "Tbarring" and *ac-BarringForCSFB* as "AC barring parameter";

3> if access to the cell is barred:

4> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating CS fallback is applicable, due to *ac-BarringForCSFB*, upon which the procedure ends;

2> else:

3> perform access barring check as specified in 5.3.3.11, using T306 as "Tbarring" and *ac-BarringForMO-Data* as "AC barring parameter";

3> if access to the cell is barred:

4> if timer T303 is not running, start T303 with the timer value of T306;

4> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating CS fallback and mobile originating calls is applicable, due to *ac-BarringForMO-Data*, upon which the procedure ends;

1> else if the UE is establishing the RRC connection for mobile originating MMTEL voice, mobile originating MMTEL video, mobile originating SMSoIP or mobile originating SMS:

2> if the UE is establishing the RRC connection for mobile originating MMTEL voice and *SystemInformationBlockType2* includes *ac-BarringSkipForMMTELVoice*; or

2> if the UE is establishing the RRC connection for mobile originating MMTEL video and *SystemInformationBlockType2* includes *ac-BarringSkipForMMTELVideo*; or

2> if the UE is establishing the RRC connection for mobile originating SMSoIP or SMS and *SystemInformationBlockType2* includes *ac-BarringSkipForSMS*:

3> consider access to the cell as not barred;

2> else:

3> if *establishmentCause* received from higher layers is set to *mo-Signalling* (including the case that *mo-Signalling* is replaced by *highPriorityAccess* according to 3GPP TS 24.301 [35] or by *mo-VoiceCall* according to the subclause 5.3.3.3)*:*

4> perform access barring check as specified in 5.3.3.11, using T305 as "Tbarring" and *ac-BarringForMO-Signalling* as "AC barring parameter";

4> if access to the cell is barred:

5> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating signalling is applicable, upon which the procedure ends;

3> if *establishmentCause* received from higher layers is set to *mo-Data* (including the case that *mo-Data* is replaced by *highPriorityAccess* according to 3GPP TS 24.301 [35] or by *mo-VoiceCall* according to the subclause 5.3.3.3):

4> perform access barring check as specified in 5.3.3.11, using T303 as "Tbarring" and *ac-BarringForMO-Data* as "AC barring parameter";

4> if access to the cell is barred:

5> if *SystemInformationBlockType2* includes *ac-BarringForCSFB* or the UE does not support CS fallback:

6> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating calls is applicable, upon which the procedure ends;

5> else (*SystemInformationBlockType2* does not include *ac-BarringForCSFB* and the UE supports CS fallback):

6> if timer T306 is not running, start T306 with the timer value of T303;

6> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating calls and mobile originating CS fallback is applicable, upon which the procedure ends;

1> apply the default physical channel configuration as specified in 9.2.4;

1> apply the default semi-persistent scheduling configuration as specified in 9.2.3;

1> apply the default MAC main configuration as specified in 9.2.2;

1> apply the CCCH configuration as specified in 9.1.1.2;

1> apply the *timeAlignmentTimerCommon* included in *SystemInformationBlockType2*;

1> start timer T300;

1> initiate transmission of the *RRCConnectionRequest* message in accordance with 5.3.3.3;

NOTE 2: Upon initiating the connection establishment procedure, the UE is not required to ensure it maintains up to date system information applicable only for UEs in RRC_IDLE state. However, the UE needs to perform system information acquisition upon cell re-selection.

5.3.3.3 Actions related to transmission of *RRCConnectionRequest* message

The UE shall set the contents of *RRCConnectionRequest* message as follows:

1> set the *ue-Identity* as follows:

2> if upper layers provide an S-TMSI:

3> set the *ue-Identity* to the value received from upper layers;

2> else:

3> draw a random value in the range 0 .. 2^{40}-1 and set the *ue-Identity* to this value;

NOTE 1: Upper layers provide the S-TMSI if the UE is registered in the TA of the current cell.

1> if the UE supports *mo-VoiceCall* establishment cause and UE is establishing the RRC connection for mobile originating MMTEL voice and *SystemInformationBlockType2* includes *voiceServiceCauseIndication*:

2> set the *establishmentCause* to *mo-VoiceCall*;

1> else:

2> set the *establishmentCause* in accordance with the information received from upper layers;

The UE shall submit the *RRCConnectionRequest* message to lower layers for transmission.

The UE shall continue cell re-selection related measurements as well as cell re-selection evaluation. If the conditions for cell re-selection are fulfilled, the UE shall perform cell re-selection as specified in 5.3.3.5.

5.3.3.4 Reception of the *RRCConnectionSetup* by the UE

NOTE: Prior to this, lower layer signalling is used to allocate a C-RNTI. For further details see TS 36.321 [6];

The UE shall:

1> perform the radio resource configuration procedure in accordance with the received *radioResourceConfigDedicated* and as specified in 5.3.10;

1> if stored, discard the cell reselection priority information provided by the *idleModeMobilityControlInfo* or inherited from another RAT;

1> stop timer T300;

1> stop timer T302, if running;

1> stop timer T303, if running;

1> stop timer T305, if running;

1> stop timer T306, if running;

1> perform the actions as specified in 5.3.3.7;

1> stop timer T320, if running;

1> stop timer T350, if running;

1> perform the actions as specified in 5.6.12.4;

1> enter RRC_CONNECTED;

1> stop the cell re-selection procedure;

1> consider the current cell to be the PCell;

1> set the content of *RRCConnectionSetupComplete* message as follows:

2> set the *selectedPLMN-Identity* to the PLMN selected by upper layers (see TS 23.122 [11], TS 24.301 [35]) from the PLMN(s) included in the *plmn-IdentityList* in *SystemInformationBlockType1*;

2> if upper layers provide the 'Registered MME', include and set the *registeredMME* as follows:

3> if the PLMN identity of the 'Registered MME' is different from the PLMN selected by the upper layers:

4> include the *plmnIdentity* in the *registeredMME* and set it to the value of the PLMN identity in the 'Registered MME' received from upper layers;

3> set the *mmegi* and the *mmec* to the value received from upper layers;

2> if upper layers provided the 'Registered MME':

3> include and set the *gummei-Type* to the value provided by the upper layers;

2> if connecting as an RN:

3> include the *rn-SubframeConfigReq*;

2> set the *dedicatedInfoNAS* to include the information received from upper layers;

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

3> include *rlf-InfoAvailable*;

2> if the UE has MBSFN logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include *logMeasAvailableMBSFN*;

2> else if the UE has logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include *logMeasAvailable*;

2> if the UE has connection establishment failure information available in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

3> include *connEstFailInfoAvailable*;

2> include the *mobilityState* and set it to the mobility state (as specified in TS 36.304 [4]) of the UE just prior to entering RRC_CONNECTED state;

2> if the UE supports storage of mobility history information and the UE has mobility history information available in *VarMobilityHistoryReport*:

3> include the *mobilityHistoryAvail*;

2> submit the *RRCConnectionSetupComplete* message to lower layers for transmission, upon which the procedure ends;

5.3.3.5 Cell re-selection while T300, T302, T303, T305 or T306 is running

The UE shall:

1> if cell reselection occurs while T300, T302, T303, T305 or T306 is running:

2> if timer T302, T303, T305 and/ or T306 is running:

3> stop timer T302, T303, T305 and T306, whichever ones were running;

3> perform the actions as specified in 5.3.3.7;

2> if timer T300 is running:

3> stop timer T300;

3> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;

3> inform upper layers about the failure to establish the RRC connection;

5.3.3.6 T300 expiry

The UE shall:

1> if timer T300 expires:

2> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;

2> if the UE supports RRC Connection Establishment failure temporary Qoffset and T300 has expired a consecutive *connEstFailCount* times on the same cell for which *txFailParams* is included in *SystemInformationBlockType2*:

3> for a period as indicated by *connEstFailOffsetValidity*:

4> use *connEstFailOffset* for the parameter $Qoffset_{temp}$ for the concerned cell when performing cell selection and reselection according to TS 36.304 [4] and TS 25.304 [40];

NOTE 1: When performing cell selection, if no suitable or acceptable cell can be found, it is up to UE implementation whether to stop using *connEstFailOffset* for the parameter $Qoffset_{temp}$ during *connEstFailOffsetValidity* for the concerned cell.

2> store the following connection establishment failure information in the *VarConnEstFailReport* by setting its fields as follows:

3> clear the information included in *VarConnEstFailReport*, if any;

3> set the *plmn-Identity* to the PLMN selected by upper layers (see TS 23.122 [11], TS 24.301 [35]) from the PLMN(s) included in the *plmn-IdentityList* in *SystemInformationBlockType1*;

3> set the *failedCellId* to the global cell identity of the cell where connection establishment failure is detected;

3> set the *measResultFailedCell* to include the RSRP and RSRQ, if available, of the cell where connection establishment failure is detected and based on measurements collected up to the moment the UE detected the failure;

3> if available, set the *measResultNeighCells*, in order of decreasing ranking-criterion as used for cell re-selection, to include neighbouring cell measurements for at most the following number of neighbouring cells: 6 intra-frequency and 3 inter-frequency neighbours per frequency as well as 3 inter-RAT neighbours, per frequency/ set of frequencies (GERAN) per RAT and according to the following:

4> for each neighbour cell included, include the optional fields that are available;

NOTE 2: The UE includes the latest results of the available measurements as used for cell reselection evaluation, which are performed in accordance with the performance requirements as specified in TS 36.133 [16].

3> if detailed location information is available, set the content of the *locationInfo* as follows:

4> include the *locationCoordinates*;

4> include the *horizontalVelocity*, if available;

3> set the *numberOfPreamblesSent* to indicate the number of preambles sent by MAC for the failed random access procedure;

3> set *contentionDetected* to indicate whether contention resolution was not successful as specified in TS 36.321 [6] for at least one of the transmitted preambles for the failed random access procedure;

3> set *maxTxPowerReached* to indicate whether or not the maximum power level was used for the last transmitted preamble, see TS 36.321 [6];

2> inform upper layers about the failure to establish the RRC connection, upon which the procedure ends;

The UE may discard the connection establishment failure information, i.e. release the UE variable *VarConnEstFailReport,* 48 hours after the failure is detected, upon power off or upon detach.

5.3.3.7 T302, T303, T305 or T306 expiry or stop

The UE shall:

1> if timer T302 expires or is stopped:

2> inform upper layers about barring alleviation for mobile terminating access;

2> if timer T303 is not running:

3> inform upper layers about barring alleviation for mobile originating calls;

2> if timer T305 is not running:

3> inform upper layers about barring alleviation for mobile originating signalling;

2> if timer T306 is not running:

3> inform upper layers about barring alleviation for mobile originating CS fallback;

1> if timer T303 expires or is stopped:

2> if timer T302 is not running:

3> inform upper layers about barring alleviation for mobile originating calls;

1> if timer T305 expires or is stopped:

2> if timer T302 is not running:

3> inform upper layers about barring alleviation for mobile originating signalling;

1> if timer T306 expires or is stopped:

2> if timer T302 is not running:

3> inform upper layers about barring alleviation for mobile originating CS fallback;

5.3.3.8 Reception of the *RRCConnectionReject* by the UE

The UE shall:

1> stop timer T300;

1> reset MAC and release the MAC configuration;

1> start timer T302, with the timer value set to the *waitTime*;

1> if the *extendedWaitTime* is present and the UE supports delay tolerant access:

2> forward the *extendedWaitTime* to upper layers;

1> if *deprioritisationReq* is included and the UE supports RRC Connection Reject with deprioritisation:

2> start or restart timer T325 with the timer value set to the *deprioritisationTimer* signalled;

2> store the *deprioritisationReq* until T325 expiry;

NOTE: The UE stores the deprioritisation request irrespective of any cell reselection absolute priority assignments (by dedicated or common signalling) and regardless of RRC connections in E-UTRAN or other RATs unless specified otherwise.

1> inform upper layers about the failure to establish the RRC connection and that access barring for mobile originating calls, mobile originating signalling, mobile terminating access and mobile originating CS fallback is applicable, upon which the procedure ends;

5.3.3.9 Abortion of RRC connection establishment

If upper layers abort the RRC connection establishment procedure while the UE has not yet entered RRC_CONNECTED, the UE shall:

1> stop timer T300, if running;

1> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;

5.3.3.10 Handling of SSAC related parameters

Upon request from the upper layers, the UE shall:

1> if *SystemInformationBlockType2* includes *ac-BarringPerPLMN-List* and the *ac-BarringPerPLMN-List* contains an *AC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers (see TS 23.122 [11], TS 24.301 [35]):

2> select the *AC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers;

2> in the remainder of this procedure, use the selected *AC-BarringPerPLMN* entry (i.e. presence or absence of access barring parameters in this entry) irrespective of the common access barring parameters included in *SystemInformationBlockType2*;

1> else:

2> in the remainder of this procedure use the common access barring parameters (i.e. presence or absence of these parameters) included in *SystemInformationBlockType2*;

1> set the local variables *BarringFactorForMMTEL-Voice* and *BarringTimeForMMTEL-Voice* as follows:

2> if *ssac-BarringForMMTEL-Voice* is present:

3> if the UE has one or more Access Classes, as stored on the USIM, with a value in the range 11..15, which is valid for the UE to use according to TS 22.011 [10] and TS 23.122 [11], and

NOTE: ACs 12, 13, 14 are only valid for use in the home country and ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN.

3> if, for at least one of these Access Classes, the corresponding bit in the *ac-BarringForSpecialAC* contained in *ssac-BarringForMMTEL-Voice* is set to zero:

4> set *BarringFactorForMMTEL-Voice* to one and *BarringTimeForMMTEL-Voice* to zero;

3> else:

4> set *BarringFactorForMMTEL-Voice* and *BarringTimeForMMTEL-Voice* to the value of *ac-BarringFactor* and *ac-BarringTime* included in *ssac-BarringForMMTEL-Voice*, respectively;

2> else set *BarringFactorForMMTEL-Voice* to one and *BarringTimeForMMTEL-Voice* to zero;

1> set the local variables *BarringFactorForMMTEL-Video* and *BarringTimeForMMTEL-Video* as follows:

2> if *ssac-BarringForMMTEL-Video* is present:

3> if the UE has one or more Access Classes, as stored on the USIM, with a value in the range 11..15, which is valid for the UE to use according to TS 22.011 [10] and TS 23.122 [11], and

3> if, for at least one of these Access Classes, the corresponding bit in the *ac-BarringForSpecialAC* contained in *ssac-BarringForMMTEL-Video* is set to zero:

4> set *BarringFactorForMMTEL-Video* to one and *BarringTimeForMMTEL-Video* to zero;

3> else:

4> set *BarringFactorForMMTEL-Video* and *BarringTimeForMMTEL-Video* to the value of *ac-BarringFactor* and *ac-BarringTime* included in *ssac-BarringForMMTEL-Video*, respectively;

2> else set *BarringFactorForMMTEL-Video* to one and *BarringTimeForMMTEL-Video* to zero;

1> forward the variables *BarringFactorForMMTEL-Voice*, *BarringTimeForMMTEL-Voice*, *BarringFactorForMMTEL-Video* and *BarringTimeForMMTEL-Video* to the upper layers;

5.3.3.11 Access barring check

1> if timer T302 or "Tbarring" is running:

2> consider access to the cell as barred;

1> else if *SystemInformationBlockType2* includes "AC barring parameter":

2> if the UE has one or more Access Classes, as stored on the USIM, with a value in the range 11..15, which is valid for the UE to use according to TS 22.011 [10] and TS 23.122 [11], and

NOTE: ACs 12, 13, 14 are only valid for use in the home country and ACs 11, 15 are only valid for use in the HPLMN/ EHPLMN.

2> for at least one of these valid Access Classes the corresponding bit in the *ac-BarringForSpecialAC* contained in "AC barring parameter" is set to *zero*:

3> consider access to the cell as not barred;

2> else:

3> draw a random number '*rand*' uniformly distributed in the range: $0 \leq rand < 1$;

3> if '*rand*' is lower than the value indicated by *ac-BarringFactor* included in "AC barring parameter":

4> consider access to the cell as not barred;

3> else:

4> consider access to the cell as barred;

1> else:

2> consider access to the cell as not barred;

1> if access to the cell is barred and both timers T302 and "Tbarring" are not running:

2> draw a random number '*rand*' that is uniformly distributed in the range $0 \leq rand < 1$;

2> start timer "Tbarring" with the timer value calculated as follows, using the *ac-BarringTime* included in "AC barring parameter":

"Tbarring" = $(0.7 + 0.6 * rand) * ac\text{-}BarringTime$.

5.3.3.12 EAB check

The UE shall:

1> if *SystemInformationBlockType14* is present and includes the *eab-Param*:

2> if the *eab-Common* is included in the *eab-Param*:

3> if the UE belongs to the category of UEs as indicated in the *eab-Category* contained in *eab-Common*; and

3> if for the Access Class of the UE, as stored on the USIM and with a value in the range 0..9, the corresponding bit in the *eab-BarringBitmap* contained in *eab-Common* is set to *one*:

4> consider access to the cell as barred;

3> else:

4> consider access to the cell as not barred due to EAB;

2> else (the *eab-PerPLMN-List* is included in the *eab-Param*):

3> select the entry in the *eab-PerPLMN-List* corresponding to the PLMN selected by upper layers (see TS 23.122 [11], TS 24.301 [35]);

3> if the *eab-Config* for that PLMN is included:

4> if the UE belongs to the category of UEs as indicated in the *eab-Category* contained in *eab-Config*; and

4> if for the Access Class of the UE, as stored on the USIM and with a value in the range 0..9, the corresponding bit in the *eab-BarringBitmap* contained in *eab-Config* is set to *one*:

5> consider access to the cell as barred;

4> else:

5> consider access to the cell as not barred due to EAB;

3> else:

4> consider access to the cell as not barred due to EAB;

1> else:

2> consider access to the cell as not barred due to EAB;

5.3.4 Initial security activation

5.3.4.1 General

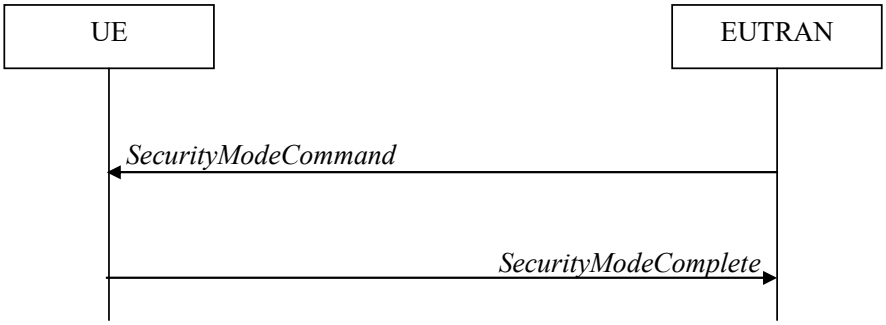


Figure 5.3.4.1-1: Security mode command, successful

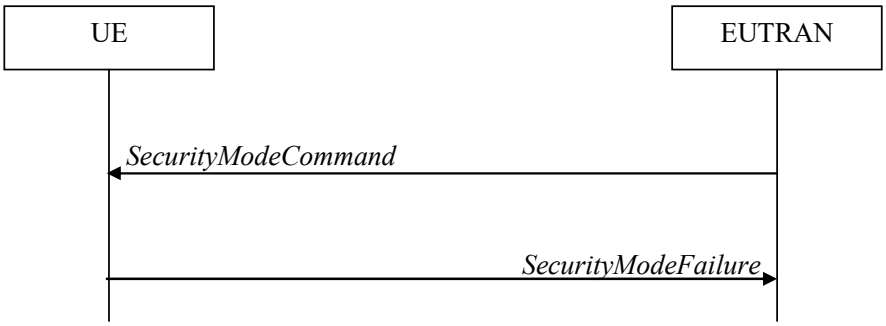


Figure 5.3.4.1-2: Security mode command, failure

The purpose of this procedure is to activate AS security upon RRC connection establishment.

5.3.4.2 Initiation

E-UTRAN initiates the security mode command procedure to a UE in RRC_CONNECTED. Moreover, E-UTRAN applies the procedure as follows:

- when only SRB1 is established, i.e. prior to establishment of SRB2 and/ or DRBs.

5.3.4.3 Reception of the *SecurityModeCommand* by the UE

The UE shall:

1> derive the K_{eNB} key, as specified in TS 33.401 [32];

1> derive the K_{RRCint} key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.401 [32];

1> request lower layers to verify the integrity protection of the *SecurityModeCommand* message, using the algorithm indicated by the *integrityProtAlgorithm* as included in the *SecurityModeCommand* message and the K_{RRCint} key;

1> if the *SecurityModeCommand* message passes the integrity protection check:

2> derive the K_{RRCenc} key and the K_{UPenc} key associated with the *cipheringAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.401 [32];

2> if connected as an RN:

3> derive the K_{UPint} key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.401 [32];

2> configure lower layers to apply integrity protection using the indicated algorithm and the K_{RRCint} key immediately, i.e. integrity protection shall be applied to all subsequent messages received and sent by the UE, including the *SecurityModeComplete* message;

2> configure lower layers to apply ciphering using the indicated algorithm, the K_{RRCenc} key and the K_{UPenc} key after completing the procedure, i.e. ciphering shall be applied to all subsequent messages received and sent by the UE, except for the *SecurityModeComplete* message which is sent unciphered;

2> if connected as an RN:

3> configure lower layers to apply integrity protection using the indicated algorithm and the K_{UPint} key, for DRBs that are subsequently configured to apply integrity protection, if any;

2> consider AS security to be activated;

2> submit the *SecurityModeComplete* message to lower layers for transmission, upon which the procedure ends;

1> else:

2> continue using the configuration used prior to the reception of the *SecurityModeCommand* message, i.e. neither apply integrity protection nor ciphering.

2> submit the *SecurityModeFailure* message to lower layers for transmission, upon which the procedure ends;

5.3.5 RRC connection reconfiguration

5.3.5.1 General

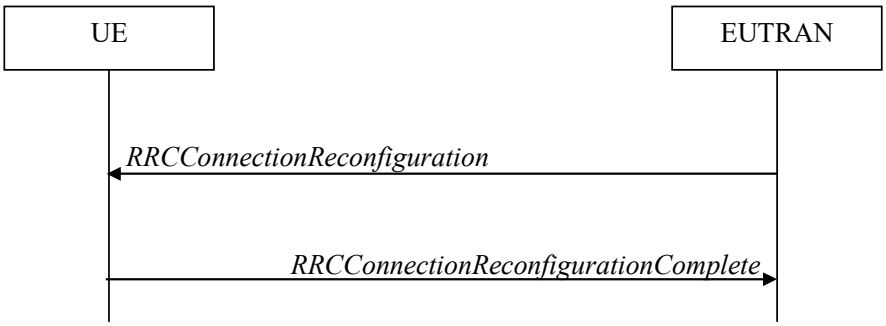


Figure 5.3.5.1-1: RRC connection reconfiguration, successful

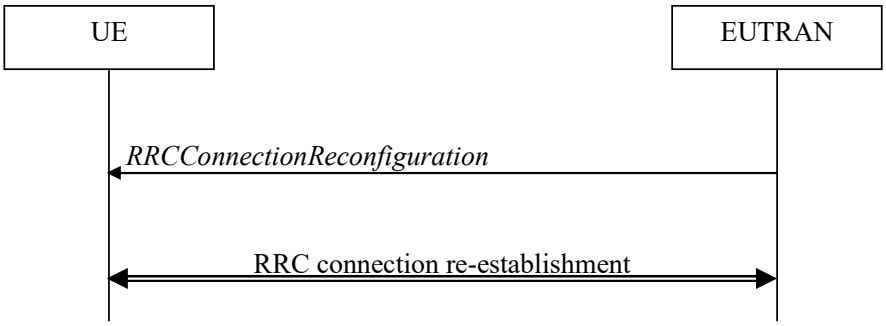


Figure 5.3.5.1-2: RRC connection reconfiguration, failure

The purpose of this procedure is to modify an RRC connection, e.g. to establish/ modify/ release RBs, to perform handover, to setup/ modify/ release measurements, to add/ modify/ release SCells. As part of the procedure, NAS dedicated information may be transferred from E-UTRAN to the UE.

5.3.5.2 Initiation

E-UTRAN may initiate the RRC connection reconfiguration procedure to a UE in RRC_CONNECTED. E-UTRAN applies the procedure as follows:

- the *mobilityControlInfo* is included only when AS-security has been activated, and SRB2 with at least one DRB are setup and not suspended;
- the establishment of RBs (other than SRB1, that is established during RRC connection establishment) is included only when AS security has been activated;
- the addition of SCells is performed only when AS security has been activated;

5.3.5.3 Reception of an *RRCConnectionReconfiguration* not including the *mobilityControlInfo* by the UE

If the *RRCConnectionReconfiguration* message does not include the *mobilityControlInfo* and the UE is able to comply with the configuration included in this message, the UE shall:

1> if this is the first *RRCConnectionReconfiguration* message after successful completion of the RRC Connection Re-establishment procedure:

2> re-establish PDCP for SRB2 and for all DRBs that are established, if any;

2> re-establish RLC for SRB2 and for all DRBs that are established, if any;

2> if the *RRCConnectionReconfiguration* message includes the *fullConfig*:

3> perform the radio configuration procedure as specified in section 5.3.5.8;

2> if the *RRCConnectionReconfiguration* message includes the *radioResourceConfigDedicated*:

3> perform the radio resource configuration procedure as specified in 5.3.10;

2> resume SRB2 and all DRBs that are suspended, if any;

NOTE 1: The handling of the radio bearers after the successful completion of the PDCP re-establishment, e.g. the re-transmission of unacknowledged PDCP SDUs (as well as the associated status reporting), the handling of the SN and the HFN, is specified in TS 36.323 [8].

NOTE 2: The UE may discard SRB2 messages and data that it receives prior to completing the reconfiguration used to resume these bearers.

1> else:

2> if the *RRCConnectionReconfiguration* message includes the *radioResourceConfigDedicated*:

3> perform the radio resource configuration procedure as specified in 5.3.10;

NOTE 3: If the *RRCConnectionReconfiguration* message includes the establishment of radio bearers other than SRB1, the UE may start using these radio bearers immediately, i.e. there is no need to wait for an outstanding acknowledgment of the *SecurityModeComplete* message.

1> if the received *RRCConnectionReconfiguration* includes the *sCellToReleaseList*:

2> perform SCell release as specified in 5.3.10.3a;

1> if the received *RRCConnectionReconfiguration* includes the *sCellToAddModList*:

2> perform SCell addition or modification as specified in 5.3.10.3b;

1> if the received *RRCConnectionReconfiguration* includes the *scg-Configuration*; or

1> if the current UE configuration includes one or more split DRBs and the received *RRCConnectionReconfiguration* includes *radioResourceConfigDedicated* including *drb-ToAddModList*:

2> perform SCG reconfiguration as specified in 5.3.10.10;

1> if the received *RRCConnectionReconfiguration* includes the *systemInformationBlockType1Dedicated*:

2> perfom the actions upon reception of the *SystemInformationBlockType1* message as specified in 5.2.2.7*;*

1> if the *RRCConnectionReconfiguration* message includes the *dedicatedInfoNASList*:

2> forward each element of the *dedicatedInfoNASList* to upper layers in the same order as listed;

1> if the *RRCConnectionReconfiguration* message includes the *measConfig*:

2> perform the measurement configuration procedure as specified in 5.5.2;

1> perform the measurement identity autonomous removal as specified in 5.5.2.2a;

1> if the *RRCConnectionReconfiguration* message includes the *otherConfig*:

2> perform the other configuration procedure as specified in 5.3.10.9;

1> if the *RRCConnectionReconfiguration* message includes the *sl-DiscConfig* or *sl-CommConfig*:

2> perform the sidelink dedicated configuration procedure as specified in 5.3.10.15;

1> if the *RRCConnectionReconfiguration* message includes *wlan-OffloadInfo*:

2> perform the dedicated WLAN offload configuration procedure as specified in 5.6.12.2;

1> submit the *RRCConnectionReconfigurationComplete* message to lower layers for transmission using the new configuration, upon which the procedure ends;

5.3.5.4 Reception of an *RRCConnectionReconfiguration* including the *mobilityControlInfo* by the UE (handover)

If the *RRCConnectionReconfiguration* message includes the *mobilityControlInfo* and the UE is able to comply with the configuration included in this message, the UE shall:

1> stop timer T310, if running;

1> stop timer T312, if running;

1> start timer T304 with the timer value set to *t304,* as included in the *mobilityControlInfo*;

1> if the *carrierFreq* is included:

2> consider the target PCell to be one on the frequency indicated by the *carrierFreq* with a physical cell identity indicated by the *targetPhysCellId*;

1> else:

2> consider the target PCell to be one on the frequency of the source PCell with a physical cell identity indicated by the *targetPhysCellId*;

1> start synchronising to the DL of the target PCell;

NOTE 1: The UE should perform the handover as soon as possible following the reception of the RRC message triggering the handover, which could be before confirming successful reception (HARQ and ARQ) of this message.

1> reset MCG MAC and SCG MAC, if configured;

1> re-establish PDCP for all RBs that are established;

NOTE 2: The handling of the radio bearers after the successful completion of the PDCP re-establishment, e.g. the re-transmission of unacknowledged PDCP SDUs (as well as the associated status reporting), the handling of the SN and the HFN, is specified in TS 36.323 [8].

1> re-establish MCG RLC and SCG RLC, if configured, for all RBs that are established;

1> configure lower layers to consider the SCell(s) other than the PSCell, if configured, to be in deactivated state;

1> apply the value of the *newUE-Identity* as the C-RNTI;

1> if the *RRCConnectionReconfiguration* message includes the *fullConfig*:

2> perform the radio configuration procedure as specified in section 5.3.5.8;

1> configure lower layers in accordance with the received *radioResourceConfigCommon*;

1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *mobilityControlInfo*;

1> if the *RRCConnectionReconfiguration* message includes the *radioResourceConfigDedicated*:

2> perform the radio resource configuration procedure as specified in 5.3.10;

1> if the *keyChangeIndicator* received in the *securityConfigHO* is set to *TRUE*:

2> update the K_{eNB} key based on the K_{ASME} key taken into use with the latest successful NAS SMC procedure, as specified in TS 33.401 [32];

1> else:

2> update the K_{eNB} key based on the current K_{eNB} or the NH, using the *nextHopChainingCount* value indicated in the *securityConfigHO*, as specified in TS 33.401 [32];

1> store the *nextHopChainingCount* value;

1> if the *securityAlgorithmConfig* is included in the *securityConfigHO*:

2> derive the K_{RRCint} key associated with the *integrityProtAlgorithm*, as specified in TS 33.401 [32];

2> if connected as an RN:

3> derive the K_{UPint} key associated with the *integrityProtAlgorithm*, as specified in TS 33.401 [32];

2> derive the K_{RRCenc} key and the K_{UPenc} key associated with the *cipheringAlgorithm*, as specified in TS 33.401 [32];

1> else:

2> derive the K_{RRCint} key associated with the current integrity algorithm, as specified in TS 33.401 [32];

2> if connected as an RN:

3> derive the K_{UPint} key associated with the current integrity algorithm, as specified in TS 33.401 [32];

2> derive the K_{RRCenc} key and the K_{UPenc} key associated with the current ciphering algorithm, as specified in TS 33.401 [32];

1> configure lower layers to apply the integrity protection algorithm and the K_{RRCint} key, i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> configure lower layers to apply the ciphering algorithm, the K_{RRCenc} key and the K_{UPenc} key, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> if connected as an RN:

2> configure lower layers to apply the integrity protection algorithm and the K_{UPint} key, for current or subsequently established DRBs that are configured to apply integrity protection, if any;

1> if the received *RRCConnectionReconfiguration* includes the *sCellToReleaseList*:

2> perform SCell release as specified in 5.3.10.3a;

1> if the received *RRCConnectionReconfiguration* includes the s*CellToAddModList*:

2> perform SCell addition or modification as specified in 5.3.10.3b;

1> if the received *RRCConnectionReconfiguration* includes the *scg-Configuration*; or

1> if the current UE configuration includes one or more split DRBs and the received *RRCConnectionReconfiguration* includes *radioResourceConfigDedicated* including *drb-ToAddModList*:

2> perform SCG reconfiguration as specified in 5.3.10.10;

1> if the received *RRCConnectionReconfiguration* includes the *systemInformationBlockType1Dedicated*:

2> perfom the actions upon reception of the *SystemInformationBlockType1* message as specified in 5.2.2.7;

1> perform the measurement related actions as specified in 5.5.6.1;

1> if the *RRCConnectionReconfiguration* message includes the *measConfig*:

2> perform the measurement configuration procedure as specified in 5.5.2;

1> perform the measurement identity autonomous removal as specified in 5.5.2.2a;

1> release *reportProximityConfig* and clear any associated proximity status reporting timer;

1> if the *RRCConnectionReconfiguration* message includes the *otherConfig*:

2> perform the other configuration procedure as specified in 5.3.10.9;

1> if the *RRCConnectionReconfiguration* message includes the *sl-DiscConfig* or *sl-CommConfig*:

2> perform the sidelink dedicated configuration procedure as specified in 5.3.10.15;

1> if the *RRCConnectionReconfiguration* message includes *wlan-OffloadInfo*:

2> perform the dedicated WLAN offload configuration procedure as specified in 5.6.12.2;

1> set the content of *RRCConnectionReconfigurationComplete* message as follows:

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

3> include *rlf-InfoAvailable*;

2> if the UE has MBSFN logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport* and if T330 is not running:

3> include *logMeasAvailableMBSFN*;

2> else if the UE has logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include the *logMeasAvailable*;

2> if the UE has connection establishment failure information available in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

3> include *connEstFailInfoAvailable*;

1> submit the *RRCConnectionReconfigurationComplete* message to lower layers for transmission;

1> if MAC successfully completes the random access procedure:

2> stop timer T304;

2> apply the parts of the CQI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the target PCell, if any;

2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the target PCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of the target PCell;

NOTE 3: Whenever the UE shall setup or reconfigure a configuration in accordance with a field that is received it applies the new configuration, except for the cases addressed by the above statements.

2> if the UE is configured to provide IDC indications:

3> if the UE has transmitted an *InDeviceCoexIndication* message during the last 1 second preceding reception of the *RRCConnectionReconfiguration* message including *mobilityControlInfo*:

4> initiate transmission of the *InDeviceCoexIndication* message in accordance with 5.6.9.3;

2> if the UE is configured to provide power preference indications:

3> if the UE has transmitted a *UEAssistanceInformation* message during the last 1 second preceding reception of the *RRCConnectionReconfiguration* message including *mobilityControlInfo*:

4> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.6.10.3;

2> if *SystemInformationBlockType15* is broadcast by the PCell:

3> if the UE has transmitted a *MBMSInterestIndication* message during the last 1 second preceding reception of the *RRCConnectionReconfiguration* message including *mobilityControlInfo*:

4> ensure having a valid version of *SystemInformationBlockType15* for the PCell;

4> determine the set of MBMS frequencies of interest in accordance with 5.8.5.3;

4> initiate transmission of the *MBMSInterestIndication* message in accordance with 5.8.5.4;

2> if *SystemInformationBlockType18* is broadcast by the target PCell; and the UE transmitted a *SidelinkUEInformation* message including *commRxInterestedFreq* or *commTxResourceReq* during the last 1 second preceding reception of the *RRCConnectionReconfiguration* message including *mobilityControlInfo*; or

2> if *SystemInformationBlockType19* is broadcast by the target PCell; and the UE transmitted a *SidelinkUEInformation* message including *discRxInterest* or *discTxResourceReq* during the last 1 second preceding reception of the *RRCConnectionReconfiguration* message including *mobilityControlInfo*:

3> initiate transmission of the *SidelinkUEInformation* message in accordance with 5.10.2.3;

2> the procedure ends;

NOTE 4: The UE is not required to determine the SFN of the target PCell by acquiring system information from that cell before performing RACH access in the target PCell.

5.3.5.5 Reconfiguration failure

The UE shall:

1> if the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message:

2> continue using the configuration used prior to the reception of *RRCConnectionReconfiguration* message;

2> if security has not been activated:

3> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause other;

2> else:

3> initiate the connection re-establishment procedure as specified in 5.3.7, upon which the connection reconfiguration procedure ends;

NOTE 1: The UE may apply above failure handling also in case the *RRCConnectionReconfiguration* message causes a protocol error for which the generic error handling as defined in 5.7 specifies that the UE shall ignore the message.

NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/ failure.

5.3.5.6 T304 expiry (handover failure)

The UE shall:

1> if T304 expires (handover failure):

NOTE 1: Following T304 expiry any dedicated preamble, if provided within the *rach-ConfigDedicated*, is not available for use by the UE anymore.

2> revert back to the configuration used in the source PCell, excluding the configuration configured by the *physicalConfigDedicated*, the *mac-MainConfig* and the *sps-Config*;

2> store the following handover failure information in *VarRLF-Report* by setting its fields as follows:

3> clear the information included in *VarRLF-Report*, if any;

3> set the *plmn-IdentityList* to include the list of EPLMNs stored by the UE (i.e. includes the RPLMN);

3> set the *measResultLastServCell* to include the RSRP and RSRQ, if available, of the source PCell based on measurements collected up to the moment the UE detected handover failure and in accordance with the following;

4> if the UE includes *rsrqResult*, include the *lastServCellRSRQ-Type*;

3> set the *measResultNeighCells* to include the best measured cells, other than the source PCell, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected handover failure, and set its fields as follows;

4> if the UE was configured to perform measurements for one or more EUTRA frequencies, include the *measResultListEUTRA*;

4> if the UE includes *rsrqResult*, include the *rsrq-Type*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring UTRA frequencies, include the *measResultListUTRA*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring GERAN frequencies, include the *measResultListGERAN*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring CDMA2000 frequencies, include the *measResultsCDMA2000*;

4> for each neighbour cell included, include the optional fields that are available;

NOTE 2: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

3> if detailed location information is available, set the content of the *locationInfo* as follows:

4> include the *locationCoordinates*;

4> include the *horizontalVelocity*, if available;

3> set the *failedPCellId* to the global cell identity, if available, and otherwise to the physical cell identity and carrier frequency of the target PCell of the failed handover;

3> include *previousPCellId* and set it to the global cell identity of the PCell where the last *RRCConnectionReconfiguration* message including *mobilityControlInfo* was received;

3> set the *timeConnFailure* to the elapsed time since reception of the last *RRCConnectionReconfiguration* message including the *mobilityControlInfo*;

3> set the *connectionFailureType* to '*hof*';

3> set the *c-RNTI* to the C-RNTI used in the source PCell;

2> initiate the connection re-establishment procedure as specified in 5.3.7, upon which the RRC connection reconfiguration procedure ends;

The UE may discard the handover failure information, i.e. release the UE variable *VarRLF-Report,* 48 hours after the failure is detected, upon power off or upon detach.

NOTE 3: E-UTRAN may retrieve the handover failure information using the UE information procedure with *rlf-ReportReq* set to *true*, as specified in 5.6.5.3.

5.3.5.7 Void

5.3.5.7a T307 expiry (SCG change failure)

The UE shall:

1> if T307 expires:

NOTE 1: Following T307 expiry any dedicated preamble, if provided within the *rach-ConfigDedicatedSCG*, is not available for use by the UE anymore.

2> initiate the SCG failure information procedure as specified in 5.6.13 to report SCG change failure;

5.3.5.8 Radio Configuration involving full configuration option

The UE shall:

1> release/ clear all current dedicated radio configurations except the MCG C-RNTI, the MCG security configuration and the PDCP, RLC, logical channel configurations for the RBs and the logged measurement configuration;

NOTE 1: Radio configuration is not just the resource configuration but includes other configurations like *MeasConfig* and *OtherConfig*.

1> if the *RRCConnectionReconfiguration* message includes the *mobilityControlInfo*:

2> release/ clear all current common radio configurations;

2> use the default values specified in 9.2.5 for timer T310, T311 and constant N310, N311;

1> else:

2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SystemInformationBlockType2*;

1> apply the default physical channel configuration as specified in 9.2.4;

1> apply the default semi-persistent scheduling configuration as specified in 9.2.3;

1> apply the default MAC main configuration as specified in 9.2.2;

1> for each *srb-Identity* value included in the *srb-ToAddModList* (SRB reconfiguration):

2> apply the specified configuration defined in 9.1.2 for the corresponding SRB;

2> apply the corresponding default RLC configuration for the SRB specified in 9.2.1.1 for SRB1 or in 9.2.1.2 for SRB2;

2> apply the corresponding default logical channel configuration for the SRB as specified in 9.2.1.1 for SRB1 or in 9.2.1.2 for SRB2;

NOTE 2: This is to get the SRBs (SRB1 and SRB2 for handover and SRB2 for reconfiguration after reestablishment) to a known state from which the reconfiguration message can do further configuration.

1> for each *eps-BearerIdentity* value included in the *drb-ToAddModList* that is part of the current UE configuration:

2> release the PDCP entity;

2> release the RLC entity or entities;

2> release the DTCH logical channel;

2> release the *drb-identity*;

NOTE 3: This will retain the *eps-bearerIdentity* but remove the DRBs including *drb-identity* of these bearers from the current UE configuration and trigger the setup of the DRBs within the AS in Section 5.3.10.3 using the new configuration. The *eps-bearerIdentity* acts as the anchor for associating the released and re-setup DRB.

1> for each *eps-BearerIdentity* value that is part of the current UE configuration but not part of the *drb-ToAddModList:*

2> perform DRB release as specified in 5.3.10.2;

5.3.6 Counter check

5.3.6.1 General

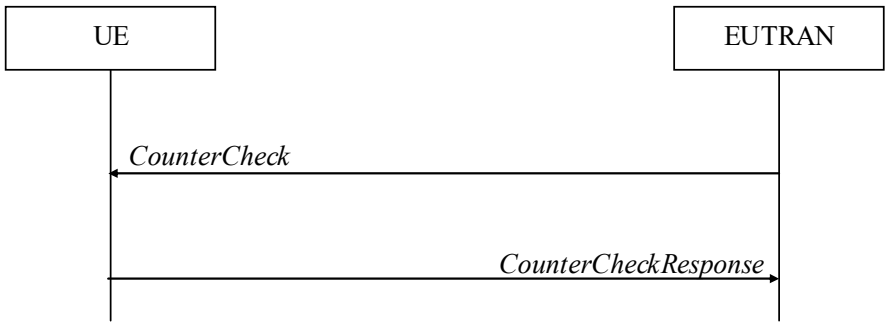


Figure 5.3.6.1-1: Counter check procedure

The counter check procedure is used by E-UTRAN to request the UE to verify the amount of data sent/ received on each DRB. More specifically, the UE is requested to check if, for each DRB, the most significant bits of the COUNT match with the values indicated by E-UTRAN.

NOTE: The procedure enables E-UTRAN to detect packet insertion by an intruder (a 'man in the middle').

5.3.6.2 Initiation

E-UTRAN initiates the procedure by sending a *CounterCheck* message.

NOTE: E-UTRAN may initiate the procedure when any of the COUNT values reaches a specific value.

5.3.6.3 Reception of the *CounterCheck* message by the UE

Upon receiving the *CounterCheck* message, the UE shall:

1> for each DRB that is established:

2> if no COUNT exists for a given direction (uplink or downlink) because it is a uni-directional bearer configured only for the other direction:

3> assume the COUNT value to be 0 for the unused direction;

2> if the *drb-Identity* is not included in the *drb-CountMSB-InfoList*:

3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of the corresponding COUNT;

2> else if, for at least one direction, the most significant bits of the COUNT are different from the value indicated in the *drb-CountMSB-InfoList*:

3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of the corresponding COUNT;

1> for each DRB that is included in the *drb-CountMSB-InfoList* in the *CounterCheck* message that is not established:

2> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* with the most significant bits set identical to the corresponding values in the *drb-CountMSB-InfoList* and the least significant bits set to zero;

1> submit the *CounterCheckResponse* message to lower layers for transmission upon which the procedure ends;

5.3.7 RRC connection re-establishment

5.3.7.1 General

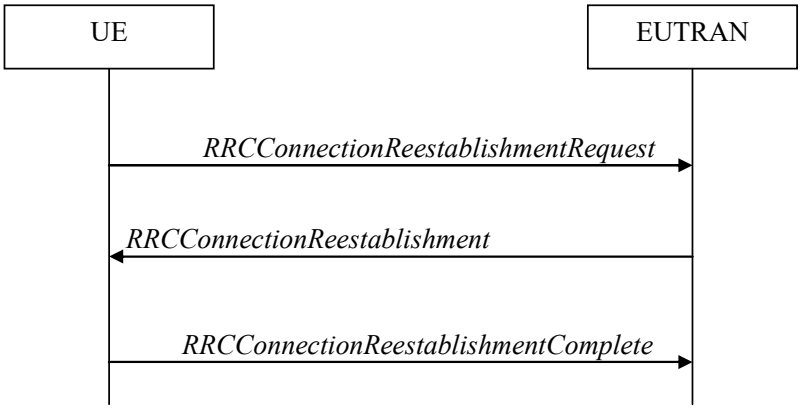


Figure 5.3.7.1-1: RRC connection re-establishment, successful

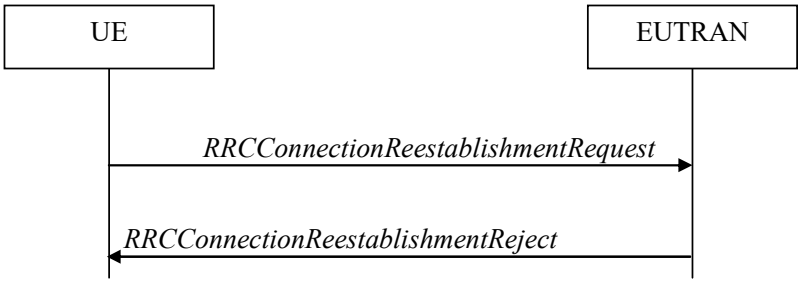


Figure 5.3.7.1-2: RRC connection re-establishment, failure

The purpose of this procedure is to re-establish the RRC connection, which involves the resumption of SRB1 operation, the re-activation of security and the configuration of only the PCell.

A UE in RRC_CONNECTED, for which security has been activated, may initiate the procedure in order to continue the RRC connection. The connection re-establishment succeeds only if the concerned cell is prepared i.e. has a valid UE context. In case E-UTRAN accepts the re-establishment, SRB1 operation resumes while the operation of other radio bearers remains suspended. If AS security has not been activated, the UE does not initiate the procedure but instead moves to RRC_IDLE directly.

E-UTRAN applies the procedure as follows:

- to reconfigure SRB1 and to resume data transfer only for this RB;
- to re-activate AS security without changing algorithms.

5.3.7.2 Initiation

The UE shall only initiate the procedure when AS security has been activated. The UE initiates the procedure when one of the following conditions is met:

1> upon detecting radio link failure, in accordance with 5.3.11; or

1> upon handover failure, in accordance with 5.3.5.6; or

1> upon mobility from E-UTRA failure, in accordance with 5.4.3.5; or

1> upon integrity check failure indication from lower layers; or

1> upon an RRC connection reconfiguration failure, in accordance with 5.3.5.5;

Upon initiation of the procedure, the UE shall:

1> stop timer T310, if running;

1> stop timer T312, if running;

1> stop timer T313, if running;

1> stop timer T307, if running;

1> start timer T311;

1> suspend all RBs except SRB0;

1> reset MAC;

1> release the MCG SCell(s), if configured, in accordance with 5.3.10.3a;

1> apply the default physical channel configuration as specified in 9.2.4;

1> for the MCG, apply the default semi-persistent scheduling configuration as specified in 9.2.3;

1> for the MCG, apply the default MAC main configuration as specified in 9.2.2;

1> release *powerPrefIndicationConfig*, if configured and stop timer T340, if running;

1> release *reportProximityConfig* and clear any associated proximity status reporting timer;

1> release *obtainLocationConfig*, if configured;

1> release *idc-Config*, if configured;

1> release *measSubframePatternPCell*, if configured;

1> release the entire SCG configuration, if configured, except for the DRB configuration (as configured by *drb-ToAddModListSCG*);

1> release *naics-Info* for the PCell, if configured;

1> if connected as an RN and configured with an RN subframe configuration:

2> release the RN subframe configuration;

1> perform cell selection in accordance with the cell selection process as specified in TS 36.304 [4];

5.3.7.3 Actions following cell selection while T311 is running

Upon selecting a suitable E-UTRA cell, the UE shall:

1> stop timer T311;

1> start timer T301;

1> apply the *timeAlignmentTimerCommon* included in *SystemInformationBlockType2*;

1> initiate transmission of the *RRCConnectionReestablishmentRequest* message in accordance with 5.3.7.4;

NOTE: This procedure applies also if the UE returns to the source PCell.

Upon selecting an inter-RAT cell, the UE shall:

1> if the selected cell is a UTRA cell, and if the UE supports Radio Link Failure Report for Inter-RAT MRO, include *selectedUTRA-CellId* in the *VarRLF-Report* and set it to the physical cell identity and carrier frequency of the selected UTRA cell;

1> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'RRC connection failure';

5.3.7.4 Actions related to transmission of *RRCConnectionReestablishmentRequest* message

If the procedure was initiated due to radio link failure or handover failure, the UE shall:

1> set the *reestablishmentCellId* in the *VarRLF-Report* to the global cell identity of the selected cell;

The UE shall set the contents of *RRCConnectionReestablishmentRequest* message as follows:

1> set the *ue-Identity* as follows:

2> set the *c-RNTI* to the C-RNTI used in the source PCell (handover and mobility from E-UTRA failure) or used in the PCell in which the trigger for the re-establishment occurred (other cases);

2> set the *physCellId* to the physical cell identity of the source PCell (handover and mobility from E-UTRA failure) or of the PCell in which the trigger for the re-establishment occurred (other cases);

2> set the *shortMAC-I* to the 16 least significant bits of the MAC-I calculated:

3> over the ASN.1 encoded as per section 8 (i.e., a multiple of 8 bits) *VarShortMAC-Input*;

3> with the K_{RRCint} key and integrity protection algorithm that was used in the source PCell (handover and mobility from E-UTRA failure) or of the PCell in which the trigger for the re-establishment occurred (other cases); and

3> with all input bits for COUNT, BEARER and DIRECTION set to binary ones;

1> set the *reestablishmentCause* as follows:

2> if the re-establishment procedure was initiated due to reconfiguration failure as specified in 5.3.5.5 (the UE is unable to comply with the reconfiguration):

3> set the *reestablishmentCause* to the value *reconfigurationFailure*;

2> else if the re-establishment procedure was initiated due to handover failure as specified in 5.3.5.6 (intra-LTE handover failure) or 5.4.3.5 (inter-RAT mobility from EUTRA failure):

3> set the *reestablishmentCause* to the value *handoverFailure*;

2> else:

3> set the *reestablishmentCause* to the value *otherFailure*;

The UE shall submit the *RRCConnectionReestablishmentRequest* message to lower layers for transmission.

5.3.7.5 Reception of the *RRCConnectionReestablishment* by the UE

NOTE 1: Prior to this, lower layer signalling is used to allocate a C-RNTI. For further details see TS 36.321 [6];

The UE shall:

1> stop timer T301;

1> consider the current cell to be the PCell;

1> re-establish PDCP for SRB1;

1> re-establish RLC for SRB1;

1> perform the radio resource configuration procedure in accordance with the received *radioResourceConfigDedicated* and as specified in 5.3.10;

1> resume SRB1;

NOTE 2: E-UTRAN should not transmit any message on SRB1 prior to receiving the *RRCConnectionReestablishmentComplete* message.

1> update the K_{eNB} key based on the K_{ASME} key to which the current K_{eNB} is associated, using the *nextHopChainingCount* value indicated in the *RRCConnectionReestablishment* message, as specified in TS 33.401 [32];

1> store the *nextHopChainingCount* value;

1> derive the K_{RRCint} key associated with the previously configured integrity algorithm, as specified in TS 33.401 [32];

1> derive the K_{RRCenc} key and the K_{UPenc} key associated with the previously configured ciphering algorithm, as specified in TS 33.401 [32];

1> if connected as an RN:

2> derive the K_{UPint} key associated with the previously configured integrity algorithm, as specified in TS 33.401 [32];

1> configure lower layers to activate integrity protection using the previously configured algorithm and the K_{RRCint} key immediately, i.e., integrity protection shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> if connected as an RN:

2> configure lower layers to apply integrity protection using the previously configured algorithm and the K_{UPint} key, for subsequently resumed or subsequently established DRBs that are configured to apply integrity protection, if any;

1> configure lower layers to apply ciphering using the previously configured algorithm, the K_{RRCenc} key and the K_{UPenc} key immediately, i.e., ciphering shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> set the content of *RRCConnectionReestablishmentComplete* message as follows:

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

3> include the *rlf-InfoAvailable*;

2> if the UE has MBSFN logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport* and if T330 is not running:

3> include *logMeasAvailableMBSFN*;

2> else if the UE has logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include the *logMeasAvailable*;

2> if the UE has connection establishment failure information available in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

3> include the *connEstFailInfoAvailable*;

1> perform the measurement related actions as specified in 5.5.6.1;

1> perform the measurement identity autonomous removal as specified in 5.5.2.2a;

1> submit the *RRCConnectionReestablishmentComplete* message to lower layers for transmission;

1> if *SystemInformationBlockType15* is broadcast by the PCell:

2> if the UE has transmitted an *MBMSInterestIndication* message during the last 1 second preceding detection of radio link failure:

3> ensure having a valid version of *SystemInformationBlockType15* for the PCell;

3> determine the set of MBMS frequencies of interest in accordance with 5.8.5.3;

3> initiate transmission of the *MBMSInterestIndication* message in accordance with 5.8.5.4;

1> if *SystemInformationBlockType18* is broadcast by the PCell; and the UE transmitted a *SidelinkUEInformation* message including *commRxInterestedFreq* or *commTxResourceReq* during the last 1 second preceding detection of radio link failure; or

1> if *SystemInformationBlockType19* is broadcast by the PCell; and the UE transmitted a *SidelinkUEInformation* message including *discRxInterest* or *discTxResourceReq* during the last 1 second preceding detection of radio link failure:

2> initiate transmission of the *SidelinkUEInformation* message in accordance with 5.10.2.3;

1> the procedure ends;

5.3.7.6 T311 expiry

Upon T311 expiry, the UE shall:

1> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'RRC connection failure';

5.3.7.7 T301 expiry or selected cell no longer suitable

The UE shall:

1> if timer T301 expires; or

1> if the selected cell becomes no longer suitable according to the cell selection criteria as specified in TS 36.304 [4]:

2> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'RRC connection failure';

5.3.7.8 Reception of *RRCConnectionReestablishmentReject* by the UE

Upon receiving the *RRCConnectionReestablishmentReject* message, the UE shall:

1> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'RRC connection failure';

5.3.8 RRC connection release

5.3.8.1 General

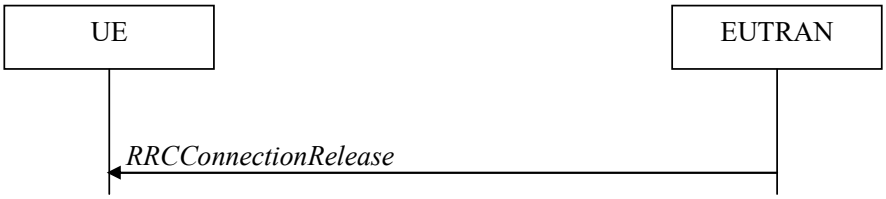


Figure 5.3.8.1-1: RRC connection release, successful

The purpose of this procedure is to release the RRC connection, which includes the release of the established radio bearers as well as all radio resources.

5.3.8.2 Initiation

E-UTRAN initiates the RRC connection release procedure to a UE in RRC_CONNECTED.

5.3.8.3 Reception of the *RRCConnectionRelease* by the UE

The UE shall:

1> delay the following actions defined in this sub-clause 60 ms from the moment the *RRCConnectionRelease* message was received or optionally when lower layers indicate that the receipt of the *RRCConnectionRelease* message has been successfully acknowledged, whichever is earlier;

1> if the *RRCConnectionRelease* message includes the *idleModeMobilityControlInfo*:

2> store the cell reselection priority information provided by the *idleModeMobilityControlInfo*;

2> if the *t320* is included:

3> start timer T320, with the timer value set according to the value of *t320*;

1> else:

2> apply the cell reselection priority information broadcast in the system information;

1> if the *releaseCause* received in the *RRCConnectionRelease* message indicates *loadBalancingTAURequired*:

2> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'load balancing TAU required';

1> else if the *releaseCause* received in the *RRCConnectionRelease* message indicates *cs-FallbackHighPriority*:

2> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'CS Fallback High Priority';

1> else:

2> if the *extendedWaitTime* is present and the UE supports delay tolerant access:

3> forward the *extendedWaitTime* to upper layers;

2> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'other';

5.3.8.4 T320 expiry

The UE shall:

1> if T320 expires:

2> if stored, discard the cell reselection priority information provided by the *idleModeMobilityControlInfo* or inherited from another RAT;

2> apply the cell reselection priority information broadcast in the system information;

5.3.9 RRC connection release requested by upper layers

5.3.9.1 General

The purpose of this procedure is to release the RRC connection. Access to the current PCell may be barred as a result of this procedure.

NOTE: Upper layers invoke the procedure, e.g. upon determining that the network has failed an authentication check, see TS 24.301 [35].

5.3.9.2 Initiation

The UE initiates the procedure when upper layers request the release of the RRC connection. The UE shall not initiate the procedure for power saving purposes.

The UE shall:

1> if the upper layers indicate barring of the PCell:

2> treat the PCell used prior to entering RRC_IDLE as barred according to TS 36.304 [4];

1> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'other';

5.3.10 Radio resource configuration

5.3.10.0 General

The UE shall:

1> if the received *radioResourceConfigDedicated* includes the *srb-ToAddModList*:

2> perform the SRB addition or reconfiguration as specified in 5.3.10.1;

1> if the received *radioResourceConfigDedicated* includes the *drb-ToReleaseList*:

2> perform DRB release as specified in 5.3.10.2;

1> if the received *radioResourceConfigDedicated* includes the *drb-ToAddModList*:

2> perform DRB addition or reconfiguration as specified in 5.3.10.3;

1> if the received *radioResourceConfigDedicated* includes the *mac-MainConfig*:

2> perform MAC main reconfiguration as specified in 5.3.10.4;

1> if the received *radioResourceConfigDedicated* includes *sps-Config*:

2> perform SPS reconfiguration according to 5.3.10.5;

1> if the received *radioResourceConfigDedicated* includes the *physicalConfigDedicated*:

2> reconfigure the physical channel configuration as specified in 5.3.10.6.

1> if the received *radioResourceConfigDedicated* includes the *rlf-TimersAndConstants*:

2> reconfigure the values of timers and constants as specified in 5.3.10.7;

1> if the received *radioResourceConfigDedicated* includes the *measSubframePatternPCell*:

2> reconfigure the time domain measurement resource restriction for the serving cell as specified in 5.3.10.8;

1> if the received *radioResourceConfigDedicated* includes the *naics-Info*:

2> perform NAICS neighbour cell information reconfiguration for the PCell as specified in 5.3.10.13;

1> if the received *RadioResourceConfigDedicatedPSCell* includes the *naics-Info*:

2> perform NAICS neighbour cell information reconfiguration for the PSCell as specified in 5.3.10.13;

1> if the received *RadioResourceConfigDedicatedSCell-r10* includes the *naics-Info*:

2> perform NAICS neighbour cell information reconfiguration for the SCell as specified in 5.3.10.13;

5.3.10.1 SRB addition/ modification

The UE shall:

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is not part of the current UE configuration (SRB establishment):

2> apply the specified configuration defined in 9.1.2 for the corresponding SRB;

2> establish a PDCP entity and configure it with the current (MCG) security configuration, if applicable;

2> establish an (MCG) RLC entity in accordance with the received *rlc-Config*;

2> establish a (MCG) DCCH logical channel in accordance with the received *logicalChannelConfig* and with the logical channel identity set in accordance with 9.1.2;

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is part of the current UE configuration (SRB reconfiguration):

2> reconfigure the RLC entity in accordance with the received *rlc-Config*;

2> reconfigure the DCCH logical channel in accordance with the received *logicalChannelConfig*;

5.3.10.2 DRB release

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToReleaseList* that is part of the current UE configuration (DRB release); or

1> for each *drb-identity* value that is to be released as the result of full configuration option according to 5.3.5.8:

2> release the PDCP entity;

2> release the RLC entity or entities;

2> release the DTCH logical channel;

1> if the procedure was triggered due to handover:

2> indicate the release of the DRB(s) and the *eps-BearerIdentity* of the released DRB(s) to upper layers after successful handover;

1> else:

2> indicate the release of the DRB(s) and the *eps-BearerIdentity* of the released DRB(s) to upper layers immediately.

NOTE: The UE does not consider the message as erroneous if the *drb-ToReleaseList* includes any *drb-Identity* value that is not part of the current UE configuration.

5.3.10.3 DRB addition/ modification

The UE shall:

1> for each *drb-Identity* value included in the *drb-ToAddModList* that is not part of the current UE configuration (DRB establishment including the case when full configuration option is used):

2> if *drb-ToAddModListSCG* is not received or does not include the *drb-Identity* value (i.e. add MCG DRB):

3> establish a PDCP entity and configure it with the current MCG security configuration and in accordance with the received *pdcp-Config*;

3> establish an MCG RLC entity or entities in accordance with the received rlc-Config;

3> establish an MCG DTCH logical channel in accordance with the received *logicalChannelIdentity* and the received *logicalChannelConfig*;

2> if the *RRCConnectionReconfiguration* message includes the *fullConfig* IE:

3> associate the established DRB with corresponding included *eps-BearerIdentity*;

2> else:

3> indicate the establishment of the DRB(s) and the *eps-BearerIdentity* of the established DRB(s) to upper layers;

1> for each *drb-Identity* value included in the *drb-ToAddModList* that is part of the current UE configuration (DRB reconfiguration):

2> if *drb-ToAddModListSCG* is not received or does not include the *drb-Identity* value:

3> if the DRB indicated by *drb-Identity* is an MCG DRB (reconfigure MCG):

4> if the *pdcp-Config* is included:

5> reconfigure the PDCP entity in accordance with the received *pdcp-Config*;

4> if the *rlc-Config* is included:

5> reconfigure the RLC entity or entities in accordance with the received *rlc-Config*;

4> if the *logicalChannelConfig* is included:

5> reconfigure the DTCH logical channel in accordance with the received *logicalChannelConfig*;

NOTE: Removal and addition of the same *drb-Identity* in single *radioResourceConfiguration* is not supported.

5.3.10.3a1 DC specific DRB addition or reconfiguration

For the *drb-Identity* value for which this procedure is initiated, the UE shall:

1> if *drb-ToAddModListSCG* is received and includes the *drb-Identity* value; and *drb-Identity* value is not part of the current UE configuration (i.e. DC specific DRB establishment):

2> if *drb-ToAddModList* is received and includes the *drb-Identity* value (i.e. add split DRB):

3> establish a PDCP entity and configure it with the current MCG security configuration and in accordance with the *pdcp-Config* included in *drb-ToAddModList*;

3> establish an MCG RLC entity and an MCG DTCH logical channel in accordance with the *rlc-Config, logicalChannelIdentity* and *logicalChannelConfig* included in *drb-ToAddModList*;

3> establish an SCG RLC entity and an SCG DTCH logical channel in accordance with the *rlc-ConfigSCG, logicalChannelIdentitySCG* and *logicalChannelConfigSCG* included in *drb-ToAddModListSCG*;

2> else (i.e. add SCG DRB):

3> establish a PDCP entity and configure it with the current SCG security configuration and in accordance with the *pdcp-Config* included in *drb-ToAddModListSCG*;

3> establish an SCG RLC entity or entities and an SCG DTCH logical channel in accordance with the *rlc-ConfigSCG, logicalChannelIdentitySCG* and *logicalChannelConfigSCG* included in *drb-ToAddModListSCG*;

2> indicate the establishment of the DRB(s) and the *eps-BearerIdentity* of the established DRB(s) to upper layers;

1> else (i.e. DC specific DRB modification; *drb-ToAddModList* and/ or *drb-ToAddModListSCG* received):

2> if the DRB indicated by *drb-Identity* is a split DRB:

3> if *drb-ToAddModList* is received and includes the *drb-Identity* value, while for this entry *drb-TypeChange* is included and set to *toMCG* (i.e. split to MCG):

4> release the SCG RLC entity and the SCG DTCH logical channel;

4> reconfigure the PDCP entity in accordance with the *pdcp-Config*, if included in *drb-ToAddModList*;

4> reconfigure the MCG RLC entity and/ or the MCG DTCH logical channel in accordance with the *rlc-Config* and *logicalChannelConfig*, if included in *drb-ToAddModList*;

3> else (i.e. reconfigure split):

4> reconfigure the PDCP entity in accordance with the *pdcp-Config*, if included in *drb-ToAddModList*;

4> reconfigure the MCG RLC entity and/ or the MCG DTCH logical channel in accordance with the *rlc-Config* and *logicalChannelConfig*, if included in *drb-ToAddModList*;

4> reconfigure the SCG RLC entity and/ or the SCG DTCH logical channel in accordance with the *rlc-ConfigSCG* and *logicalChannelConfigSCG*, if included in *drb-ToAddModListSCG*;

2> if the DRB indicated by *drb-Identity* is an SCG DRB:

3> if *drb-ToAddModList* is received and includes the *drb-Identity* value, while for this entry *drb-TypeChange* is included and set to *toMCG* (i.e. SCG to MCG):

4> reconfigure the PDCP entity with the current MCG security configuration and in accordance with the *pdcp-Config*, if included in *drb-ToAddModList*;

4> reconfigure the SCG RLC entity or entities and the SCG DTCH logical channel to be an MCG RLC entity or entities and an MCG DTCH logical channel;

4> reconfigure the MCG RLC entity or entities and/ or the MCG DTCH logical channel in accordance with the *rlc-Config, logicalChannelIdentity* and *logicalChannelConfig*, if included in *drb-ToAddModList*;

3> else (i.e. *drb-ToAddModListSCG* is received and includes the *drb-Identity* value i.e. reconfigure SCG):

4> reconfigure the PDCP entity in accordance with the *pdcp-Config*, if included in *drb-ToAddModListSCG*;

4> reconfigure the SCG RLC entity or entities and/ or the SCG DTCH logical channel in accordance with the *rlc-ConfigSCG* and *logicalChannelConfigSCG*, if included in *drb-ToAddModListSCG*;

2> if the DRB indicated by *drb-Identity* is an MCG DRB:

3> if *drb-ToAddModListSCG* is received and includes the *drb-Identity* value, while for this entry *drb-Type* is included and set to *split* (i.e. MCG to split):

4> reconfigure the PDCP entity in accordance with the *pdcp-Config*, if included in *drb-ToAddModList*;

4> reconfigure the MCG RLC entity and/ or the MCG DTCH logical channel in accordance with the *rlc-Config* and *logicalChannelConfig*, if included in *drb-ToAddModList*;

4> establish an SCG RLC entity and an SCG DTCH logical channel in accordance with the *rlc-ConfigSCG, logicalChannelIdentitySCG* and *logicalChannelConfigSCG*, included in *drb-ToAddModListSCG*;

3> else (i.e. *drb-Type* is included and set to *scg* i.e. MCG to SCG):

4> reconfigure the PDCP entity with the current SCG security configuration and in accordance with the *pdcp-Config*, if included in *drb-ToAddModListSCG*;

4> reconfigure the MCG RLC entity or entities and the MCG DTCH logical channel to be an SCG RLC entity or entities and an SCG DTCH logical channel;

4> reconfigure the SCG RLC entity or entities and/ or the SCG DTCH logical channel in accordance with the *rlc-ConfigSCG*, *logicalChannelIdentitySCG* and *logicalChannelConfigSCG*, if included in *drb-ToAddModListSCG*;

5.3.10.3a SCell release

The UE shall:

1> if the release is triggered by reception of the *sCellToReleaseList* or the *sCellToReleaseListSCG*:

2> for each *sCellIndex* value included either in the *sCellToReleaseList* or in the *sCellToReleaseListSCG*:

3> if the current UE configuration includes an SCell with value *sCellIndex*:

4> release the SCell;

1> if the release is triggered by RRC connection re-establishment:

2> release all SCells that are part of the current UE configuration;

5.3.10.3b SCell addition/ modification

The UE shall:

1> for each *sCellIndex* value included either in the *sCellToAddModList* or in the *sCellToAddModListSCG* that is not part of the current UE configuration (SCell addition):

2> add the SCell, corresponding to the *cellIdentification*, in accordance with the *radioResourceConfigCommonSCell* and *radioResourceConfigDedicatedSCell*, both included either in the *sCellToAddModList* or in the *sCellToAddModListSCG*;

2> configure lower layers to consider the SCell to be in deactivated state;

2> for each *measId* included in the *measIdList* within *VarMeasConfig*:

3> if SCells are not applicable for the associated measurement; and

3> if the concerned SCell is included in *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:

4> remove the concerned SCell from *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

1> for each *sCellIndex* value included either in the *sCellToAddModList* or in the *sCellToAddModListSCG* that is part of the current UE configuration (SCell modification):

2> modify the SCell configuration in accordance with the *radioResourceConfigDedicatedSCell*, included either in the *sCellToAddModList* or in the *sCellToAddModListSCG*;

5.3.10.3c PSCell addition or modification

The UE shall:

1> if the PSCell is not part of the current UE configuration (i.e. PSCell addition):

2> add the PSCell, corresponding to the *cellIdentification*, in accordance with the received *radioResourceConfigCommonPSCell* and *radioResourceConfigDedicatedPSCell*;

2> configure lower layers to consider the PSCell to be in activated state;

1> if the PSCell is part of the current UE configuration (i.e. PSCell modification):

2> modify the PSCell configuration in accordance with the received *radioResourceConfigDedicatedPSCell*;

5.3.10.4 MAC main reconfiguration

The UE shall:

1> if the procedure is triggered to perform SCG MAC main reconfiguration:

2> if SCG MAC is not part of the current UE configuration (i.e. SCG establishment):

3> create an SCG MAC entity;

2> reconfigure the SCG MAC main configuration as specified in the following i.e. assuming it concerns the SCG MAC whenever MAC main configuration is referenced and that it is based on the received *mac-MainConfigSCG* instead of *mac-MainConfig*:

1> reconfigure the MAC main configuration in accordance with the received *mac-MainConfig* other than *stag-ToReleaseList* and *stag-ToAddModList*;

1> if the received *mac-MainConfig* includes the *stag-ToReleaseList*:

2> for each *STAG-Id* value included in the *stag-ToReleaseList* that is part of the current UE configuration:

3> release the STAG indicated by *STAG-Id*;

1> if the received *mac-MainConfig* includes the *stag-ToAddModList*:

2> for each *stag-Id* value included in *stag-ToAddModList* that is not part of the current UE configuration (STAG addition):

3> add the STAG, corresponding to the *stag-Id*, in accordance with the received *timeAlignmentTimerSTAG*;

2> for each *stag-Id* value included in *stag-ToAddModList* that is part of the current UE configuration (STAG modification):

3> reconfigure the STAG, corresponding to the *stag-Id*, in accordance with the received *timeAlignmentTimerSTAG*;

5.3.10.5 Semi-persistent scheduling reconfiguration

The UE shall:

1> reconfigure the semi-persistent scheduling in accordance with the received *sps-Config*;

5.3.10.6 Physical channel reconfiguration

The UE shall:

1> if the *antennaInfo-r10* is included in the received *physicalConfigDedicated* and the previous version of this field that was received by the UE was *antennaInfo* (without suffix i.e. the version defined in REL-8):

2> apply the default antenna configuration as specified in section 9.2.4;

1> if the *cqi-ReportConfig-r10* is included in the received *physicalConfigDedicated* and the previous version of this field that was received by the UE was *cqi-ReportConfig* (without suffix i.e. the version defined in REL-8):

2> apply the default CQI reporting configuration as specified in 9.2.4;

NOTE: Application of the default configuration involves release of all extensions introduced in REL-9 and later.

1> reconfigure the physical channel configuration in accordance with the received *physicalConfigDedicated*;

1> if the *antennaInfo* is included and set to *explicitValue*:

2> if the configured *transmissionMode* is *tm1*, *tm2*, *tm5*, *tm6* or *tm7*; or

2> if the configured *transmissionMode* is *tm8* and *pmi-RI-Report* is not present; or

2> if the configured *transmissionMode* is *tm9* and *pmi-RI-Report* is not present; or

2> if the configured *transmissionMode* is *tm9* and *pmi-RI-Report* is present and *antennaPortsCount* within *csi-RS* is set to *an1*:

3> release *ri-ConfigIndex* in *cqi-ReportPeriodic*, if previously configured;

1> else if the *antennaInfo* is included and set to *defaultValue*:

2> release *ri-ConfigIndex* in *cqi-ReportPeriodic*, if previously configured;

5.3.10.7 Radio Link Failure Timers and Constants reconfiguration

The UE shall:

1> if the received *rlf-TimersAndConstants* is set to release:

2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SystemInformationBlockType2*;

1> else:

2> reconfigure the value of timers and constants in accordance with received *rlf-TimersAndConstants*;

1> if the received *rlf-TimersAndConstantsSCG* is set to release:

2> stop timer T313, if running, and

2> release the value of timer *t313* as well as constants *n313* and *n314*;

1> else:

2> reconfigure the value of timers and constants in accordance with received *rlf-TimersAndConstantsSCG*;

5.3.10.8 Time domain measurement resource restriction for serving cell

The UE shall:

1> if the received *measSubframePatternPCell* is set to *release*:

2> release the time domain measurement resource restriction for the PCell, if previously configured

1> else:

2> apply the time domain measurement resource restriction for the PCell in accordance with the received *measSubframePatternPCell;*

5.3.10.9 Other configuration

The UE shall:

1> if the received *otherConfig* includes the *reportProximityConfig*:

2> if *proximityIndicationEUTRA* is set to *enabled*:

3> consider itself to be configured to provide proximity indications for E-UTRA frequencies in accordance with 5.3.14;

2> else:

3> consider itself not to be configured to provide proximity indications for E-UTRA frequencies;

2> if *proximityIndicationUTRA* is set to *enabled*:

3> consider itself to be configured to provide proximity indications for UTRA frequencies in accordance with 5.3.14;

2> else:

3> consider itself not to be configured to provide proximity indications for UTRA frequencies;

1> if the received *otherConfig* includes the *obtainLocation*:

2> attempt to have detailed location information available for any subsequent measurement report;

NOTE: The UE is requested to attempt to have valid detailed location information available whenever sending a measurement report for which it is configured to include available detailed location information. The UE may not succeed e.g. because the user manually disabled the GPS hardware, due to no/poor satellite coverage. Further details, e.g. regarding when to activate GNSS, are up to UE implementation.

1> if the received *otherConfig* includes the *idc-Config*:

2> if *idc-Indication* is included (i.e. set to *setup*):

3> consider itself to be configured to provide IDC indications in accordance with 5.6.9;

3> if *idc-Indication-UL-CA* is included (i.e. set to *setup*):

4> consider itself to be configured to indicate UL CA related information in IDC indications in accordance with 5.6.9;

2> else:

3> consider itself not to be configured to provide IDC indications;

2> if *autonomousDenialParameters* is included:

3> consider itself to be allowed to deny any transmission in a particular UL subframe if during the number of subframes indicated by *autonomousDenialValidity*, preceeding and including this particular subframe, it autonomously denied fewer UL subframes than indicated by *autonomousDenialSubframes*;

2> else:

3> consider itself not to be allowed to deny any UL transmission;

1> if the received *otherConfig* includes the *powerPrefIndicationConfig*:

2> if *powerPrefIndicationConfig* is set to *setup*:

3> consider itself to be configured to provide power preference indications in accordance with 5.6.10;

2> else:

3> consider itself not to be configured to provide power preference indications;

5.3.10.10 SCG reconfiguration

The UE shall:

1> if the received *scg-Configuration* is set to *release* or includes the *mobilityControlInfoSCG* (i.e. SCG release/ change):

2> if *mobilityControlInfo* is not received (i.e. SCG release/ change without HO):

3> reset SCG MAC, if configured;

3> for each *drb-Identity* value that is part of the current UE configuration:

4> if the DRB indicated by *drb-Identity* is an SCG DRB:

5> re-establish the PDCP entity and the SCG RLC entity or entities;

4> if the DRB indicated by *drb-Identity* is a split DRB:

5> perform PDCP data recovery and re-establish the SCG RLC entity;

4> if the DRB indicated by *drb-Identity* is an MCG DRB; and

4> *drb-ToAddModListSCG* is received and includes the *drb-Identity* value, while for this entry *drb-Type* is included and set to *scg* (i.e. MCG to SCG):

5> re-establish the PDCP entity and the MCG RLC entity or entities;

3> configure lower layers to consider the SCG SCell(s), except for the PSCell, to be in deactivated state;

1> if the received *scg-Configuration* is set to *release*:

2> release the entire SCG configuration, except for the DRB configuration (i.e. as configured by *drb-ToAddModListSCG*);

2> if the current UE configuration includes one or more split or SCG DRBs and the received *RRCConnectionReconfiguration* message includes *radioResourceConfigDedicated* including *drb-ToAddModList*:

3> reconfigure the SCG or split DRB by *drb-ToAddModList* as specified in 5.3.10.12;

2> stop timer T313, if running;

2> stop timer T307, if running;

1> else:

2> if the received *scg-ConfigPartMCG* includes the *scg-Counter*:

3> update the S-K_{eNB} key based on the K_{eNB} key and using the received *scg-Counter* value, as specified in TS 33.401 [32];

3> derive the K_{UPenc} key associated with the *cipheringAlgorithmSCG* included in *mobilityControlInfoSCG* within the received *scg-ConfigPartSCG*, as specified in TS 33.401 [32];

3> configure lower layers to apply the ciphering algorithm and the K_{UPenc} key;

2> if the received *scg-ConfigPartSCG* includes the *radioResourceConfigDedicatedSCG*:

3> reconfigure the dedicated radio resource configuration for the SCG as specified in 5.3.10.11;

2> if the current UE configuration includes one or more split or SCG DRBs and the received *RRCConnectionReconfiguration* message includes *radioResourceConfigDedicated* including *drb-ToAddModList*:

3> reconfigure the SCG or split DRB by *drb-ToAddModList* as specified in 5.3.10.12;

2> if the received *scg-ConfigPartSCG* includes the *pSCellToAddMod*:

3> perform PSCell addition or modification as specified in 5.3.10.3c;

2> if the received *scg-ConfigPartSCG* includes the *sCellToReleaseListSCG*:

3> perform SCell release for the SCG as specified in 5.3.10.3a;

2> if the received *scg-ConfigPartSCG* includes the *sCellToAddModListSCG*:

3> perform SCell addition or modification as specified in 5.3.10.3b;

2> configure lower layers in accordance with *mobilityControlInfoSCG*, if received;

2> if the received *scg-ConfigPartSCG* includes the *mobilityControlInfoSCG* (i.e. SCG change):

3> resume all SCG DRBs and resume SCG transmission for split DRBs, if suspended;

3> stop timer T313, if running;

3> start timer T307 with the timer value set to *t307,* as included in the *mobilityControlInfoSCG*;

3> start synchronising to the DL of the target PSCell;

3> initiate the random access procedure on the PSCell, as specified in TS 36.321 [6]:

NOTE 1: The UE is not required to determine the SFN of the target PSCell by acquiring system information from that cell before performing RACH access in the target PSCell.

3> the procedure ends, except that the following actions are performed when MAC successfully completes the random access procedure on the PSCell:

4> stop timer T307;

4> apply the parts of the CQI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the target PSCell, if any;

4> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the target PSCell (e.g. periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of the target PSCell;

NOTE 2: Whenever the UE shall setup or reconfigure a configuration in accordance with a field that is received it applies the new configuration, except for the cases addressed by the above statements.

5.3.10.11 SCG dedicated resource configuration

The UE shall:

1> if the received *radioResourceConfigDedicatedSCG* includes the *drb-ToAddModListSCG*:

2> for each *drb-Identity* value included in the *drb-ToAddModListSCG* perform the DC specific DRB addition or reconfiguration as specified in 5.3.10.3a1

1> if the received *radioResourceConfigDedicatedSCG* includes the *mac-MainConfigSCG*:

2> perform the SCG MAC main reconfiguration as specified in 5.3.10.4;

1> if the received *radioResourceConfigDedicatedSCG* includes the *rlf-TimersAndConstantsSCG*:

2> reconfigure the values of timers and constants as specified in 5.3.10.7;

5.3.10.12 Reconfiguration SCG or split DRB by *drb-ToAddModList*

The UE shall:

1> for each split or SCG DRBs that is part of the current configuration:

2> if the corresponding *drb-Identity* value is included in the received *drb-ToAddModList; and*:

2> if the corresponding *drb-Identity* value is not included in the received *drb-ToAddModListSCG* (i.e. reconfigure split, split to MCG or SCG to MCG):

3> perform the DC specific DRB addition or reconfiguration as specified in 5.3.10.3a1;

5.3.10.13 Neighbour cell information reconfiguration

The UE shall:

1> if the received *naics-Info* is set to *release*:

2> instruct lower layer to release all the NAICS neighbour cell information for the concerned cell, if previously configured;

1> if the received *naics-Info* includes the *neighCellsToReleaseList-r12*:

2> for each *physCellId-r12* value included in the *neighCellsToReleaseList-r12* that is part of the current NAICS neighbour cell information of the concerned cell:

3> instruct lower layer to release the NAICS neighbour cell information for the concerned cell;

1> if the received *naics-Info* includes the *NeighCellsToAddModList-r12*:

2> for each *physCellId-r12* value included in the *neighCellsToAddModList-r12* that is not part of the current NAICS neighbour cell information of the concerned cell:

3> instruct lower layer to add the NAICS neighbour cell information for the concerned cell;

2> for each *physCellId-r12* value included in the *neighCellsToAddModList-r12* that is part of the current NAICS neighbour cell information of the concerned cell:

3> instruct lower layer to modify the NAICS neighbour cell information in accordance with the received *NeighCellsInfo* for the concerned cell;

5.3.10.14 Void

5.3.10.15 Sidelink dedicated configuration

The UE shall:

1> if the *RRCConnectionReconfiguration* message includes the *sl-CommConfig*:

2> if *commTxResources* is included and set to *setup*:

3> from the next SC period use the resources indicated by *commTxResources* for sidelink communication transmission, as specified in 5.10.4;

2> else if *commTxResources* is included and set to *release*:

3> from the next SC period, release the resources allocated for sidelink communication transmission previously configured by *commTxResources*;

1> if the *RRCConnectionReconfiguration* message includes the *sl-DiscConfig*:

2> if *discTxResources* is included and set to *setup*:

3> from the next discovery period, as defined by *discPeriod*, use the resources indicated by *discTxResources* for sidelink discovery announcement, as specified in 5.10.6;

2> else if *discTxResources* is included and set to *release*:

3> from the next discovery period, as defined by *discPeriod*, release the resources allocated for sidelink discovery announcement previously configured by *discTxResources*;

5.3.11 Radio link failure related actions

5.3.11.1 Detection of physical layer problems in RRC_CONNECTED

The UE shall:

1> upon receiving N310 consecutive "out-of-sync" indications for the PCell from lower layers while neither T300, T301, T304 nor T311 is running:

2> start timer T310;

1> upon receiving N313 consecutive "out-of-sync" indications for the PSCell from lower layers while T307 is not running:

2> start T313;

NOTE: Physical layer monitoring and related autonomous actions do not apply to SCells except for the PSCell.

5.3.11.2 Recovery of physical layer problems

Upon receiving N311 consecutive "in-sync" indications for the PCell from lower layers while T310 is running, the UE shall:

1> stop timer T310;

1> stop timer T312, if running;

NOTE 1: In this case, the UE maintains the RRC connection without explicit signalling, i.e. the UE maintains the entire radio resource configuration.

NOTE 2: Periods in time where neither "in-sync" nor "out-of-sync" is reported by layer 1 do not affect the evaluation of the number of consecutive "in-sync" or "out-of-sync" indications.

Upon receiving N314 consecutive "in-sync" indications for the PSCell from lower layers while T313 is running, the UE shall:

1> stop timer T313;

5.3.11.3 Detection of radio link failure

The UE shall:

1> upon T310 expiry; or

1> upon T312 expiry; or

1> upon random access problem indication from MCG MAC while neither T300, T301, T304 nor T311 is running; or

1> upon indication from MCG RLC that the maximum number of retransmissions has been reached for an SRB or for an MCG or split DRB:

2> consider radio link failure to be detected for the MCG i.e. RLF;

2> store the following radio link failure information in the *VarRLF-Report* by setting its fields as follows:

3> clear the information included in *VarRLF-Report*, if any;

3> set the *plmn-IdentityList* to include the list of EPLMNs stored by the UE (i.e. includes the RPLMN);

3> set the *measResultLastServCell* to include the RSRP and RSRQ, if available, of the PCell based on measurements collected up to the moment the UE detected radio link failure;

3> set the *measResultNeighCells* to include the best measured cells, other than the PCell, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected radio link failure, and set its fields as follows;

4> if the UE was configured to perform measurements for one or more EUTRA frequencies, include the *measResultListEUTRA*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring UTRA frequencies, include the *measResultListUTRA*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring GERAN frequencies, include the *measResultListGERAN*;

4> if the UE was configured to perform measurement reporting for one or more neighbouring CDMA2000 frequencies, include the *measResultsCDMA2000*;

4> for each neighbour cell included, include the optional fields that are available;

NOTE 1: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

3> if detailed location information is available, set the content of the *locationInfo* as follows:

4> include the *locationCoordinates*;

4> include the *horizontalVelocity*, if available;

3> set the *failedPCellId* to the global cell identity, if available, and otherwise to the physical cell identity and carrier frequency of the PCell where radio link failure is detected;

3> set the *tac-FailedPCell* to the tracking area code, if available, of the PCell where radio link failure is detected;

3> if an *RRCConnectionReconfiguration* message including the *mobilityControlInfo* was received before the connection failure:

4> if the last *RRCConnectionReconfiguration* message including the *mobilityControlInfo* concerned an intra E-UTRA handover:

5> include the *previousPCellId* and set it to the global cell identity of the PCell where the last *RRCConnectionReconfiguration* message including *mobilityControlInfo* was received;

5> set the *timeConnFailure* to the elapsed time since reception of the last *RRCConnectionReconfiguration* message including the *mobilityControlInfo*;

4> if the last *RRCConnectionReconfiguration* message including the *mobilityControlInfo* concerned a handover to E-UTRA from UTRA and if the UE supports Radio Link Failure Report for Inter-RAT MRO:

5> include the *previousUTRA-CellId* and set it to the physical cell identity, the carrier frequency and the global cell identity, if available, of the UTRA Cell in which the last *RRCConnectionReconfiguration* message including *mobilityControlInfo* was received;

5> set the *timeConnFailure* to the elapsed time since reception of the last *RRCConnectionReconfiguration* message including the *mobilityControlInfo*;

3> set the *connectionFailureType* to *rlf*;

3> set the *c-RNTI* to the C-RNTI used in the PCell;

3> set the *rlf-Cause* to the trigger for detecting radio link failure;

2> if AS security has not been activated:

3> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'other';

2> else:

3> initiate the connection re-establishment procedure as specified in 5.3.7;

The UE shall:

1> upon T313 expiry; or

1> upon random access problem indication from SCG MAC; or

1> upon indication from SCG RLC that the maximum number of retransmissions has been reached for an SCG or split DRB:

2> consider radio link failure to be detected for the SCG i.e. SCG-RLF;

2> initiate the SCG failure information procedure as specified in 5.6.13 to report SCG radio link failure;

The UE may discard the radio link failure information, i.e. release the UE variable *VarRLF-Report*, 48 hours after the radio link failure is detected, upon power off or upon detach.

5.3.12 UE actions upon leaving RRC_CONNECTED

Upon leaving RRC_CONNECTED, the UE shall:

1> reset MAC;

1> stop all timers that are running except T320, T325 and T330;

1> release all radio resources, including release of the RLC entity, the MAC configuration and the associated PDCP entity for all established RBs;

1> indicate the release of the RRC connection to upper layers together with the release cause;

1> if leaving RRC_CONNECTED was triggered neither by reception of the *MobilityFromEUTRACommand* message nor by selecting an inter-RAT cell while T311 was running:

2> if timer T350 is configured:

3> start timer T350;

2> else:

3> release the *wlan-OffloadConfigDedicated*, if received;

3> if the *wlan-OffloadConfigCommon* corresponding to the RPLMN is broadcast by the cell:

4> apply the *wlan-OffloadConfigCommon* corresponding to the RPLMN included in *SystemInformationBlockType17*;

2> enter RRC_IDLE and perform procedures as specified in TS 36.304 [4, 5.2.7];

1> else:

2> release the *wlan-OffloadConfigDedicated*, if received;

5.3.13 UE actions upon PUCCH/ SRS release request

Upon receiving a PUCCH/ SRS release request from lower layers, the UE shall:

1> apply the default physical channel configuration for *cqi-ReportConfig* as specified in 9.2.4 and release *cqi-ReportConfigSCell*, for each SCell of the concerned CG that is configured, if any;

1> apply the default physical channel configuration for *soundingRS-UL-ConfigDedicated* as specified in 9.2.4, for all serving cells of the concerned CG;

1> apply the default physical channel configuration for *schedulingRequestConfig* as specified in 9.2.4, for the concerned CG;

Upon receiving an SRS release request from lower layers, the UE shall:

1> apply the default physical channel configuration for *soundingRS-UL-ConfigDedicated,* as specified in 9.2.4, for the cells of the concerned TAG;

NOTE: Upon PUCCH/ SRS release request, the UE does not modify the *soundingRS-UL-ConfigDedicatedAperiodic* i.e. it does not apply the default for this field (release).

5.3.14 Proximity indication

5.3.14.1 General

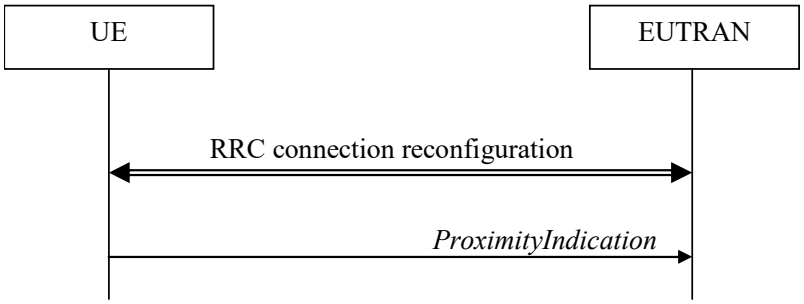


Figure 5.3.14.1-1: Proximity indication

The purpose of this procedure is to indicate that the UE is entering or leaving the proximity of one or more CSG member cells. The detection of proximity is based on an autonomous search function as defined in TS 36.304 [4].

5.3.14.2 Initiation

A UE in RRC_CONNECTED shall:

1> if the UE enters the proximity of one or more CSG member cell(s) on an E-UTRA frequency while proximity indication is enabled for such E-UTRA cells; or

1> if the UE enters the proximity of one or more CSG member cell(s) on an UTRA frequency while proximity indication is enabled for such UTRA cells; or

1> if the UE leaves the proximity of all CSG member cell(s) on an E-UTRA frequency while proximity indication is enabled for such E-UTRA cells; or

1> if the UE leaves the proximity of all CSG member cell(s) on an UTRA frequency while proximity indication is enabled for such UTRA cells:

2> if the UE has previously not transmitted a *ProximityIndication* for the RAT and frequency during the current RRC connection, or if more than 5 s has elapsed since the UE has last transmitted a *ProximityIndication* (either entering or leaving) for the RAT and frequency:

3> initiate transmission of the *ProximityIndication* message in accordance with 5.3.14.3;

NOTE: In the conditions above, "if the UE enters the proximity of one or more CSG member cell(s)" includes the case of already being in the proximity of such cell(s) at the time proximity indication for the corresponding RAT is enabled.

5.3.14.3 Actions related to transmission of *ProximityIndication* message

The UE shall set the contents of *ProximityIndication* message as follows:

1> if the UE applies the procedure to report entering the proximity of CSG member cell(s):

2> set *type* to *entering*;

1> else if the UE applies the procedure to report leaving the proximity of CSG member cell(s):

2> set *type* to *leaving*;

1> if the proximity indication was triggered for one or more CSG member cell(s) on an E-UTRA frequency:

2> set the *carrierFreq* to *eutra* with the value set to the E-ARFCN value of the E-UTRA cell(s) for which proximity indication was triggered;

1> else if the proximity indication was triggered for one or more CSG member cell(s) on a UTRA frequency:

2> set the *carrierFreq* to *utra* with the value set to the ARFCN value of the UTRA cell(s) for which proximity indication was triggered;

The UE shall submit the *ProximityIndication* message to lower layers for transmission.

5.3.15 Void

5.4 Inter-RAT mobility

5.4.1 Introduction

The general principles of connected mode mobility are described in 5.3.1.3. The general principles of the security handling upon connected mode mobility are described in 5.3.1.2.

For the (network controlled) inter RAT mobility from E-UTRA for a UE in RRC_CONNECTED, a single procedure is defined that supports both handover, cell change order with optional network assistance (NACC) and enhanced CS fallback to CDMA2000 1xRTT. In case of mobility to CDMA2000, the eNB decides when to move to the other RAT while the target RAT determines to which cell the UE shall move.

5.4.2 Handover to E-UTRA

5.4.2.1 General

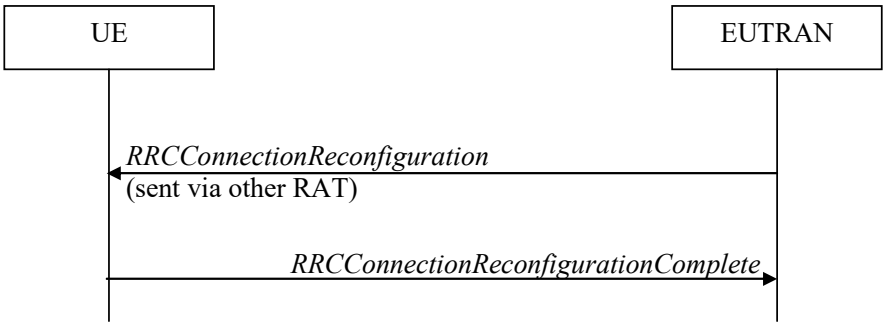


Figure 5.4.2.1-1: Handover to E-UTRA, successful

The purpose of this procedure is to, under the control of the network, transfer a connection between the UE and another Radio Access Network (e.g. GERAN or UTRAN) to E-UTRAN.

The handover to E-UTRA procedure applies when SRBs, possibly in combination with DRBs, are established in another RAT. Handover from UTRAN to E-UTRAN applies only after integrity has been activated in UTRAN.

5.4.2.2 Initiation

The RAN using another RAT initiates the Handover to E-UTRA procedure, in accordance with the specifications applicable for the other RAT, by sending the *RRCConnectionReconfiguration* message via the radio access technology from which the inter-RAT handover is performed.

E-UTRAN applies the procedure as follows:

- to activate ciphering, possibly using NULL algorithm, if not yet activated in the other RAT;
- to establish SRB1, SRB2 and one or more DRBs, i.e. at least the DRB associated with the default EPS bearer is established;

5.4.2.3 Reception of the *RRCConnectionReconfiguration* by the UE

If the UE is able to comply with the configuration included in the *RRCConnectionReconfiguration* message, the UE shall:

1> apply the default physical channel configuration as specified in 9.2.4;

1> apply the default semi-persistent scheduling configuration as specified in 9.2.3;

1> apply the default MAC main configuration as specified in 9.2.2;

1> start timer T304 with the timer value set to *t304,* as included in the *mobilityControlInfo*;

1> consider the target PCell to be one on the frequency indicated by the *carrierFreq* with a physical cell identity indicated by the *targetPhysCellId*;

1> start synchronising to the DL of the target PCell;

1> set the C-RNTI to the value of the *newUE-Identity*;

1> for the target PCell, apply the downlink bandwidth indicated by the *dl-Bandwidth;*

1> for the target PCell, apply the uplink bandwidth indicated by (the absence or presence of) the *ul-Bandwidth;*

1> configure lower layers in accordance with the received *radioResourceConfigCommon*;

1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *mobilityControlInfo*;

1> perform the radio resource configuration procedure as specified in 5.3.10;

1> forward the *nas-SecurityParamToEUTRA* to the upper layers;

1> derive the K_{eNB} key, as specified in TS 33.401 [32];

1> derive the K_{RRCint} key associated with the *integrityProtAlgorithm*, as specified in TS 33.401 [32];

1> derive the K_{RRCenc} key and the K_{UPenc} key associated with the *cipheringAlgorithm*, as specified in TS 33.401 [32];

1> configure lower layers to apply the indicated integrity protection algorithm and the K_{RRCint} key immediately, i.e. the indicated integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> configure lower layers to apply the indicated ciphering algorithm, the K_{RRCenc} key and the K_{UPenc} key immediately, i.e. the indicated ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

1> if the received *RRCConnectionReconfiguration* includes the s*CellToAddModList*:

2> perform SCell addition as specified in 5.3.10.3b;

1> if the *RRCConnectionReconfiguration* message includes the *measConfig*:

2> perform the measurement configuration procedure as specified in 5.5.2;

1> perform the measurement identity autonomous removal as specified in 5.5.2.2a;

1> if the *RRCConnectionReconfiguration* message includes the *otherConfig*:

2> perform the other configuration procedure as specified in 5.3.10.9;

1> if the *RRCConnectionReconfiguration* message includes *wlan-OffloadInfo*:

2> perform the dedicated WLAN offload configuration procedure as specified in 5.6.12.2;

1> set the content of *RRCConnectionReconfigurationComplete* message as follows:

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

3> include *rlf-InfoAvailable*;

2> if the UE has MBSFN logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport* and if T330 is not running:

3> include *logMeasAvailableMBSFN*;

2> else if the UE has logged measurements available for E-UTRA and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include the *logMeasAvailable*;

2> if the UE has connection establishment failure information available in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

3> include *connEstFailInfoAvailable*;

1> submit the *RRCConnectionReconfigurationComplete* message to lower layers for transmission using the new configuration;

1> if the *RRCConnectionReconfiguration* message does not include *rlf-TimersAndConstants* set to *setup*:

2> use the default values specified in 9.2.5 for timer T310, T311 and constant N310, N311;

1> if MAC successfully completes the random access procedure:

2> stop timer T304;

2> apply the parts of the CQI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the target PCell, if any;

2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the target PCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of the target PCell;

NOTE 1: Whenever the UE shall setup or reconfigure a configuration in accordance with a field that is received it applies the new configuration, except for the cases addressed by the above statements.

2> enter E-UTRA RRC_CONNECTED, upon which the procedure ends;

NOTE 2: The UE is not required to determine the SFN of the target PCell by acquiring system information from that cell before performing RACH access in the target PCell.

5.4.2.4 Reconfiguration failure

The UE shall:

1> if the UE is unable to comply with (part of) the configuration included in the *RRCConnectionReconfiguration* message:

2> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT;

NOTE 1: The UE may apply above failure handling also in case the *RRCConnectionReconfiguration* message causes a protocol error for which the generic error handling as defined in 5.7 specifies that the UE shall ignore the message.

NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/ failure.

5.4.2.5 T304 expiry (handover to E-UTRA failure)

The UE shall:

1> upon T304 expiry (handover to E-UTRA failure):

2> reset MAC;

2> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT;

5.4.3 Mobility from E-UTRA

5.4.3.1 General

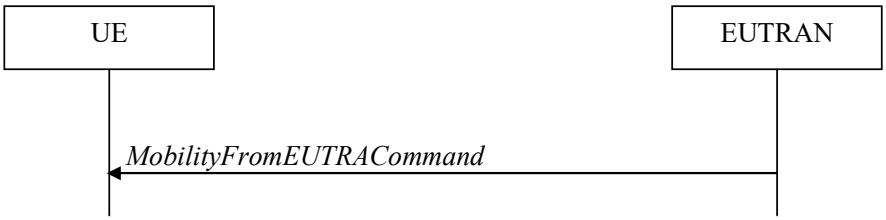


Figure 5.4.3.1-1: Mobility from E-UTRA, successful

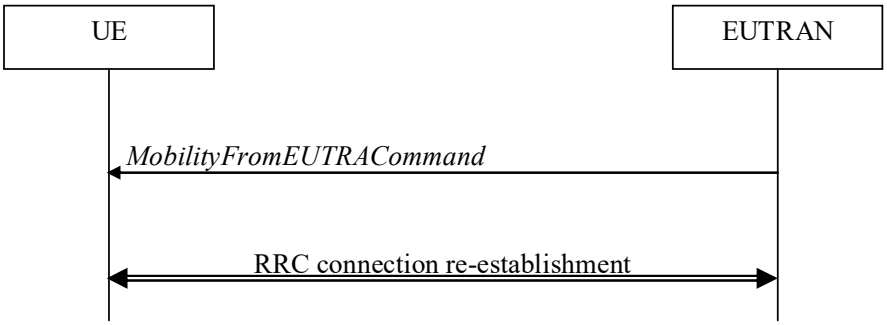


Figure 5.4.3.1-2: Mobility from E-UTRA, failure

The purpose of this procedure is to move a UE in RRC_CONNECTED to a cell using another Radio Access Technology (RAT), e.g. GERAN, UTRA or CDMA2000 systems. The mobility from E-UTRA procedure covers the following type of mobility:

- handover, i.e. the *MobilityFromEUTRACommand* message includes radio resources that have been allocated for the UE in the target cell;
- cell change order, i.e. the *MobilityFromEUTRACommand* message may include information facilitating access of and/ or connection establishment in the target cell, e.g. system information. Cell change order is applicable only to GERAN; and
- enhanced CS fallback to CDMA2000 1xRTT, i.e. the *MobilityFromEUTRACommand* message includes radio resources that have been allocated for the UE in the target cell. The enhanced CS fallback to CDMA2000 1xRTT may be combined with concurrent handover or redirection to CDMA2000 HRPD.

NOTE: For the case of dual receiver/transmitter enhanced CS fallback to CDMA2000 1xRTT, the *DLInformationTransfer* message is used instead of the *MobilityFromEUTRACommand* message (see TS 36.300 [9]).

5.4.3.2 Initiation

E-UTRAN initiates the mobility from E-UTRA procedure to a UE in RRC_CONNECTED, possibly in response to a *MeasurementReport* message or in response to reception of CS fallback indication for the UE from MME, by sending a *MobilityFromEUTRACommand* message. E-UTRAN applies the procedure as follows:

- the procedure is initiated only when AS-security has been activated, and SRB2 with at least one DRB are setup and not suspended;

5.4.3.3 Reception of the *MobilityFromEUTRACommand* by the UE

The UE shall be able to receive a *MobilityFromEUTRACommand* message and perform a cell change order to GERAN, even if no prior UE measurements have been performed on the target cell.

The UE shall:

1> stop timer T310, if running;

1> stop timer T312, if running;

1> if the *MobilityFromEUTRACommand* message includes the *purpose* set to *handover*:

2> if the *targetRAT-Type* is set to *utra* or *geran*:

3> consider inter-RAT mobility as initiated towards the RAT indicated by the *targetRAT-Type* included in the *MobilityFromEUTRACommand* message;

3> forward the *nas-SecurityParamFromEUTRA* to the upper layers;

3> access the target cell indicated in the inter-RAT message in accordance with the specifications of the target RAT;

3> if the *targetRAT-Type* is set to *geran*:

4> use the contents of *systemInformation*, if provided for PS Handover, as the system information to begin access on the target GERAN cell;

NOTE 1: If there are DRBs for which no radio bearers are established in the target RAT as indicated in the *targetRAT-MessageContainer* in the message, the E-UTRA RRC part of the UE does not indicate the release of the concerned DRBs to the upper layers. Upper layers may derive which bearers are not established from information received from the AS of the target RAT.

NOTE 2: In case of SR-VCC, the DRB to be replaced is specified in [61].

2> else if the *targetRAT-Type* is set to *cdma2000-1XRTT* or *cdma2000-HRPD*:

3> forward the *targetRAT-Type* and the *targetRAT-MessageContainer* to the CDMA2000 upper layers for the UE to access the cell(s) indicated in the inter-RAT message in accordance with the specifications of the CDMA2000 target-RAT;

1> else if the *MobilityFromEUTRACommand* message includes the *purpose* set to *cellChangeOrder*:

2> start timer T304 with the timer value set to *t304,* as included in the *MobilityFromEUTRACommand* message;

2> if the *targetRAT-Type* is set to *geran*:

3> if *networkControlOrder* is included in the *MobilityFromEUTRACommand* message:

4> apply the value as specified in TS 44.060 [36];

3> else:

4> acquire *networkControlOrder* and apply the value as specified in TS 44.060 [36];

3> use the contents of *systemInformation*, if provided, as the system information to begin access on the target GERAN cell;

2> establish the connection to the target cell indicated in the *CellChangeOrder*;

NOTE 3: The criteria for success or failure of the cell change order to GERAN are specified in TS 44.060[36].

1> if the *MobilityFromEUTRACommand* message includes the *purpose* set to *e-CSFB*:

2> if *messageContCDMA2000-1XRTT* is present:

3> forward the *messageContCDMA2000-1XRTT* to the CDMA2000 upper layers for the UE to access the cell(s) indicated in the inter-RAT message in accordance with the specification of the target RAT;

2> if *mobilityCDMA2000-HRPD* is present and is set to *handover*:

3> forward the *messageContCDMA2000-HRPD* to the CDMA2000 upper layers for the UE to access the cell(s) indicated in the inter-RAT message in accordance with the specification of the target RAT;

2> if *mobilityCDMA2000-HRPD* is present and is set to *redirection*:

3> forward the *redirectCarrierCDMA2000-HRPD* to the CDMA2000 upper layers;

NOTE 4: When the CDMA2000 upper layers in the UE receive both the *messageContCDMA2000-1XRTT* and *messageContCDMA2000-HRPD* the UE performs concurrent access to both CDMA2000 1xRTT and CDMA2000 HRPD RAT.

NOTE 5: The UE should perform the handover, the cell change order or enhanced 1xRTT CS fallback as soon as possible following the reception of the RRC message *MobilityFromEUTRACommand*, which could be before confirming successful reception (HARQ and ARQ) of this message.

5.4.3.4 Successful completion of the mobility from E-UTRA

Upon successfully completing the handover, the cell change order or enhanced 1xRTT CS fallback, the UE shall:

1> perform the actions upon leaving RRC_CONNECTED as specified in 5.3.12, with release cause 'other';

NOTE: If the UE performs enhanced 1xRTT CS fallback along with concurrent mobility to CDMA2000 HRPD and the connection to either CDMA2000 1xRTT or CDMA2000 HRPD succeeds, then the mobility from E-UTRA is considered successful.

5.4.3.5 Mobility from E-UTRA failure

The UE shall:

1> if T304 expires (mobility from E-UTRA failure); or

1> if the UE does not succeed in establishing the connection to the target radio access technology; or

1> if the UE is unable to comply with (part of) the configuration included in the *MobilityFromEUTRACommand* message; or

1> if there is a protocol error in the inter RAT information included in the *MobilityFromEUTRACommand* message, causing the UE to fail the procedure according to the specifications applicable for the target RAT:

2> stop T304, if running;

2> if the *cs-FallbackIndicator* in the *MobilityFromEUTRACommand* message was set to *TRUE* or *e-CSFB* was present:

3> indicate to upper layers that the CS Fallback procedure has failed;

2> revert back to the configuration used in the source PCell, excluding the configuration configured by the *physicalConfigDedicated*, *mac-MainConfig* and *sps-Config*;

2> initiate the connection re-establishment procedure as specified in 5.3.7;

NOTE: For enhanced CS fallback to CDMA2000 1xRTT, the above UE behavior applies only when the UE is attempting the enhanced 1xRTT CS fallback and connection to the target radio access technology fails or if the UE is attempting enhanced 1xRTT CS fallback along with concurrent mobility to CDMA2000 HRPD and connection to both the target radio access technologies fails.

5.4.4 Handover from E-UTRA preparation request (CDMA2000)

5.4.4.1 General

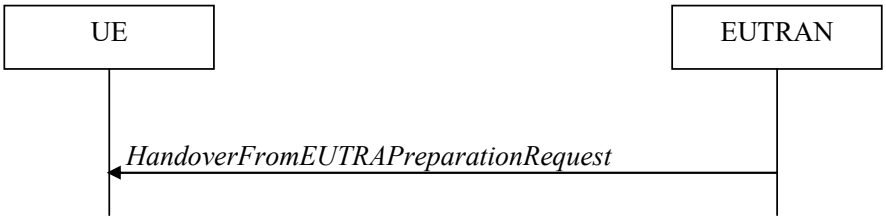


Figure 5.4.4.1-1: Handover from E-UTRA preparation request

The purpose of this procedure is to trigger the UE to prepare for handover or enhanced 1xRTT CS fallback to CDMA2000 by requesting a connection with this network. The UE may use this procedure to concurrently prepare for handover to CDMA2000 HRPD along with preparation for enhanced CS fallback to CDMA2000 1xRTT. This procedure applies to CDMA2000 capable UEs only.

This procedure is also used to trigger the UE which supports dual Rx/Tx enhanced 1xCSFB to redirect its second radio to CDMA2000 1xRTT.

The handover from E-UTRA preparation request procedure applies when signalling radio bearers are established.

5.4.4.2 Initiation

E-UTRAN initiates the handover from E-UTRA preparation request procedure to a UE in RRC_CONNECTED, possibly in response to a *MeasurementReport* message or CS fallback indication for the UE, by sending a *HandoverFromEUTRAPreparationRequest* message. E-UTRA initiates the procedure only when AS security has been activated.

5.4.4.3 Reception of the *HandoverFromEUTRAPreparationRequest* by the UE

Upon reception of the *HandoverFromEUTRAPreparationRequest* message, the UE shall:

1> if *dualRxTxRedirectIndicator* is present in the received message:

2> forward *dualRxTxRedirectIndicator* to the CDMA2000 upper layers;

2> forward *redirectCarrierCDMA2000-1XRTT* to the CDMA2000 upper layers, if included;

1> else:

2> indicate the request to prepare handover or enhanced 1xRTT CS fallback and forward the *cdma2000-Type* to the CDMA2000 upper layers;

2> if *cdma2000-Type* is set to *type1XRTT*:

3> forward the *rand* and the *mobilityParameters* to the CDMA2000 upper layers;

2> if *concurrPrepCDMA2000-HRPD* is present in the received message:

3> forward *concurrPrepCDMA2000-HRPD* to the CDMA2000 upper layers;

2> else:

3> forward *concurrPrepCDMA2000-HRPD*, with its value set to *FALSE*, to the CDMA2000 upper layers;

5.4.5 UL handover preparation transfer (CDMA2000)

5.4.5.1 General

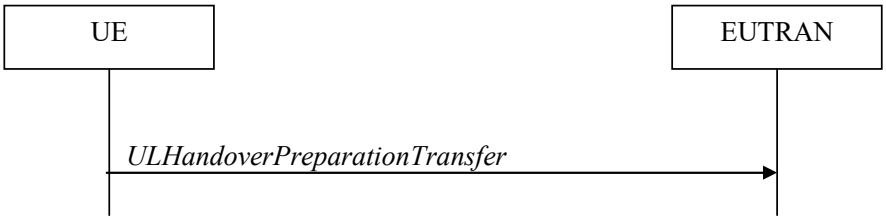


Figure 5.4.5.1-1: UL handover preparation transfer

The purpose of this procedure is to tunnel the handover related CDMA2000 dedicated information or enhanced 1xRTT CS fallback related CDMA2000 dedicated information from UE to E-UTRAN when requested by the higher layers. The procedure is triggered by the higher layers on receipt of *HandoverFromEUTRAPreparationRequest* message. If preparing for enhanced CS fallback to CDMA2000 1xRTT and handover to CDMA2000 HRPD, the UE sends two consecutive *ULHandoverPreparationTransfer* messages to E-UTRAN, one per addressed CDMA2000 RAT Type. This procedure applies to CDMA2000 capable UEs only.

5.4.5.2 Initiation

A UE in RRC_CONNECTED initiates the UL Handover Preparation Transfer procedure whenever there is a need to transfer handover or enhanced 1xRTT CS fallback related non-3GPP dedicated information. The UE initiates the UL handover preparation transfer procedure by sending the *ULHandoverPreparationTransfer* message.

5.4.5.3 Actions related to transmission of the *ULHandoverPreparationTransfer* message

The UE shall set the contents of the *ULHandoverPreparationTransfer* message as follows:

1> include the *cdma2000-Type* and the *dedicatedInfo*;

1> if the *cdma2000-Type* is set to *type1XRTT*:

2> include the *meid* and set it to the value received from the CDMA2000 upper layers;

1> submit the *ULHandoverPreparationTransfer* message to lower layers for transmission, upon which the procedure ends;

5.4.5.4 Failure to deliver the *ULHandoverPreparationTransfer* message

The UE shall:

1> if the UE is unable to guarantee successful delivery of *ULHandoverPreparationTransfer* messages:

2> inform upper layers about the possible failure to deliver the information contained in the concerned *ULHandoverPreparationTransfer* message;

5.4.6 Inter-RAT cell change order to E-UTRAN

5.4.6.1 General

The purpose of the inter-RAT cell change order to E-UTRAN procedure is to transfer, under the control of the source radio access technology, a connection between the UE and another radio access technology (e.g. GSM/ GPRS) to E-UTRAN.

5.4.6.2 Initiation

The procedure is initiated when a radio access technology other than E-UTRAN, e.g. GSM/GPRS, using procedures specific for that RAT, orders the UE to change to an E-UTRAN cell. In response, upper layers request the establishment of an RRC connection as specified in subclause 5.3.3.

NOTE: Within the message used to order the UE to change to an E-UTRAN cell, the source RAT should specify the identity of the target E-UTRAN cell as specified in the specifications for that RAT.

The UE shall:

1> upon receiving an *RRCConnectionSetup* message:

2> consider the inter-RAT cell change order procedure to have completed successfully;

5.4.6.3 UE fails to complete an inter-RAT cell change order

If the inter-RAT cell change order fails the UE shall return to the other radio access technology and proceed as specified in the appropriate specifications for that RAT.

The UE shall:

1> upon failure to establish the RRC connection as specified in subclause 5.3.3:

2> consider the inter-RAT cell change order procedure to have failed;

NOTE: The cell change was network ordered. Therefore, failure to change to the target PCell should not cause the UE to move to UE-controlled cell selection.

5.5 Measurements

5.5.1 Introduction

The UE reports measurement information in accordance with the measurement configuration as provided by E-UTRAN. E-UTRAN provides the measurement configuration applicable for a UE in RRC_CONNECTED by means of dedicated signalling, i.e. using the *RRCConnectionReconfiguration* message.

The UE can be requested to perform the following types of measurements:

- Intra-frequency measurements: measurements at the downlink carrier frequency(ies) of the serving cell(s).
- Inter-frequency measurements: measurements at frequencies that differ from any of the downlink carrier frequency(ies) of the serving cell(s).
- Inter-RAT measurements of UTRA frequencies.
- Inter-RAT measurements of GERAN frequencies.
- Inter-RAT measurements of CDMA2000 HRPD or CDMA2000 1xRTT frequencies.

The measurement configuration includes the following parameters:

1. **Measurement objects:** The objects on which the UE shall perform the measurements.
   - For intra-frequency and inter-frequency measurements a measurement object is a single E-UTRA carrier frequency. Associated with this carrier frequency, E-UTRAN can configure a list of cell specific offsets and a list of 'blacklisted' cells. Blacklisted cells are not considered in event evaluation or measurement reporting.
   - For inter-RAT UTRA measurements a measurement object is a set of cells on a single UTRA carrier frequency.
   - For inter-RAT GERAN measurements a measurement object is a set of GERAN carrier frequencies.

- For inter-RAT CDMA2000 measurements a measurement object is a set of cells on a single (HRPD or 1xRTT) carrier frequency.

NOTE 1: Some measurements using the above mentioned measurement objects, only concern a single cell, e.g. measurements used to report neighbouring cell system information, PCell UE Rx-Tx time difference.

2. **Reporting configurations**: A list of reporting configurations where each reporting configuration consists of the following:

   - Reporting criterion: The criterion that triggers the UE to send a measurement report. This can either be periodical or a single event description.

   - Reporting format: The quantities that the UE includes in the measurement report and associated information (e.g. number of cells to report).

3. **Measurement identities**: A list of measurement identities where each measurement identity links one measurement object with one reporting configuration. By configuring multiple measurement identities it is possible to link more than one measurement object to the same reporting configuration, as well as to link more than one reporting configuration to the same measurement object. The measurement identity is used as a reference number in the measurement report.

4. **Quantity configurations:** One quantity configuration is configured per RAT type. The quantity configuration defines the measurement quantities and associated filtering used for all event evaluation and related reporting of that measurement type. One filter can be configured per measurement quantity.

5. **Measurement gaps:** Periods that the UE may use to perform measurements, i.e. no (UL, DL) transmissions are scheduled.

E-UTRAN only configures a single measurement object for a given frequency, i.e. it is not possible to configure two or more measurement objects for the same frequency with different associated parameters, e.g. different offsets and/ or blacklists. E-UTRAN may configure multiple instances of the same event e.g. by configuring two reporting configurations with different thresholds.

The UE maintains a single measurement object list, a single reporting configuration list, and a single measurement identities list. The measurement object list includes measurement objects, that are specified per RAT type, possibly including intra-frequency object(s) (i.e. the object(s) corresponding to the serving frequency(ies)), inter-frequency object(s) and inter-RAT objects. Similarly, the reporting configuration list includes E-UTRA and inter-RAT reporting configurations. Any measurement object can be linked to any reporting configuration of the same RAT type. Some reporting configurations may not be linked to a measurement object. Likewise, some measurement objects may not be linked to a reporting configuration.

The measurement procedures distinguish the following types of cells:

1. The serving cell(s)– these are the PCell and one or more SCells, if configured for a UE supporting CA.

2. Listed cells - these are cells listed within the measurement object(s).

3. Detected cells - these are cells that are not listed within the measurement object(s) but are detected by the UE on the carrier frequency(ies) indicated by the measurement object(s).

For E-UTRA, the UE measures and reports on the serving cell(s), listed cells and detected cells. For inter-RAT UTRA, the UE measures and reports on listed cells and optionally on cells that are within a range for which reporting is allowed by E-UTRAN. For inter-RAT GERAN, the UE measures and reports on detected cells. For inter-RAT CDMA2000, the UE measures and reports on listed cells.

NOTE 2: For inter-RAT UTRA and CDMA2000, the UE measures and reports also on detected cells for the purpose of SON.

NOTE 3: This specification is based on the assumption that typically CSG cells of home deployment type are not indicated within the neighbour list. Furthermore, the assumption is that for non-home deployments, the physical cell identity is unique within the area of a large macro cell (i.e. as for UTRAN).

Whenever the procedural specification, other than contained in sub-clause 5.5.2, refers to a field it concerns a field included in the *VarMeasConfig* unless explicitly stated otherwise i.e. only the measurement configuration procedure covers the direct UE action related to the received *measConfig*.

5.5.2 Measurement configuration

5.5.2.1 General

E-UTRAN applies the procedure as follows:

- to ensure that, whenever the UE has a *measConfig*, it includes a *measObject* for each serving frequency;
- to configure at most one measurement identity using a reporting configuration with the *purpose* set to *reportCGI*;
- for serving frequencies, set the EARFCN within the corresponding *measObject* according to the band as used for reception/ transmission;

The UE shall:

1> if the received *measConfig* includes the *measObjectToRemoveList*:

2> perform the measurement object removal procedure as specified in 5.5.2.4;

1> if the received *measConfig* includes the *measObjectToAddModList*:

2> perform the measurement object addition/ modification procedure as specified in 5.5.2.5;

1> if the received *measConfig* includes the *reportConfigToRemoveList*:

2> perform the reporting configuration removal procedure as specified in 5.5.2.6;

1> if the received *measConfig* includes the *reportConfigToAddModList*:

2> perform the reporting configuration addition/ modification procedure as specified in 5.5.2.7;

1> if the received *measConfig* includes the *quantityConfig*:

2> perform the quantity configuration procedure as specified in 5.5.2.8;

1> if the received *measConfig* includes the *measIdToRemoveList*:

2> perform the measurement identity removal procedure as specified in 5.5.2.2;

1> if the received *measConfig* includes the *measIdToAddModList*:

2> perform the measurement identity addition/ modification procedure as specified in 5.5.2.3;

1> if the received *measConfig* includes the *measGapConfig*:

2> perform the measurement gap configuration procedure as specified in 5.5.2.9;

1> if the received *measConfig* includes the *s-Measure*:

2> set the parameter *s-Measure* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-Measure*;

1> if the received *measConfig* includes the *preRegistrationInfoHRPD*:

2> forward the *preRegistrationInfoHRPD* to CDMA2000 upper layers;

1> if the received *measConfig* includes the *speedStatePars*:

2> set the parameter *speedStatePars* within *VarMeasConfig* to the received value of *speedStatePars*;

1> if the received *measConfig* includes the *allowInterruptions*:

2> set the parameter *allowInterruptions* within *VarMeasConfig* to the received value of *allowInterruptions*;

5.5.2.2 Measurement identity removal

The UE shall:

1> for each *measId* included in the received *measIdToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:

2> remove the entry with the matching *measId* from the *measIdList* within the *VarMeasConfig*;

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

NOTE: The UE does not consider the message as erroneous if the *measIdToRemoveList* includes any *measId* value that is not part of the current UE configuration.

5.5.2.2a Measurement identity autonomous removal

The UE shall:

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the associated *reportConfig* concerns an event involving a serving cell while the concerned serving cell is not configured:

3> remove the *measId* from the *measIdList* within the *VarMeasConfig*;

3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

3> stop the periodical reporting timer if running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

NOTE 1: The above UE autonomous removal of *measId*'s applies only for measurement events A1, A2, A6, and also applies for events A3 and A5 if configured for PSCell.

NOTE 2: When performed during re-establishment, the UE is only configured with a primary frequency (i.e. the SCell(s) are released, if configured).

5.5.2.3 Measurement identity addition/ modification

E-UTRAN applies the procedure as follows:

- configure a *measId* only if the corresponding measurement object, the corresponding reporting configuration and the corresponding quantity configuration, are configured;

The UE shall:

1> for each *measId* included in the received *measIdToAddModList*:

2> if an entry with the matching *measId* exists in the *measIdList* within the *VarMeasConfig*:

3> replace the entry with the value received for this *measId*;

2> else:

3> add a new entry for this *measId* within the *VarMeasConfig*;

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> if the *triggerType* is set to *periodical* and the *purpose* is set to *reportCGI* in the *reportConfig* associated with this *measId*:

3> if the *measObject* associated with this *measId* concerns E-UTRA:

4> if the *si-RequestForHO* is included in the *reportConfig* associated with this *measId*:

5> start timer T321 with the timer value set to 150 ms for this *measId*;

4> else:

5> start timer T321 with the timer value set to 1 second for this *measId*;

3> else if the *measObject* associated with this *measId* concerns UTRA:

4> if the *si-RequestForHO* is included in the *reportConfig* associated with this *measId*:

5> for UTRA FDD, start timer T321 with the timer value set to 2 seconds for this *measId*;

5> for UTRA TDD, start timer T321 with the timer value set to [1 second] for this *measId*;

4> else:

5> start timer T321 with the timer value set to 8 seconds for this *measId*;

3> else:

4> start timer T321 with the timer value set to 8 seconds for this *measId*;

5.5.2.4 Measurement object removal

The UE shall:

1> for each *measObjectId* included in the received *measObjectToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:

2> remove the entry with the matching *measObjectId* from the *measObjectList* within the *VarMeasConfig*;

2> remove all *measId* associated with this *measObjectId* from the *measIdList* within the *VarMeasConfig,* if any;

2> if a *measId* is removed from the *measIdList:*

3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

3> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

NOTE: The UE does not consider the message as erroneous if the *measObjectToRemoveList* includes any *measObjectId* value that is not part of the current UE configuration.

5.5.2.5 Measurement object addition/ modification

The UE shall:

1> for each *measObjectId* included in the received *measObjectToAddModList*:

2> if an entry with the matching *measObjectId* exists in the *measObjectList* within the *VarMeasConfig*, for this entry:

3> reconfigure the entry with the value received for this *measObject*, except for the fields *cellsToAddModList*, *blackCellsToAddModList*, *altTTT-CellsToAddModList, cellsToRemoveList, blackCellsToRemoveList, altTTT-CellsToRemoveList*, *measSubframePatternConfigNeigh* and *measDS-Config*;

3> if the received *measObject* includes the *cellsToRemoveList*:

4> for each *cellIndex* included in the *cellsToRemoveList*:

5> remove the entry with the matching *cellIndex* from the *cellsToAddModList*;

3> if the received *measObject* includes the *cellsToAddModList*:

4> for each *cellIndex* value included in the *cellsToAddModList*:

5> if an entry with the matching *cellIndex* exists in the *cellsToAddModList*:

6> replace the entry with the value received for this *cellIndex*;

5> else:

6> add a new entry for the received *cellIndex* to the *cellsToAddModList*;

3> if the received *measObject* includes the *blackCellsToRemoveList*:

4> for each *cellIndex* included in the *blackCellsToRemoveList*:

5> remove the entry with the matching *cellIndex* from the *blackCellsToAddModList*;

NOTE 1: For each *cellIndex* included in the *blackCellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the black list of cells only if all cell indexes containing it are removed.

3> if the received *measObject* includes the *blackCellsToAddModList*:

4> for each *cellIndex* included in the *blackCellsToAddModList*:

5> if an entry with the matching *cellIndex* is included in the *blackCellsToAddModList*:

6> replace the entry with the value received for this *cellIndex*;

5> else:

6> add a new entry for the received *cellIndex* to the *blackCellsToAddModList*;

3> if the received *measObject* includes the *altTTT-CellsToRemoveList*:

4> for each *cellIndex* included in the *altTTT-CellsToRemoveList*:

5> remove the entry with the matching *cellIndex* from the *altTTT-CellsToAddModList*;

NOTE 2: For each *cellIndex* included in the *altTTT-CellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the list of cells only if all cell indexes containing it are removed.

3> if the received *measObject* includes the *altTTT-CellsToAddModList*:

4> for each *cellIndex* value included in the *altTTT-CellsToAddModList*:

5> if an entry with the matching *cellIndex* exists in the *altTTT-CellsToAddModList*:

6> replace the entry with the value received for this *cellIndex*;

5> else:

6> add a new entry for the received *cellIndex* to the *altTTT-CellsToAddModList*;

3> if the received *measObject* includes *measSubframePatternConfigNeigh*:

4> set *measSubframePatternConfigNeigh* within the *VarMeasConfig* to the value of the received field

3> if the received *measObject* includes *measDS-Config*:

4> if *measDS-Config* is set to *setup*:

5> if the received *measDS-Config* includes the *measCSI-RS-ToRemoveList*:

6> for each *measCSI-RS-Id* included in the *measCSI-RS-ToRemoveList*:

7> remove the entry with the matching *measCSI-RS-Id* from the *measCSI-RS-ToAddModList*;

5> if the received *measDS-Config* includes the *measCSI-RS-ToAddModList*, for each *measCSI-RS-Id* value included in the *measCSI-RS-ToAddModList*:

6> if an entry with the matching *measCSI-RS-Id* exists in the *measCSI-RS-ToAddModList*:

7> replace the entry with the value received for this *measCSI-RS-Id*;

6> else:

7> add a new entry for the received *measCSI-RS-Id* to the *measCSI-RS-ToAddModList*;

5> set other fields of the *measDS-Config* within the *VarMeasConfig* to the value of the received fields;

5> perform the discovery signals measurement timing configuration procedure as specified in 5.5.2.10;

4> else:

5> release the discovery signals measurement configuration;

3> for each *measId* associated with this *measObjectId* in the *measIdList* within the *VarMeasConfig*, if any:

4> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

4> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received *measObject* to the *measObjectList* within *VarMeasConfig*;

NOTE 3: UE does not need to retain *cellForWhichToReportCGI* in the *measObject* after reporting *cgi-Info*.

5.5.2.6 Reporting configuration removal

The UE shall:

1> for each *reportConfigId* included in the received *reportConfigToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:

2> remove the entry with the matching *reportConfigId* from the *reportConfigList* within the *VarMeasConfig*;

2> remove all *measId* associated with the *reportConfigId* from the *measIdList* within the *VarMeasConfig*, if any;

2> if a *measId* is removed from the *measIdList*:

3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

3> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

NOTE: The UE does not consider the message as erroneous if the *reportConfigToRemoveList* includes any *reportConfigId* value that is not part of the current UE configuration.

5.5.2.7 Reporting configuration addition/ modification

The UE shall:

1> for each *reportConfigId* included in the received *reportConfigToAddModList*:

2> if an entry with the matching *reportConfigId* exists in the *reportConfigList* within the *VarMeasConfig*, for this entry:

3> reconfigure the entry with the value received for this *reportConfig*;

3> for each *measId* associated with this *reportConfigId* included in the *measIdList* within the *VarMeasConfig*, if any:

4> remove the measurement reporting entry for this *measId* from in *VarMeasReportList*, if included;

4> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

2> else:

3> add a new entry for the received *reportConfig* to the *reportConfigList* within the *VarMeasConfig*;

5.5.2.8 Quantity configuration

The UE shall:

1> for each RAT for which the received *quantityConfig* includes parameter(s):

2> set the corresponding parameter(s) in *quantityConfig* within *VarMeasConfig* to the value of the received *quantityConfig* parameter(s);

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

5.5.2.9 Measurement gap configuration

The UE shall:

1> if *measGapConfig* is set to *setup*:

2> if a measurement gap configuration is already setup, release the measurement gap configuration;

2> setup the measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition (SFN and subframe of MCG cells):

SFN mod T = FLOOR(*gapOffset*/10);

subframe = *gapOffset* mod 10;

with T = MGRP/10 as defined in TS 36.133 [16];

NOTE: The UE applies a single gap, which timing is relative to the MCG cells, even when configured with DC.

1> else:

2> release the measurement gap configuration;

5.5.2.10 Discovery signals measurement timing configuration

The UE shall setup the discovery signals measurement timing configuration (DMTC) in accordance with the received *dmtc-PeriodOffset*, i.e., the first subframe of each DMTC occasion occurs at an SFN and subframe of the PCell meeting the following condition:

SFN mod T = FLOOR(*dmtc-Offset*/10);

subframe = *dmtc-Offset* mod 10;

with T = *dmtc-Periodicity*/10;

On the concerned frequency, the UE shall not consider discovery signals transmission in subframes outside the DMTC occasion.

5.5.3 Performing measurements

5.5.3.1 General

For all measurements the UE applies the layer 3 filtering as specified in 5.5.3.2, before using the measured results for evaluation of reporting criteria or for measurement reporting.

The UE shall:

1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell as follows:

2> for the PCell, apply the time domain measurement resource restriction in accordance with *measSubframePatternPCell,* if configured;

2> if the UE supports CRS based discovery signals measurement:

3> for each SCell in deactivated state, apply the discovery signals measurement timing configuration in accordance with *measDS-Config*, if configured within the *measObject* corresponding to the frequency of the SCell;

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the *purpose* for the associated *reportConfig* is set to *reportCGI*:

3> if *si-RequestForHO* is configured for the associated *reportConfig*:

4> perform the corresponding measurements on the frequency and RAT indicated in the associated *measObject* using autonomous gaps as necessary;

3> else:

4> perform the corresponding measurements on the frequency and RAT indicated in the associated *measObject* using available idle periods or using autonomous gaps as necessary;

NOTE 1: If autonomous gaps are used to perform measurements, the UE is allowed to temporarily abort communication with all serving cell(s), i.e. create autonomous gaps to perform the corresponding measurements within the limits specified in TS 36.133 [16]. Otherwise, the UE only supports the measurements with the purpose set to *reportCGI* only if E-UTRAN has provided sufficient idle periods.

3> try to acquire the global cell identity of the cell indicated by the *cellForWhichToReportCGI* in the associated *measObject* by acquiring the relevant system information from the concerned cell;

3> if the cell indicated by the *cellForWhichToReportCGI* included in the associated *measObject* is an E-UTRAN cell:

4> try to acquire the CSG identity, if the CSG identity is broadcast in the concerned cell;

4> try to acquire the *trackingAreaCode* in the concerned cell;

4> try to acquire the list of additional PLMN Identities, as included in the *plmn-IdentityList*, if multiple PLMN identities are broadcast in the concerned cell;

NOTE 2: The 'primary' PLMN is part of the global cell identity.

3> if the cell indicated by the *cellForWhichToReportCGI* included in the associated *measObject* is a UTRAN cell:

4> try to acquire the LAC, the RAC and the list of additional PLMN Identities, if multiple PLMN identities are broadcast in the concerned cell;

4> try to acquire the CSG identity, if the CSG identity is broadcast in the concerned cell;

3> if the cell indicated by the *cellForWhichToReportCGI* included in the associated *measObject* is a GERAN cell:

4> try to acquire the RAC in the concerned cell;

3> if the cell indicated by the *cellForWhichToReportCGI* included in the associated *measObject* is a CDMA2000 cell and the *cdma2000-Type* included in the *measObject* is *typeHRPD*:

4> try to acquire the Sector ID in the concerned cell;

3> if the cell indicated by the *cellForWhichToReportCGI* included in the associated *measObject* is a CDMA2000 cell and the *cdma2000-Type* included in the *measObject* is *type1XRTT*:

4> try to acquire the BASE ID, SID and NID in the concerned cell;

2> else:

3> if a measurement gap configuration is setup; or

3> if the UE does not require measurement gaps to perform the concerned measurements:

4> if *s-Measure* is not configured; or

4> if *s-Measure* is configured and the PCell RSRP, after layer 3 filtering, is lower than this value; or

4> if *measDS-Config* is configured in the associated *measObject*:

5> if the UE supports CSI-RS based discovery signals measurement; and

5> if the *eventId* in the associated *reportConfig* is set to *eventC1* or *eventC2*, or if *reportStrongestCSI-RSs* is included in the associated *reportConfig*:

6> perform the corresponding measurements of CSI-RS resources on the frequency indicated in the concerned *measObject*, applying the discovery signals measurement timing configuration in accordance with *measDS-Config* in the concerned *measObject*;

6> if *reportCRS-Meas* is included in the associated *reportConfig,* perform the corresponding measurements of neighbouring cells on the frequencies indicated in the concerned *measObject* as follows:

7> for neighbouring cells on the primary frequency, apply the time domain measurement resource restriction in accordance with *measSubframePatternConfigNeigh,* if configured in the concerned *measObject*;

7> apply the discovery signals measurement timing configuration in accordance with *measDS-Config* in the concerned *measObject*;

5> else:

6> perform the corresponding measurements of neighbouring cells on the frequencies and RATs indicated in the concerned *measObject* as follows:

7> for neighbouring cells on the primary frequency, apply the time domain measurement resource restriction in accordance with *measSubframePatternConfigNeigh,* if configured in the concerned *measObject*;

7> if the UE supports CRS based discovery signals measurement, apply the discovery signals measurement timing configuration in accordance with *measDS-Config*, if configured in the concerned *measObject*;

4> if the *ue-RxTxTimeDiffPeriodical* is configured in the associated *reportConfig*:

5> perform the UE Rx–Tx time difference measurements on the PCell;

2> perform the evaluation of reporting criteria as specified in 5.5.4;

NOTE 3: The *s-Measure* defines when the UE is required to perform measurements. The UE is however allowed to perform measurements also when the PCell RSRP exceeds *s-Measure*, e.g., to measure cells broadcasting a CSG identity following use of the autonomous search function as defined in TS 36.304 [4].

5.5.3.2 Layer 3 filtering

The UE shall:

1> for each measurement quantity that the UE performs measurements according to 5.5.3.1:

NOTE 1: This does not include quantities configured solely for UE Rx-Tx time difference measurements i.e. for those type of measurements the UE ignores the *triggerQuantity* and *reportQuantity*.

2> filter the measured result, before using for evaluation of reporting criteria or for measurement reporting, by the following formula:

$$F_n = (1-a) \cdot F_{n-1} + a \cdot M_n$$

where

M_n is the latest received measurement result from the physical layer;

F_n is the updated filtered measurement result, that is used for evaluation of reporting criteria or for measurement reporting;

F_{n-1} is the old filtered measurement result, where F_0 is set to M_1 when the first measurement result from the physical layer is received; and

$a = 1/2^{(k/4)}$, where k is the *filterCoefficient* for the corresponding measurement quantity received by the *quantityConfig*;

2> adapt the filter such that the time characteristics of the filter are preserved at different input rates, observing that the *filterCoefficient* k assumes a sample rate equal to 200 ms;

NOTE 2: If k is set to 0, no layer 3 filtering is applicable.

NOTE 3: The filtering is performed in the same domain as used for evaluation of reporting criteria or for measurement reporting, i.e., logarithmic filtering for logarithmic measurements.

NOTE 4: The filter input rate is implementation dependent, to fulfil the performance requirements set in [16]. For further details about the physical layer measurements, see TS 36.133 [16].

5.5.4 Measurement report triggering

5.5.4.1 General

If security has been activated successfully, the UE shall:

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the corresponding *reportConfig* includes a purpose set to *reportStrongestCellsForSON*:

3> consider any neighbouring cell detected on the associated frequency to be applicable;

2> else if the corresponding *reportConfig* includes a purpose set to *reportCGI*:

3> consider any neighbouring cell detected on the associated frequency/ set of frequencies (GERAN) which has a physical cell identity matching the value of the *cellForWhichToReportCGI* included in the corresponding *measObject* within the *VarMeasConfig* to be applicable;

2> else:

3> if the corresponding *measObject* concerns E-UTRA:

4> if the *ue-RxTxTimeDiffPeriodical* is configured in the corresponding *reportConfig*:

5> consider only the PCell to be applicable;

4> else if the *eventA1* or *eventA2* is configured in the corresponding *reportConfig*:

5> consider only the serving cell to be applicable;

4> else if *eventC1* or *eventC2* is configured in the corresponding *reportConfig*; or if *reportStrongestCSI-RSs* is included in the corresponding *reportConfig*:

5> consider a CSI-RS resource on the associated frequency to be applicable when the concerned CSI-RS resource is included in the *measCSI-RS-ToAddModList* defined within the *VarMeasConfig* for this *measId*;

4> else:

5> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is not included in the *blackCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;

5> for events involving a serving cell on one frequency and neighbours on another frequency, consider the serving cell on the other frequency as a neighbouring cell;

4> if the corresponding *reportConfig* includes *alternativeTimeToTrigger* and if the UE supports *alternativeTimeToTrigger*:

5> use the value of *alternativeTimeToTrigger* as the time to trigger instead of the value of *timeToTrigger* in the corresponding *reportConfig* for cells included in the *altTTT-CellsToAddModList* of the corresponding *measObject*;

3> else if the corresponding *measObject* concerns UTRA or CDMA2000:

4> consider a neighbouring cell on the associated frequency to be applicable when the concerned cell is included in the *cellsToAddModList* defined within the *VarMeasConfig* for this *measId* (i.e. the cell is included in the white-list);

NOTE 0: The UE may also consider a neighbouring cell on the associated UTRA frequency to be applicable when the concerned cell is included in the *csg-allowedReportingCells* within the *VarMeasConfig* for this *measId*, if configured in the corresponding *measObjectUTRA* (i.e. the cell is included in the range of physical cell identities for which reporting is allowed).

3> else if the corresponding *measObject* concerns GERAN:

4> consider a neighbouring cell on the associated set of frequencies to be applicable when the concerned cell matches the *ncc-Permitted* defined within the *VarMeasConfig* for this *measId*;

2> if the *triggerType* is set to *event* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig*, while the *VarMeasReportList* does not include an measurement reporting entry for this *measId* (a first cell triggers the event):

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> if the UE supports T312 and if *useT312* is included for this event and if T310 is running:

4> if T312 is not running:

5> start timer T312 with the value configured in the corresponding *measObject*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *triggerType* is set to *event* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells not included in the *cellsTriggeredList* for all measurements after layer 3 filtering

taken during *timeToTrigger* defined for this event within the *VarMeasConfig* (a subsequent cell triggers the event):

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> if the UE supports T312 and if *useT312* is included for this event and if T310 is running:

4> if T312 is not running:

5> start timer T312 with the value configured in the corresponding *measObject*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *triggerType* is set to *event* and if the leaving condition applicable for this event is fulfilled for one or more of the cells included in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* for all measurements after layer 3 filtering taken during *timeToTrigger* defined within the *VarMeasConfig* for this event:

3> remove the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> if the UE supports T312 and if *useT312* is included for this event and if T310 is running:

4> if T312 is not running:

5> start timer T312 with the value configured in the corresponding *measObject*;

3> if *reportOnLeave* is set to *TRUE* for the corresponding reporting configuration or if *a6-ReportOnLeave* is set to *TRUE* for the corresponding reporting configuration:

4> initiate the measurement reporting procedure, as specified in 5.5.5;

3> if the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* is empty:

4> remove the measurement reporting entry within the *VarMeasReportList* for this *measId*;

4> stop the periodical reporting timer for this *measId*, if running;

2> if the *triggerType* is set to *event* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable CSI-RS resources for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig*, while the *VarMeasReportList* does not include an measurement reporting entry for this *measId* (i.e. a first CSI-RS resource triggers the event):

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned CSI-RS resource(s) in the *csi-RS-TriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *triggerType* is set to *event* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable CSI-RS resources not included in the *csi-RS-TriggeredList* for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig* (i.e. a subsequent CSI-RS resource triggers the event):

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> include the concerned CSI-RS resource(s) in the *csi-RS-TriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *triggerType* is set to *event* and if the leaving condition applicable for this event is fulfilled for one or more of the CSI-RS resources included in the *csi-RS-TriggeredList* defined within the *VarMeasReportList* for this *measId* for all measurements after layer 3 filtering taken during *timeToTrigger* defined within the *VarMeasConfig* for this event:

3> remove the concerned CSI-RS resource(s) in the *csi-RS-TriggeredList* defined within the *VarMeasReportList* for this *measId*;

3> if *c1-ReportOnLeave* is set to *TRUE* for the corresponding reporting configuration or if *c2-ReportOnLeave* is set to *TRUE* for the corresponding reporting configuration:

4> initiate the measurement reporting procedure, as specified in 5.5.5;

3> if the *csi-RS-TriggeredList* defined within the *VarMeasReportList* for this *measId* is empty:

4> remove the measurement reporting entry within the *VarMeasReportList* for this *measId*;

4> stop the periodical reporting timer for this *measId*, if running;

2> if the *purpose* is included and set to *reportStrongestCells* or to *reportStrongestCellsForSON* and if a (first) measurement result is available:

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

NOTE 1: If the *purpose* is set to *reportStrongestCells* and *reportStrongestCSI-RSs* is not included and *reportAmount* > 1, the UE initiates a first measurement report immediately after the quantity to be reported becomes available for the PCell. If the *purpose* is set to *reportStrongestCells* and *reportStrongestCSI-RSs* is not included and *reportAmount* = 1, the UE initiates a first measurement report immediately after the quantity to be reported becomes available for the PCell and for the strongest cell among the applicable cells. If the purpose is set to *reportStrongestCellsForSON*, the UE initiates a first measurement report when it has determined the strongest cells on the associated frequency.

2> upon expiry of the periodical reporting timer for this *measId*:

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *purpose is* included and set to *reportCGI* and if the UE acquired the information needed to set all fields of *cgi-Info* for the requested cell:

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> stop timer T321;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

2> upon expiry of the T321 for this *measId*:

3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;

3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;

3> initiate the measurement reporting procedure, as specified in 5.5.5;

NOTE 2: The UE does not stop the periodical reporting with *triggerType* set to *event* or to *periodical* while the corresponding measurement is not performed due to the PCell RSRP being equal to or better than *s-Measure* or due to the measurement gap not being setup.

NOTE 3: If the UE is configured with DRX, the UE may delay the measurement reporting for event triggered and periodical triggered measurements until the Active Time, which is defined in TS 36.321 [6].

5.5.4.2 Event A1 (Serving becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A1-2, as specified below, is fulfilled;

1> for this measurement, consider the primary or secondary cell that is configured on the frequency indicated in the associated *measObjectEUTRA* to be the serving cell;

Inequality A1-1 (Entering condition)

$$Ms - Hys > Thresh$$

Inequality A1-2 (Leaving condition)

$$Ms + Hys < Thresh$$

The variables in the formula are defined as follows:

Ms is the measurement result of the serving cell, not taking into account any offsets.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Thresh is the threshold parameter for this event (i.e. *a1-Threshold* as defined within *reportConfigEUTRA* for this event).

Ms is expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Hys is expressed in dB.

Thresh is expressed in the same unit as ***Ms***.

5.5.4.3 Event A2 (Serving becomes worse than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A2-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A2-2, as specified below, is fulfilled;

1> for this measurement, consider the primary or secondary cell that is configured on the frequency indicated in the associated *measObjectEUTRA* to be the serving cell;

Inequality A2-1 (Entering condition)

$$Ms + Hys < Thresh$$

Inequality A2-2 (Leaving condition)

$$Ms - Hys > Thresh$$

The variables in the formula are defined as follows:

Ms is the measurement result of the serving cell, not taking into account any offsets.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Thresh is the threshold parameter for this event (i.e. *a2-Threshold* as defined within *reportConfigEUTRA* for this event).

Ms is expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Hys is expressed in dB.

Thresh is expressed in the same unit as ***Ms***.

5.5.4.4 Event A3 (Neighbour becomes offset better than PCell/ PSCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A3-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A3-2, as specified below, is fulfilled;

1> if *usePSCell* of the corresponding *reportConfig* is set to *true*:

2> use the PSCell for *Mp*, *Ofp and Ocp*;

1> else:

2> use the PCell for *Mp*, *Ofp and Ocp*;

NOTE The cell(s) that triggers the event is on the frequency indicated in the associated *measObject* which may be different from the frequency used by the PCell/ PSCell.

Inequality A3-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Mp + Ofp + Ocp + Off$$

Inequality A3-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Mp + Ofp + Ocp + Off$$

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

Mp is the measurement result of the PCell/ PSCell, not taking into account any offsets.

Ofp is the frequency specific offset of the frequency of the PCell/ PSCell (i.e. *offsetFreq* as defined within *measObjectEUTRA* corresponding to the frequency of the PCell/ PSCell).

Ocp is the cell specific offset of the PCell/ PSCell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the PCell/ PSCell), and is set to zero if not configured for the PCell/ PSCell.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Off is the offset parameter for this event (i.e. *a3-Offset* as defined within *reportConfigEUTRA* for this event).

Mn, Mp are expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Ofn, Ocn, Ofp, Ocp, Hys, Off are expressed in dB.

5.5.4.5 Event A4 (Neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A4-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A4-2, as specified below, is fulfilled;

Inequality A4-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Thresh$$

Inequality A4-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Thresh$$

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Thresh is the threshold parameter for this event (i.e. *a4-Threshold* as defined within *reportConfigEUTRA* for this event).

Mn is expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Ofn, Ocn, Hys are expressed in dB.

Thresh is expressed in the same unit as ***Mn***.

5.5.4.6 Event A5 (PCell/ PSCell becomes worse than threshold1 and neighbour becomes better than threshold2)

The UE shall:

1> consider the entering condition for this event to be satisfied when both condition A5-1 and condition A5-2, as specified below, are fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A5-3 or condition A5-4, i.e. at least one of the two, as specified below, is fulfilled;

1> if *usePSCell* of the corresponding *reportConfig* is set to *true*:

2> use the PSCell for *Mp*;

1> else:

2> use the PCell for *Mp*;

NOTE: The cell(s) that triggers the event is on the frequency indicated in the associated *measObject* which may be different from the frequency used by the PCell/ PSCell.

Inequality A5-1 (Entering condition 1)

$$Mp + Hys < Thresh1$$

Inequality A5-2 (Entering condition 2)

$$Mn + Ofn + Ocn - Hys > Thresh2$$

Inequality A5-3 (Leaving condition 1)

$$Mp - Hys > Thresh1$$

Inequality A5-4 (Leaving condition 2)

$$Mn + Ofn + Ocn + Hys < Thresh2$$

The variables in the formula are defined as follows:

Mp is the measurement result of the PCell/ PSCell, not taking into account any offsets.

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ofn is the frequency specific offset of the frequency of the neighbour cell (i.e. *offsetFreq* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Thresh1 is the threshold parameter for this event (i.e. *a5-Threshold1* as defined within *reportConfigEUTRA* for this event).

Thresh2 is the threshold parameter for this event (i.e. *a5-Threshold2* as defined within *reportConfigEUTRA* for this event).

Mn, Mp are expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Ofn, Ocn, Hys are expressed in dB.

Thresh1 is expressed in the same unit as ***Mp***.

Thresh2 is expressed in the same unit as ***Mn***.

5.5.4.6a Event A6 (Neighbour becomes offset better than SCell)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A6-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A6-2, as specified below, is fulfilled;

1> for this measurement, consider the (secondary) cell that is configured on the frequency indicated in the associated *measObjectEUTRA* to be the serving cell;

NOTE: The neighbour(s) is on the same frequency as the SCell i.e. both are on the frequency indicated in the associated *measObject*.

Inequality A6-1 (Entering condition)

$$Mn + Ocn - Hys > Ms + Ocs + Off$$

Inequality A6-2 (Leaving condition)

$$Mn + Ocn + Hys < Ms + Ocs + Off$$

The variables in the formula are defined as follows:

Mn is the measurement result of the neighbouring cell, not taking into account any offsets.

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

Ms is the measurement result of the serving cell, not taking into account any offsets.

Ocs is the cell specific offset of the serving cell (i.e. *cellIndividualOffset* as defined within *measObjectEUTRA* corresponding to the serving frequency), and is set to zero if not configured for the serving cell.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Off is the offset parameter for this event (i.e. *a6-Offset* as defined within *reportConfigEUTRA* for this event).

Mn, Ms are expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Ocn, Ocs, Hys, Off are expressed in dB.

5.5.4.7 Event B1 (Inter RAT neighbour becomes better than threshold)

The UE shall:

1> for UTRA and CDMA2000, only trigger the event for cells included in the corresponding measurement object;

1> consider the entering condition for this event to be satisfied when condition B1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition B1-2, as specified below, is fulfilled;

Inequality B1-1 (Entering condition)

$$Mn + Ofn - Hys > Thresh$$

Inequality B1-2 (Leaving condition)

$$Mn + Ofn + Hys < Thresh$$

The variables in the formula are defined as follows:

Mn is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets. For CDMA 2000 measurement result, *pilotStrength* is divided by -2.

Ofn is the frequency specific offset of the frequency of the inter-RAT neighbour cell (i.e. *offsetFreq* as defined within the *measObject* corresponding to the frequency of the neighbour inter-RAT cell).

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigInterRAT* for this event).

Thresh is the threshold parameter for this event (i.e. *b1-Threshold* as defined within *reportConfigInterRAT* for this event). For CDMA2000, *b1-Threshold* is divided by -2.

Mn is expressed in dBm or in dB, depending on the measurement quantity of the inter-RAT neighbour cell.

Ofn, Hys are expressed in dB.

Thresh is expressed in the same unit as ***Mn***.

5.5.4.8 Event B2 (PCell becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2)

The UE shall:

1> for UTRA and CDMA2000, only trigger the event for cells included in the corresponding measurement object;

1> consider the entering condition for this event to be satisfied when both condition B2-1 and condition B2-2, as specified below, are fulfilled;

1> consider the leaving condition for this event to be satisfied when condition B2-3 or condition B2-4, i.e. at least one of the two, as specified below, is fulfilled;

Inequality B2-1 (Entering condition 1)

$$Mp + Hys < Thresh1$$

Inequality B2-2 (Entering condition 2)

$$Mn + Ofn - Hys > Thresh2$$

Inequality B2-3 (Leaving condition 1)

$$Mp - Hys > Thresh1$$

Inequality B2-4 (Leaving condition 2)

$$Mn + Ofn + Hys < Thresh2$$

The variables in the formula are defined as follows:

Mp is the measurement result of the PCell, not taking into account any offsets.

Mn is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets. For CDMA2000 measurement result, *pilotStrength* is divided by -2.

Ofn is the frequency specific offset of the frequency of the inter-RAT neighbour cell (i.e. *offsetFreq* as defined within the *measObject* corresponding to the frequency of the inter-RAT neighbour cell).

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigInterRAT* for this event).

Thresh1 is the threshold parameter for this event (i.e. b2-*Threshold1* as defined within *reportConfigInterRAT* for this event).

Thresh2 is the threshold parameter for this event (i.e. *b2-Threshold2* as defined within *reportConfigInterRAT* for this event). For CDMA2000, *b2-Threshold2* is divided by -2.

Mp is expressed in dBm in case of RSRP, or in dB in case of RSRQ.

Mn is expressed in dBm or dB, depending on the measurement quantity of the inter-RAT neighbour cell.

Ofn, Hys are expressed in dB.

Thresh1 is expressed in the same unit as ***Mp***.

Thresh2 is expressed in the same unit as ***Mn***.

5.5.4.9 Event C1 (CSI-RS resource becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition C1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition C1-2, as specified below, is fulfilled;

Inequality C1-1 (Entering condition)

$$Mcr + Ocr - Hys > Thresh$$

Inequality C1-2 (Leaving condition)

$$Mcr + Ocr + Hys < Thresh$$

The variables in the formula are defined as follows:

Mcr is the measurement result of the CSI-RS resource, not taking into account any offsets.

Ocr is the CSI-RS specific offset (i.e. *csi-RS-IndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the CSI-RS resource), and set to zero if not configured for the CSI-RS resource.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Thresh is the threshold parameter for this event (i.e. *c1-Threshold* as defined within *reportConfigEUTRA* for this event).

Mcr, Thresh are expressed in dBm.

Ocr, Hys are expressed in dB.

5.5.4.10 Event C2 (CSI-RS resource becomes offset better than reference CSI-RS resource)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition C2-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition C2-2, as specified below, is fulfilled;

NOTE: The CSI-RS resource(s) that triggers the event is on the same frequency as the reference CSI-RS resource, i.e. both are on the frequency indicated in the associated *measObject*.

Inequality C2-1 (Entering condition)

$$Mcr + Ocr - Hys > Mref + Oref + Off$$

Inequality C2-2 (Leaving condition)

$$Mcr + Ocr + Hys < Mref + Oref + Off$$

The variables in the formula are defined as follows:

Mcr is the measurement result of the CSI-RS resource, not taking into account any offsets.

Ocr is the CSI-RS specific offset of the CSI-RS resource (i.e. *csi-RS-IndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the CSI-RS resource), and set to zero if not configured for the CSI-RS resource.

Mref is the measurement result of the reference CSI-RS resource (i.e. *c2-RefCSI-RS* as defined within *reportConfigEUTRA* for this event), not taking into account any offsets.

Oref is the CSI-RS specific offset of the reference CSI-RS resource (i.e. *csi-RS-IndividualOffset* as defined within *measObjectEUTRA* corresponding to the frequency of the reference CSI-RS resource), and is set to zero if not configured for the reference CSI-RS resource.

Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigEUTRA* for this event).

Off is the offset parameter for this event (i.e. *c2-Offset* as defined within *reportConfigEUTRA* for this event).

Mcr, Mref are expressed in dBm.

Ocr, Oref, Hys, Off are expressed in dB.

5.5.5 Measurement reporting

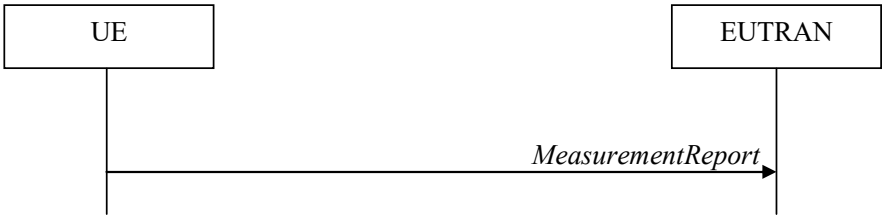


Figure 5.5.5-1: Measurement reporting

The purpose of this procedure is to transfer measurement results from the UE to E-UTRAN. The UE shall initiate this procedure only after successful security activation.

For the *measId* for which the measurement reporting procedure was triggered, the UE shall set the *measResults* within the *MeasurementReport* message as follows:

1> set the *measId* to the measurement identity that triggered the measurement reporting;

1> set the *measResultPCell* to include the quantities of the PCell;

1> set the *measResultServFreqList* to include for each SCell that is configured, if any, within *measResultSCell* the quantities of the concerned SCell, if available according to performance requirements in [16];

1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:

2> for each serving frequency for which *measObjectId* is referenced in the *measIdList*, other than the frequency corresponding with the *measId* that triggered the measurement reporting:

3> set the *measResultServFreqList* to include within *measResultBestNeighCell* the *physCellId* and the quantities of the best non-serving cell, based on RSRP, on the concerned serving frequency;

1> if there is at least one applicable neighbouring cell to report:

2> set the *measResultNeighCells* to include the best neighbouring cells up to *maxReportCells* in accordance with the following:

3> if the *triggerType* is set to *event*:

4> include the cells included in the *cellsTriggeredList* as defined within the *VarMeasReportList* for this *measId*;

3> else:

4> include the applicable cells for which the new measurement results became available since the last periodical reporting or since the measurement was initiated or reset;

NOTE 1: The reliability of the report (i.e. the certainty it contains the strongest cells on the concerned frequency) depends on the measurement configuration i.e. the *reportInterval*. The related performance requirements are specified in TS 36.133 [16].

3> for each cell that is included in the *measResultNeighCells*, include the *physCellId*;

3> if the *triggerType* is set to *event*; or the *purpose* is set to *reportStrongestCells* or to *reportStrongestCellsForSON*:

4> for each included cell, include the layer 3 filtered measured results in accordance with the *reportConfig* for this *measId*, ordered as follows:

5> if the *measObject* associated with this *measId* concerns E-UTRA:

6> set the *measResult* to include the quantity(ies) indicated in the *reportQuantity* within the concerned *reportConfig* in order of decreasing *triggerQuantity*, i.e. the best cell is included first;

5> if the *measObject* associated with this *measId* concerns UTRA FDD and if *ReportConfigInterRAT* includes the *reportQuantityUTRA-FDD*:

6> set the *measResult* to include the quantities indicated by the *reportQuantityUTRA-FDD* in order of decreasing *measQuantityUTRA-FDD* within the *quantityConfig*, i.e. the best cell is included first;

5> if the *measObject* associated with this *measId* concerns UTRA FDD and if *ReportConfigInterRAT* does not include the *reportQuantityUTRA-FDD*; or

5> if the *measObject* associated with this *measId* concerns UTRA TDD, GERAN or CDMA2000:

6> set the *measResult* to the quantity as configured for the concerned RAT within the *quantityConfig* in order of either decreasing quantity for UTRA and GERAN or increasing quantity for CDMA2000 *pilotStrength*, i.e. the best cell is included first;

3> else if the *purpose* is set to *reportCGI*:

4> if the mandatory present fields of the *cgi-Info* for the cell indicated by the *cellForWhichToReportCGI* in the associated *measObject* have been obtained:

5> if the cell broadcasts a CSG identity:

6> include the *csg-Identity*;

6> include the *csg-MemberStatus* and set it to *member* if the cell is a CSG member cell;

5> if the *si-RequestForHO* is configured within the *reportConfig* associated with this *measId*:

6> include the *cgi-Info* containing all the fields that have been successfully acquired and in accordance with the following:

7> if the cell is a CSG member cell, determine the subset of the PLMN identities, starting from the second entry of PLMN identities in the broadcast information, that meet the following conditions:

a) equal to the RPLMN or an EPLMN; and

b) the CSG whitelist of the UE includes an entry comprising of the concerned PLMN identity and the CSG identity broadcast by the cell;

7> if the subset of PLMN identities determined according to the previous includes at least one PLMN identity, include the *plmn-IdentityList* and set it to include this subset of the PLMN identities;

7> if the cell is a CSG member cell, include the *primaryPLMN-Suitable* if the primary PLMN meets conditions a) and b) specified above;

5> else:

6> include the *cgi-Info* containing all the fields that have been successfully acquired and in accordance with the following:

7> include in the *plmn-IdentityList* the list of identities starting from the second entry of PLMN Identities in the broadcast information;

1> for the cells included according to the previous (i.e. covering the PCell, the SCells, the best non-serving cells on serving frequencies as well as neighbouring EUTRA cells) include results according to the extended RSRQ if corresponding results are available according to the associated performance requirements defined in 36.133 [16];

1> if there is at least one applicable CSI-RS resource to report:

2> set the *measResultCSI-RS-List* to include the best CSI-RS resources up to *maxReportCells* in accordance with the following:

3> if the *triggerType* is set to *event*:

4> include the CSI-RS resources included in the *csi-RS-TriggeredList* as defined within the *VarMeasReportList* for this *measId*;

3> else:

4> include the applicable CSI-RS resources for which the new measurement results became available since the last periodical reporting or since the measurement was initiated or reset;

NOTE 2: The reliability of the report (i.e. the certainty it contains the strongest CSI-RS resources on the concerned frequency) depends on the measurement configuration i.e. the *reportInterval*. The related performance requirements are specified in TS 36.133 [16].

3> for each CSI-RS resource that is included in the *measResultCSI-RS-List*:

4> include the *measCSI-RS-Id*;

4> include the layer 3 filtered measured results in accordance with the *reportConfig* for this *measId*, ordered as follow:

5> set the *csi-RSRP-Result* to include the quantity indicated in the *reportQuantity* within the concerned *reportConfig* in order of decreasing *triggerQuantityCSI-RS*, i.e. the best CSI-RS resource is included first;

4> if *reportCRS-Meas* is included within the associated *reportConfig*, and the cell indicated by *physCellId* of this CSI-RS resource is not a serving cell:

5> set the *measResultNeighCells* to include the cell indicated by *physCellId* of this CSI-RS resource, and include the *physCellId*;

5> set the *rsrpResult* to include the RSRP of the concerned cell, if available according to performance requirements in [16];

5> set the *rsrqResult* to include the RSRQ of the concerned cell, if available according to performance requirements in [16];

1> if the *ue-RxTxTimeDiffPeriodical* is configured within the corresponding *reportConfig* for this *measId*;

2> set the *ue-RxTxTimeDiffResult* to the measurement result provided by lower layers;

2> set the *currentSFN*;

1> if the *includeLocationInfo* is configured in the corresponding *reportConfig* for this *measId* and detailed location information that has not been reported is available, set the content of the *locationInfo* as follows:

2> include the *locationCoordinates*;

2> if available, include the *gnss-TOD-msec*;

1> increment the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* by 1;

1> stop the periodical reporting timer, if running;

1> if the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than the *reportAmount* as defined within the corresponding *reportConfig* for this *measId*:

2> start the periodical reporting timer with the value of *reportInterval* as defined within the corresponding *reportConfig* for this *measId*;

1> else:

2> if the *triggerType* is set to *periodical*:

3> remove the entry within the *VarMeasReportList* for this *measId*;

3> remove this *measId* from the *measIdList* within *VarMeasConfig*;

1> if the measured results are for CDMA2000 HRPD:

2> set the *preRegistrationStatusHRPD* to the UE's CDMA2000 upper layer's HRPD *preRegistrationStatus*;

1> if the measured results are for CDMA2000 1xRTT:

2> set the *preRegistrationStatusHRPD* to *FALSE*;

1> submit the *MeasurementReport* message to lower layers for transmission, upon which the procedure ends;

5.5.6 Measurement related actions

5.5.6.1 Actions upon handover and re-establishment

E-UTRAN applies the handover procedure as follows:

- when performing the handover procedure, as specified in 5.3.5.4, ensure that a *measObjectId* corresponding to each handover target serving frequency is configured as a result of the procedures described in this sub-clause and in 5.3.5.4;

- when changing the band while the physical frequency remains unchanged, E-UTRAN releases the *measObject* corresponding to the source frequency and adds a *measObject* corresponding to the target frequency (i.e. it does not reconfigure the *measObject*);

E-UTRAN applies the re-establishment procedure as follows:

- when performing the connection re-establishment procedure, as specified in 5.3.7, ensure that a *measObjectId* corresponding each target serving frequency is configured as a result of the procedure described in this sub-

clause and the subsequent connection reconfiguration procedure immediately following the re-establishment procedure;

- in the first reconfiguration following the re-establishment when changing the band while the physical frequency remains unchanged, E-UTRAN releases the *measObject* corresponding to the source frequency and adds a *measObject* corresponding to the target frequency (i.e. it does not reconfigure the *measObject*);

The UE shall:

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the *triggerType* is set to *periodical*:

3> remove this *measId* from the *measIdList* within *VarMeasConfig*:

1> if the procedure was triggered due to a handover or successful re-establishment and the procedure involves a change of primary frequency, update the *measId* values in the *measIdList* within *VarMeasConfig* as follows:

2> if a *measObjectId* value corresponding to the target primary frequency exists in the *measObjectList* within *VarMeasConfig*:

3> for each *measId* value in the *measIdList*:

4> if the *measId* value is linked to the *measObjectId* value corresponding to the source primary frequency:

5> link this *measId* value to the *measObjectId* value corresponding to the target primary frequency;

4> else if the *measId* value is linked to the *measObjectId* value corresponding to the target primary frequency:

5> link this *measId* value to the *measObjectId* value corresponding to the source primary frequency;

2> else:

3> remove all *measId* values that are linked to the *measObjectId* value corresponding to the source primary frequency;

1> remove all measurement reporting entries within *VarMeasReportList*;

1> stop the periodical reporting timer or timer T321, whichever one is running, as well as associated information (e.g. *timeToTrigger*) for all *measId*;

1> release the measurement gaps, if activated;

NOTE: If the UE requires measurement gaps to perform inter-frequency or inter-RAT measurements, the UE resumes the inter-frequency and inter-RAT measurements after the E-UTRAN has setup the measurement gaps.

5.5.6.2 Speed dependant scaling of measurement related parameters

The UE shall adjust the value of the following parameter configured by the E-UTRAN depending on the UE speed: *timeToTrigger*. The UE shall apply 3 different levels, which are selected as follows:

The UE shall:

1> perform mobility state detection using the mobility state detection as specified in TS 36.304 [4] with the following modifications:

2> counting handovers instead of cell reselections;

2> applying the parameter applicable for RRC_CONNECTED as included in *speedStatePars* within *VarMeasConfig*;

1> if high mobility state is detected:

2> use the *timeToTrigger* value multiplied by *sf-High* within *VarMeasConfig*;

1> else if medium mobility state is detected:

2> use the *timeToTrigger* value multiplied by *sf-Medium* within *VarMeasConfig*;

1> else:

2> no scaling is applied;

5.5.7 Inter-frequency RSTD measurement indication

5.5.7.1 General

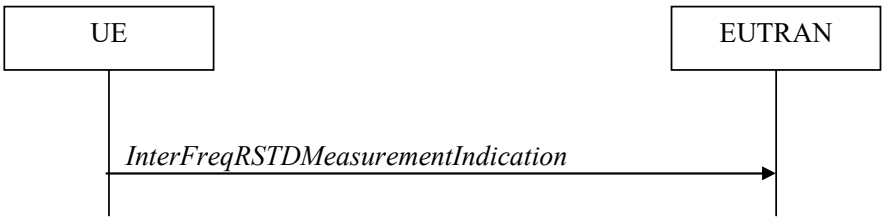


Figure 5.5.7.1-1: Inter-frequency RSTD measurement indication

The purpose of this procedure is to indicate to the network that the UE is going to start/stop OTDOA inter-frequency RSTD measurements which require measurement gaps as specified in [16, 8.1.2.6].

NOTE: It is a network decision to configure the measurement gap.

5.5.7.2 Initiation

The UE shall:

1> if and only if upper layers indicate to start performing inter-frequency RSTD measurements and the UE requires measurement gaps for these measurements while measurement gaps are either not configured or not sufficient:

2> initiate the procedure to indicate start;

NOTE 1: The UE verifies the measurement gap situation only upon receiving the indication from upper layers. If at this point in time sufficient gaps are available, the UE does not initiate the procedure. Unless it receives a new indication from upper layers, the UE is only allowed to further repeat the procedure in the same PCell once per frequency if the provided measurement gaps are insufficient.

1> if and only if upper layers indicate to stop performing inter-frequency RSTD measurements:

2> initiate the procedure to indicate stop;

NOTE 2: The UE may initiate the procedure to indicate stop even if it did not previously initiate the procedure to indicate start.

5.5.7.3 Actions related to transmission of *InterFreqRSTDMeasurementIndication* message

The UE shall set the contents of *InterFreqRSTDMeasurementIndication* message as follows:

1> set the *rstd-InterFreqIndication* as follows:

2> if the procedure is initiated to indicate start of inter-frequency RSTD measurements:

3> set the *rstd-InterFreqInfoList* according to the information received from upper layers;

2> else if the procedure is initiated to indicate stop of inter-frequency RSTD measurements:

3> set the *rstd-InterFreqIndication* to the value *stop*;

1> submit the *InterFreqRSTDMeasurementIndication* message to lower layers for transmission, upon which the procedure ends;

5.6 Other

5.6.1 DL information transfer

5.6.1.1 General

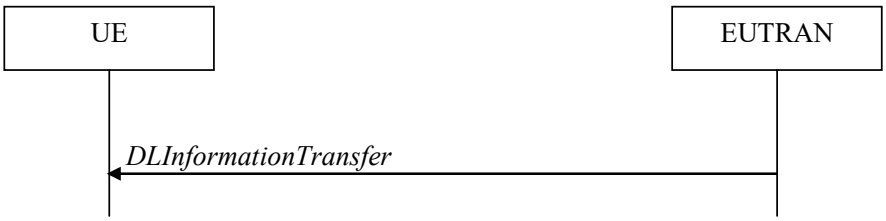


Figure 5.6.1.1-1: DL information transfer

The purpose of this procedure is to transfer NAS or (tunnelled) non-3GPP dedicated information from E-UTRAN to a UE in RRC_CONNECTED.

5.6.1.2 Initiation

E-UTRAN initiates the DL information transfer procedure whenever there is a need to transfer NAS or non-3GPP dedicated information. E-UTRAN initiates the DL information transfer procedure by sending the *DLInformationTransfer* message.

5.6.1.3 Reception of the *DLInformationTransfer* by the UE

Upon receiving *DLInformationTransfer* message, the UE shall:

1> if the *dedicatedInfoType* is set to *dedicatedInfoNAS*:

2> forward the *dedicatedInfoNAS* to the NAS upper layers.

1> if the *dedicatedInfoType* is set to *dedicatedInfoCDMA2000-1XRTT* or to *dedicatedInfoCDMA2000-HRPD*:

2> forward the *dedicatedInfoCDMA2000* to the CDMA2000 upper layers;

5.6.2 UL information transfer

5.6.2.1 General

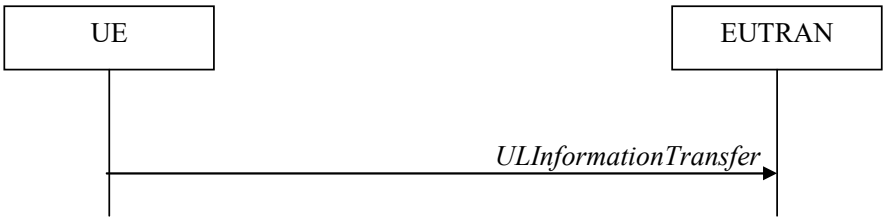


Figure 5.6.2.1-1: UL information transfer

The purpose of this procedure is to transfer NAS or (tunnelled) non-3GPP dedicated information from the UE to E-UTRAN.

5.6.2.2 Initiation

A UE in RRC_CONNECTED initiates the UL information transfer procedure whenever there is a need to transfer NAS or non-3GPP dedicated information, except at RRC connection establishment in which case the NAS information is piggybacked to the *RRCConnectionSetupComplete* message. The UE initiates the UL information transfer procedure by sending the *ULInformationTransfer* message. When CDMA2000 information has to be transferred, the UE shall initiate the procedure only if SRB2 is established.

5.6.2.3 Actions related to transmission of *ULInformationTransfer* message

The UE shall set the contents of the *ULInformationTransfer* message as follows:

1> if there is a need to transfer NAS information:

2> set the *dedicatedInfoType* to include the *dedicatedInfoNAS*;

1> if there is a need to transfer CDMA2000 1XRTT information:

2> set the *dedicatedInfoType* to include the *dedicatedInfoCDMA2000-1XRTT*;

1> if there is a need to transfer CDMA2000 HRPD information:

2> set the *dedicatedInfoType* to include the *dedicatedInfoCDMA2000-HRPD*;

1> submit the *ULInformationTransfer* message to lower layers for transmission, upon which the procedure ends;

5.6.2.4 Failure to deliver *ULInformationTransfer* message

The UE shall:

1> if mobility (i.e. handover, RRC connection re-establishment) occurs before the successful delivery of *ULInformationTransfer* messages has been confirmed by lower layers:

2> inform upper layers about the possible failure to deliver the information contained in the concerned *ULInformationTransfer* messages;

5.6.3 UE capability transfer

5.6.3.1 General

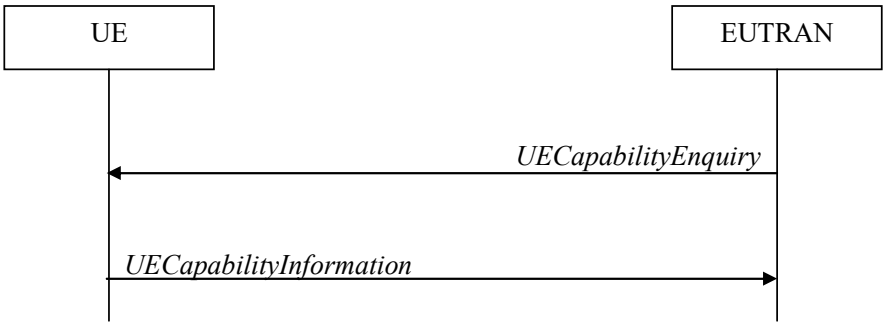


Figure 5.6.3.1-1: UE capability transfer

The purpose of this procedure is to transfer UE radio access capability information from the UE to E-UTRAN.

If the UE has changed its E-UTRAN radio access capabilities, the UE shall request higher layers to initiate the necessary NAS procedures (see TS 23.401 [41]) that would result in the update of UE radio access capabilities using a new RRC connection.

NOTE: Change of the UE's GERAN UE radio capabilities in RRC_IDLE is supported by use of Tracking Area Update.

5.6.3.2 Initiation

E-UTRAN initiates the procedure to a UE in RRC_CONNECTED when it needs (additional) UE radio access capability information.

5.6.3.3 Reception of the *UECapabilityEnquiry* by the UE

The UE shall:

1> set the contents of *UECapabilityInformation* message as follows:

2> if the *ue-CapabilityRequest* includes *eutra*:

3> include the *UE-EUTRA-Capability* within a *ue-CapabilityRAT-Container* and with the *rat-Type* set to *eutra*;

3> if the UE supports FDD and TDD:

4> set all fields of *UECapabilityInformation*, except field *fdd-Add-UE-EUTRA-Capabilities* and *tdd-Add-UE-EUTRA-Capabilities* (including their sub-fields), to include the values applicable for both FDD and TDD (i.e. functionality supported by both modes);

4> if (some of) the UE capability fields have a different value for FDD and TDD:

5> if for FDD, the UE supports additional functionality compared to what is indicated by the previous fields of *UECapabilityInformation*:

6> include field *fdd-Add-UE-EUTRA-Capabilities* and set it to include fields reflecting the additional functionality applicable for FDD;

5> if for TDD, the UE supports additional functionality compared to what is indicated by the previous fields of *UECapabilityInformation*:

6> include field *tdd-Add-UE-EUTRA-Capabilities* and set it to include fields reflecting the additional functionality applicable for TDD;

NOTE: The UE includes fields of *XDD-Add-UE-EUTRA-Capabilities* in accordance with the following:

- The field is included only if one or more of its sub-fields has a value that is different compared to the value signalled elsewhere within *UE-EUTRA-Capability*;

  (this value signalled elsewhere is also referred to as the *Common value*, that is supported for both XDD modes)
- For the fields that are included in *XDD-Add-UE-EUTRA-Capabilities*, the UE sets:
  - the sub-fields that are not allowed to be different the same as the *Common value*;
  - the sub-fields that are allowed to be different to a value indicating at least the same functionality as indicated by the *Common value*;

3> else (UE supports single xDD mode):

4> set all fields of *UECapabilityInformation*, except field *fdd-Add-UE-EUTRA-Capabilities* and *tdd-Add-UE-EUTRA-Capabilities* (including their sub-fields), to include the values applicable for the xDD mode supported by the UE;

3> if the *UECapabilityEnquiry* message includes *requestedFrequencyBands* and UE supports *requestedFrequencyBands:*

4> create a set of band combinations supported by the UE, including non-CA combinations, target for being included in *supportedBandCombination* while observing the following order (i.e. listed in order of decreasing priority):

- include all non-CA bands, regardless of whether UE supports carrier aggregation, only:
  - if the UE includes *ue-Category-v1020* (i.e. indicating category 6 to 8); or

- if for at least one of the non-CA bands, the UE supports more MIMO layers with TM9 and TM10 than implied by the UE category; or
- if the UE supports TM10 with one or more CSI processes;

- include all 2DL+1UL CA band combinations, only consisting of bands included in *requestedFrequencyBands*;
- include all other 2DL+1UL CA band combinations;
- include all other CA band combinations, only consisting of bands included in *requestedFrequencyBands*, and prioritized in the order of *requestedFrequencyBands*, (i.e. first include remaining band combinations containing the first-listed band, then include remaining band combinations containing the second-listed band, and so on);

4> include in *supportedBandCombination* as many of the target band combinations as possible, determined according to the above, while observing the priority order;

4> include in *supportedBandCombinationAdd* as many of the remaining target band combinations as possible, i.e. the target band combinations the UE was not able to include in *supportedBandCombination*, and limited to those consisting of bands included in *requestedFrequencyBands*, while observing the priority order;

4> indicate in *requestedBands* the same bands and in the same order as included in the received *requestedFrequencyBands*;

3> else

4> create a set of band combinations supported by the UE, including non-CA combinations, target for being included in *supportedBandCombination*:

- include all non-CA bands, regardless of whether UE supports carrier aggregation, only:
  - if the UE includes *ue-Category-v1020* (i.e. indicating category 6 to 8); or
  - if for at least one of the non-CA bands, the UE supports more MIMO layers with TM9 and TM10 than implied by the UE category; or
  - if the UE supports TM10 with one or more CSI processes;
- include all 2DL+1UL CA band combinations;
- include all other CA band combinations;

4> include in *supportedBandCombination* as many of the target band combinations as possible, determined according to the above;

4> if the number of non-CA and CA band combinations supported by UE exceeds the maximum number of band combinations of *supportedBandCombination*, the selection of subset of band combinations is up to UE implementation;

NOTE: If the *UECapabilityEnquiry* message does not include *requestedFrequencyBands*, UE does not include *supportedBandCombinationAdd*.

3> if the UE is a category 0 UE according to TS 36.306 [5]:

4> include *ue-RadioPagingInfo* including *ue-Category*;

2> if the *ue-CapabilityRequest* includes *geran-cs* and if the UE supports GERAN CS domain:

3> include the UE radio access capabilities for GERAN CS within a *ue-CapabilityRAT-Container* and with the *rat-Type* set to *geran-cs*;

2> if the *ue-CapabilityRequest* includes *geran-ps* and if the UE supports GERAN PS domain:

3> include the UE radio access capabilities for GERAN PS within a *ue-CapabilityRAT-Container* and with the *rat-Type* set to *geran-ps*;

2> if the *ue-CapabilityRequest* includes *utra* and if the UE supports UTRA:

3> include the UE radio access capabilities for UTRA within a *ue-CapabilityRAT-Container* and with the *rat-Type* set to *utra*;

2> if the *ue-CapabilityRequest* includes *cdma2000-1XRTT* and if the UE supports CDMA2000 1xRTT:

3> include the UE radio access capabilities for CDMA2000 within a *ue-CapabilityRAT-Container* and with the *rat-Type* set to *cdma2000-1XRTT*;

1> submit the *UECapabilityInformation* message to lower layers for transmission, upon which the procedure ends;

5.6.4 CSFB to 1x Parameter transfer

5.6.4.1 General

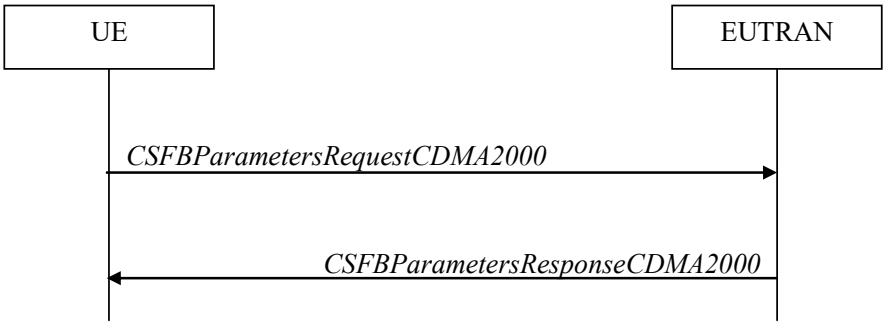


Figure 5.6.4.1-1: CSFB to 1x Parameter transfer

The purpose of this procedure is to transfer the CDMA2000 1xRTT parameters required to register the UE in the CDMA2000 1xRTT network for CSFB support.

5.6.4.2 Initiation

A UE in RRC_CONNECTED initiates the CSFB to 1x Parameter transfer procedure upon request from the CDMA2000 upper layers. The UE initiates the CSFB to 1x Parameter transfer procedure by sending the *CSFBParametersRequestCDMA2000* message.

5.6.4.3 Actions related to transmission of *CSFBParametersRequestCDMA2000* message

The UE shall:

1> submit the *CSFBParametersRequestCDMA2000* message to lower layers for transmission using the current configuration;

5.6.4.4 Reception of the *CSFBParametersResponseCDMA2000* message

Upon reception of the *CSFBParametersResponseCDMA2000* message, the UE shall:

1> forward the *rand* and the *mobilityParameters* to the CDMA2000 1xRTT upper layers;

5.6.5 UE Information

5.6.5.1 General

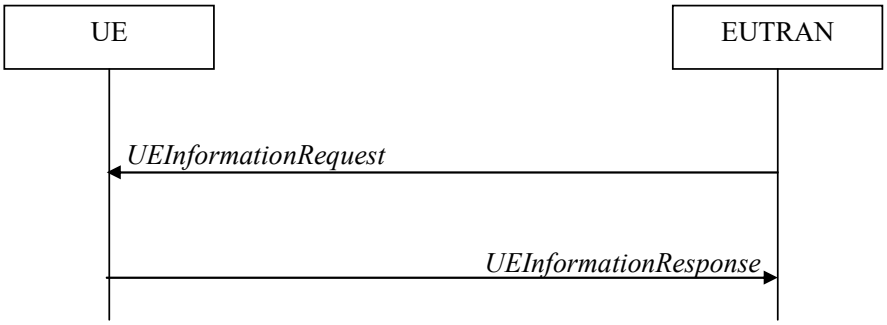


Figure 5.6.5.1-1: UE information procedure

The UE information procedure is used by E-UTRAN to request the UE to report information.

5.6.5.2 Initiation

E-UTRAN initiates the procedure by sending the *UEInformationRequest* message. E-UTRAN should initiate this procedure only after successful security activation.

5.6.5.3 Reception of the *UEInformationRequest* message

Upon receiving the *UEInformationRequest* message, the UE shall, only after successful security activation:

1> if *rach-ReportReq* is set to *true*, set the contents of the *rach-Report* in the *UEInformationResponse* message as follows:

2> set the *numberOfPreamblesSent* to indicate the number of preambles sent by MAC for the last successfully completed random access procedure;

2> if contention resolution was not successful as specified in TS 36.321 [6] for at least one of the transmitted preambles for the last successfully completed random access procedure:

3> set the *contentionDetected* to *true*;

2> else:

3> set the *contentionDetected* to *false*;

1> if *rlf-ReportReq* is set to *true* and the UE has radio link failure information or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

2> set *timeSinceFailure* in *VarRLF-Report* to the time that elapsed since the last radio link or handover failure in E-UTRA;

2> set the *rlf-Report* in the *UEInformationResponse* message to the value of *rlf-Report* in *VarRLF-Report*;

2> discard the *rlf-Report* from *VarRLF-Report* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if *connEstFailReportReq* is set to *true* and the UE has connection establishment failure information in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

2> set *timeSinceFailure* in *VarConnEstFailReport* to the time that elapsed since the last connection establishment failure in E-UTRA;

2> set the *connEstFailReport* in the *UEInformationResponse* message to the value of *connEstFailReport* in *VarConnEstFailReport*;

2> discard the *connEstFailReport* from *VarConnEstFailReport* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if the *logMeasReportReq* is present and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

2> if *VarLogMeasReport* includes one or more logged measurement entries, set the contents of the *logMeasReport* in the *UEInformationResponse* message as follows:

3> include the *absoluteTimeStamp* and set it to the value of *absoluteTimeInfo* in the *VarLogMeasReport*;

3> include the *traceReference* and set it to the value of *traceReference* in the *VarLogMeasReport*;

3> include the *traceRecordingSessionRef* and set it to the value of *traceRecordingSessionRef* in the *VarLogMeasReport;*

3> include the *tce-Id* and set it to the value of *tce-Id* in the *VarLogMeasReport*;

3> include the *logMeasInfoList* and set it to include one or more entries from *VarLogMeasReport* starting from the entries logged first;

3> if the *VarLogMeasReport* includes one or more additional logged measurement entries that are not included in the *logMeasInfoList* within the *UEInformationResponse* message:

4> include the *logMeasAvailable*;

1> if *mobilityHistoryReportReq* is set to *true*:

2> include the *mobilityHistoryReport* and set it to include entries from *VarMobilityHistoryReport*;

2> include in the *mobilityHistoryReport* an entry for the current cell, possibly after removing the oldest entry if required, and set its fields as follows:

3> set *visitedCellId* to the global cell identity of the current cell:

3> set field *timeSpent* to the time spent in the current cell;

1> if the *logMeasReport* is included in the *UEInformationResponse*:

2> submit the *UEInformationResponse* message to lower layers for transmission via SRB2;

2> discard the logged measurement entries included in the *logMeasInfoList* from *VarLogMeasReport* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> else:

2> submit the *UEInformationResponse* message to lower layers for transmission via SRB1;

5.6.6 Logged Measurement Configuration

5.6.6.1 General

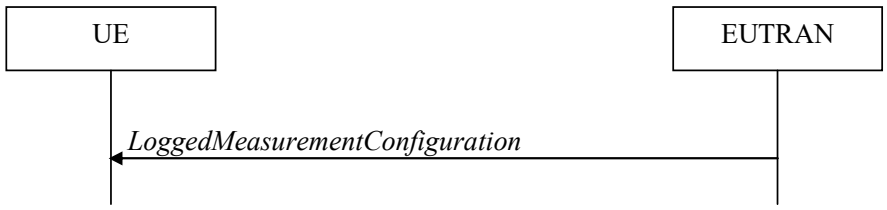


Figure 5.6.6.1-1: Logged measurement configuration

The purpose of this procedure is to configure the UE to perform logging of measurement results while in RRC_IDLE and to perform logging of measurement results for MBSFN in both RRC_IDLE and RRC_CONNECTED. The procedure applies to logged measurements capable UEs that are in RRC_CONNECTED.

NOTE E-UTRAN may retrieve stored logged measurement information by means of the UE Information procedure.

5.6.6.2 Initiation

E-UTRAN initiates the logged measurement configuration procedure to UE in RRC_CONNECTED by sending the *LoggedMeasurementConfiguration* message.

5.6.6.3 Reception of the *LoggedMeasurementConfiguration* by the UE

Upon receiving the *LoggedMeasurementConfiguration* message the UE shall:

1> discard the logged measurement configuration as well as the logged measurement information as specified in 5.6.7;

1> store the received *loggingDuration*, *loggingInterval* and *areaConfiguration*, if included, in *VarLogMeasConfig*;

1> if the *LoggedMeasurementConfiguration* message includes *plmn-IdentityList*:

2> set *plmn-IdentityList* in *VarLogMeasReport* to include the RPLMN as well as the PLMNs included in *plmn-IdentityList*;

1> else:

2> set *plmn-IdentityList* in *VarLogMeasReport* to include the RPLMN;

1> store the received *absoluteTimeInfo*, *traceReference, traceRecordingSessionRef* and *tce-Id* in *VarLogMeasReport*;

1> store the received *targetMBSFN-AreaList*, if included, in *VarLogMeasConfig*;

1> start timer T330 with the timer value set to the *loggingDuration*;

5.6.6.4 T330 expiry

Upon expiry of T330 the UE shall:

1> release *VarLogMeasConfig*;

The UE is allowed to discard stored logged measurements, i.e. to release *VarLogMeasReport*, 48 hours after T330 expiry.

5.6.7 Release of Logged Measurement Configuration

5.6.7.1 General

The purpose of this procedure is to release the logged measurement configuration as well as the logged measurement information.

5.6.7.2 Initiation

The UE shall initiate the procedure upon receiving a logged measurement configuration in another RAT. The UE shall also initiate the procedure upon power off or detach.

The UE shall:

1> stop timer T330, if running;

1> if stored, discard the logged measurement configuration as well as the logged measurement information, i.e. release the UE variables *VarLogMeasConfig* and *VarLogMeasReport*;

5.6.8 Measurements logging

5.6.8.1 General

This procedure specifies the logging of available measurements by a UE in RRC_IDLE that has a logged measurement configuration and the logging of available measurements by a UE in both RRC_IDLE and RRC_CONNECTED if *targetMBSFN-AreaList* is included in *VarLogMeasConfig*.

5.6.8.2 Initiation

While T330 is running, the UE shall:

1> perform the logging in accordance with the following:

2> if *targetMBSFN-AreaList* is included in *VarLogMeasConfig*:

3> if the UE is camping normally on an E-UTRA cell or is connected to E-UTRA; and

3> if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*; and

3> if the PCell (in RRC_CONNECTED) or cell where the UE is camping (in RRC_IDLE) is part of the area indicated by *areaConfiguration* if configured in *VarLogMeasConfig*:

4> for MBSFN areas, indicated in *targetMBSFN-AreaList,* from which the UE is receiving MBMS service:

5> perform MBSFN measurements in accordance with the performance requirements as specified in TS 36.133 [16];

NOTE 1: When configured to perform MBSFN measurement logging by *targetMBSFN-AreaList*, the UE is not required to receive additional MBSFN subframes, i.e. logging is based on the subframes corresponding to the MBMS services the UE is receiving.

5> perform logging at regular time intervals as defined by the *loggingInterval* in *VarLogMeasConfig,* but only for those intervals for which MBSFN measurement results are available as specified in TS 36.133 [16];

2> *else* if the UE is camping normally on an E-UTRA cell and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport* and, if the cell is part of the area indicated by *areaConfiguration* if configured in *VarLogMeasConfig*:

3> perform the logging at regular time intervals, as defined by the *loggingInterval* in *VarLogMeasConfig*;

2> when adding a logged measurement entry in *VarLogMeasReport*, include the fields in accordance with the following:

3> set the *relativeTimeStamp* to indicate the elapsed time since the moment at which the logged measurement configuration was received;

3> if detailed location information became available during the last logging interval, set the content of the *locationInfo* as follows:

4> include the *locationCoordinates*;

3> if *targetMBSFN-AreaList* is included in *VarLogMeasConfig*:

4> for each MBSFN area, for which the mandatory measurements result fields became available during the last logging interval:

5> set the *rsrpResultMBSFN*, *rsrqResultMBSFN* to include measurement results that became available during the last logging interval;

5> include the fields *signallingBLER-Result* or *dataBLER-MCH-ResultList* if the concerned BLER results are availble,

5> set the *mbsfn-AreaId* and *carrierFrequency* to indicate the MBSFN area in which the UE is receiving MBSFN transmission;

4> if in RRC_CONNECTED:

5> set the *servCellIdentity* to indicate global cell identity of the PCell;

5> set the *measResultServCell* to include the layer 3 filtered measured results of the PCell;

5> if available, set the *measResultNeighCells* to include the layer 3 filtered measured results of SCell(s) and neighbouring cell(s) measurements that became available during the last logging interval, in order of decreasing RSRP, for at most the following number of cells: 6 intra-frequency and 3 inter-frequency cells per frequency and according to the following:

6> for each cell included, include the optional fields that are available;

5> if available, optionally set the *measResultNeighCells* to include the layer 3 filtered measured results of neighbouring cell(s) measurements that became available during the last logging interval, in order of decreasing RSCP(UTRA)/RSSI(GERAN)/PilotStrength(cdma2000), for at most the following number of cells: 3 inter-RAT cells per frequency (UTRA, cdma2000)/set of frequencies (GERAN), and according to the following:

6> for each cell included, include the optional fields that are available;

4> if in RRC_IDLE:

5> set the *servCellIdentity* to indicate global cell identity of the serving cell;

5> set the *measResultServCell* to include the quantities of the serving cell;

5> if available, set the *measResultNeighCells*, in order of decreasing ranking-criterion as used for cell re-selection, to include neighbouring cell measurements that became available during the last logging interval for at most the following number of neighbouring cells: 6 intra-frequency and 3 inter-frequency neighbours per frequency and according to the following:

6> for each neighbour cell included, include the optional fields that are available;

5> if available, optionally set the *measResultNeighCells,* in order of decreasing ranking-criterion as used for cell re-selection, to include neighbouring cell measurements that became available during the last logging interval, for at most the following number of cells: 3 inter-RAT cells per frequency (UTRA, cdma2000)/set of frequencies (GERAN), and according to the following:

6> for each cell included, include the optional fields that are available;

4> for the cells included according to the previous (i.e. covering previous and current serving cells as well as neighbouring EUTRA cells) include results according to the extended RSRQ if corresponding results are available according to the associated performance requirements defined in TS 36.133 [16];

4> for the cells included according to the previous (i.e. covering previous and current serving cells as well as neighbouring EUTRA cells) include RSRQ type if the result was based on measurements using a wider band or using all OFDM symbols;

NOTE 2: The UE includes the latest results in accordance with the performance requirements as specified in TS 36.133 [16]. E.g. RSRP and RSRQ results are available only if the UE has a sufficient number of results/ receives a sufficient number of subframes during the logging interval.

3> else:

4> set the *servCellIdentity* to indicate global cell identity of the cell the UE is camping on;

4> set the *measResultServCell* to include the quantities of the cell the UE is camping on;

4> if available, set the *measResultNeighCells*, in order of decreasing ranking-criterion as used for cell re-selection, to include neighbouring cell measurements that became available during the last logging interval for at most the following number of neighbouring cells: 6 intra-frequency and 3 inter-frequency neighbours per frequency as well as 3 inter-RAT neighbours, per frequency/ set of frequencies (GERAN) per RAT and according to the following:

5> for each neighbour cell included, include the optional fields that are available;

4> for the cells included according to the previous (i.e. covering previous and current serving cells as well as neighbouring EUTRA cells) include results according to the extended RSRQ if corresponding results are available according to the associated performance requirements defined in TS 36.133 [16];

4> for the cells included according to the previous (i.e. covering previous and current serving cells as well as neighbouring EUTRA cells) include RSRQ type if the result was based on measurements using a wider band or using all OFDM symbols;

NOTE 3: The UE includes the latest results of the available measurements as used for cell reselection evaluation in RRC_IDLE or as used for evaluation of reporting criteria or for measurement reporting according to 5.5.3 in RRC_CONNECTED, which are performed in accordance with the performance requirements as specified in TS 36.133 [16].

2> when the memory reserved for the logged measurement information becomes full, stop timer T330 and perform the same actions as performed upon expiry of T330, as specified in 5.6.6.4;

5.6.9 In-device coexistence indication

5.6.9.1 General

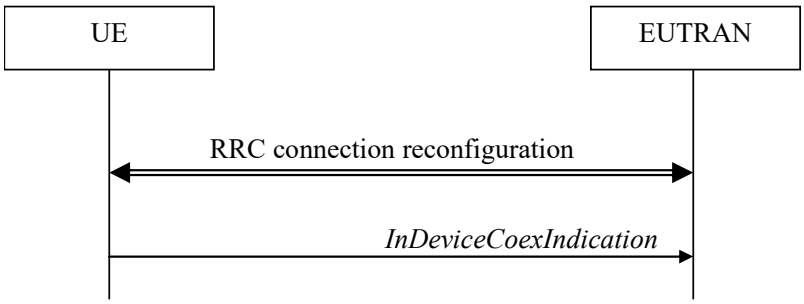


Figure 5.6.9.1-1: In-device coexistence indication

The purpose of this procedure is to inform E-UTRAN about (a change of) the In-Device Coexistence (IDC) problems experienced by the UE in RRC_CONNECTED, as described in TS 36.300 [9], and to provide the E-UTRAN with information in order to resolve them.

5.6.9.2 Initiation

A UE capable of providing IDC indications may initiate the procedure when it is configured to provide IDC indications and upon change of IDC problem information.

Upon initiating the procedure, the UE shall:

1> if configured to provide IDC indications:

2> if the UE did not transmit an *InDeviceCoexIndication* message since it was configured to provide IDC indications:

3> if on one or more frequencies for which a *measObjectEUTRA* is configured, the UE is experiencing IDC problems that it cannot solve by itself; or

3> if configured to provide IDC indications for UL CA; and if on one or more supported UL CA combination comprising of carrier frequencies for which a measurement object is configured, the UE is experiencing IDC problems that it cannot solve by itself:

4> initiate transmission of the *InDeviceCoexIndication* message in accordance with 5.6.9.3;

2> else:

3> if the set of frequencies, for which a *measObjectEUTRA* is configured and on which the UE is experiencing IDC problems that it cannot solve by itself, is different from the set indicated in the last transmitted *InDeviceCoexIndication* message; or

3> if for one or more of the frequencies in the previously reported set of frequencies, the *interferenceDirection* is different from the value indicated in the last transmitted *InDeviceCoexIndication* message; or

3> if the TDM assistance information is different from the assistance information included in the last transmitted *InDeviceCoexIndication* message; or

3> if configured to provide IDC indications for UL CA; and if the set of supported UL CA combination comprising of carrier frequencies for which a measurement object is configured and on which the UE is experiencing IDC problems that it cannot solve by itself, is different from the set indicated in the last transmitted *InDeviceCoexIndication* message:

4> initiate transmission of the *InDeviceCoexIndication* message in accordance with 5.6.9.3;

NOTE 1: The term "IDC problems" refers to interference issues applicable across several subframes/slots where not necessarily all the subframes/slots are affected.

NOTE 2: For the frequencies on which a serving cell or serving cells is configured that is activated, IDC problems consist of interference issues that the UE cannot solve by itself, during either active data exchange or upcoming data activity which is expected in up to a few hundred milliseconds.
For frequencies on which a SCell or SCells is configured that is deactivated, reporting IDC problems indicates an anticipation that the activation of the SCell or SCells would result in interference issues that the UE would not be able to solve by itself.
For a non-serving frequency, reporting IDC problems indicates an anticipation that if the non-serving frequency or frequencies became a serving frequency or serving frequencies then this would result in interference issues that the UE would not be able to solve by itself.

5.6.9.3 Actions related to transmission of *InDeviceCoexIndication* message

The UE shall set the contents of the *InDeviceCoexIndication* message as follows:

1> if there is at least one E-UTRA carrier frequency, for which a measurement object is configured, that is affected by IDC problems:

2> include the IE *affectedCarrierFreqList* with an entry for each affected E-UTRA carrier frequency for which a measurement object is configured;

2> for each E-UTRA carrier frequency included in the IE *affectedCarrierFreqList*, include *interferenceDirection* and set it accordingly;

2> include Time Domain Multiplexing (TDM) based assistance information:

3> if the UE has DRX related assistance information that could be used to resolve the IDC problems:

4> include *drx-CycleLength*, *drx-Offset* and *drx-ActiveTime*;

3> else (the UE has desired subframe reservation patterns related assistance information that could be used to resolve the IDC problems):

4> include *idc-SubframePatternList*;

3> use the MCG as timing reference if TDM based assistance information regarding the SCG is included;

1> if the UE is configured to provide UL CA information and there is a supported UL CA combination comprising of carrier frequencies for which a measurement object is configured, that is affected by IDC problems:

2> include *victimSystemType* in *ul-CA-AssistanceInfo*;

2> if the UE sets *victimSystemType* to *wlan* or *Bluetooth*:

3> include *affectedCarrierFreqCombList* in *ul-CA-AssistanceInfo* with an entry for each supported UL CA combination comprising of carrier frequencies for which a measurement object is configured, that is affected by IDC problems;

2> else:

3> optionally include *affectedCarrierFreqCombList* in *ul-CA-AssistanceInfo* with an entry for each supported UL CA combination comprising of carrier frequencies for which a measurement object is configured, that is affected by IDC problems;

NOTE 1: When sending an *InDeviceCoexIndication* message to inform E-UTRAN the IDC problems, the UE includes all assistance information (rather than providing e.g. the changed part(s) of the assistance information).

The UE shall submit the *InDeviceCoexIndication* message to lower layers for transmission.

5.6.10 UE Assistance Information

5.6.10.1 General

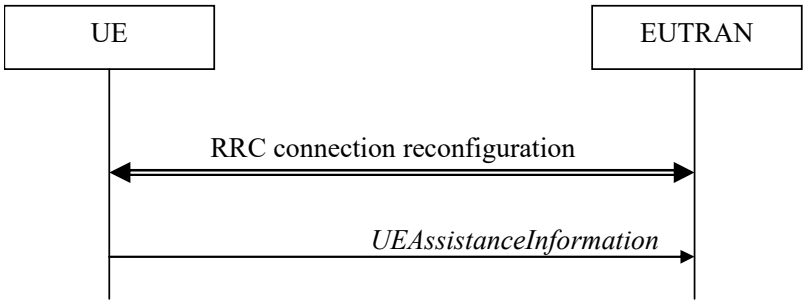


Figure 5.6.10.1-1: UE Assistance Information

The purpose of this procedure is to inform E-UTRAN of the UE's power saving preference. Upon configuring the UE to provide power preference indications E-UTRAN may consider that the UE does not prefer a configuration primarily optimised for power saving until the UE explictly indicates otherwise.

5.6.10.2 Initiation

A UE capable of providing power preference indications in RRC_CONNECTED may initiate the procedure in several cases including upon being configured to provide power preference indications and upon change of power preference.

Upon initiating the procedure, the UE shall:

1> if configured to provide power preference indications:

2> if the UE did not transmit a *UEAssistanceInformation* message since it was configured to provide power preference indications; or

2> if the current power preference is different from the one indicated in the last transmission of the *UEAssistanceInformation* message and timer T340 is not running:

3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.6.10.3;

5.6.10.3 Actions related to transmission of *UEAssistanceInformation* message

The UE shall set the contents of the *UEAssistanceInformation* message:

1> if the UE prefers a configuration primarily optimised for power saving:

2> set *powerPrefIndication* to *lowPowerConsumption*;

1> else:

2> start or restart timer T340 with the timer value set to the *powerPrefIndicationTimer*;

2> set *powerPrefIndication* to *normal*;

The UE shall submit the *UEAssistanceInformation* message to lower layers for transmission.

5.6.11 Mobility history information

5.6.11.1 General

This procedure specifies how the mobility history information is stored by the UE, covering RRC_CONNECTED and RRC_IDLE.

5.6.11.2 Initiation

If the UE supports storage of mobility history information, the UE shall:

1> Upon change of cell, consisting of PCell in RRC_CONNECTED or serving cell in RRC_IDLE, to another E-UTRA or inter-RAT cell or when entering out of service:

2> include an entry in variable *VarMobilityHistoryReport* possibly after removing the oldest entry, if necessary, according to following:

3> if the global cell identity of the previous PCell/ serving cell is available:

4> include the global cell identity of that cell in the field *visitedCellId* of the entry;

3> else:

4> include the physical cell identity and carrier frequency of that cell in the field *visitedCellId* of the entry;

3> set the field *timeSpent* of the entry as the time spent in the previous PCell/ serving cell;

1> upon entering E-UTRA (in RRC_CONNECTED or RRC_IDLE) while previously out of service and/ or using another RAT:

2> include an entry in variable *VarMobilityHistoryReport* possibly after removing the oldest entry, if necessary, according to following:

3> set the field *timeSpent* of the entry as the time spent outside E-UTRA;

5.6.12 RAN-assisted WLAN interworking

5.6.12.1 General

The purpose of this procedure is to facilitate access network selection and traffic steering between E-UTRAN and WLAN.

If required by upper layers (see TS 24.312 [66], the UE shall provide an up-to-date set of the applicable parameters provided by *wlan-OffloadConfigCommon* or *wlan-OffloadConfigDedicated* to upper layers, and inform upper layers when no parameters are configured. The parameter set from either *wlan-OffloadConfigCommon* or *wlan-OffloadConfigDedicated* is selected as specified in subclauses 5.2.2.24, 5.3.12, 5.6.12.2 and 5.6.12.4.

5.6.12.2 Dedicated WLAN offload configuration

The UE shall:

1> if the received *wlan-OffloadInfo* is set to *release*:

2> release *wlan-OffloadConfigDedicated* and *t350*;

2> if the *wlan-OffloadConfigCommon* corresponding to the RPLMN is broadcast by the cell:

3> apply the *wlan-OffloadConfigCommon* corresponding to the RPLMN included in *SystemInformationBlockType17*;

1> else:

2> apply the received *wlan-OffloadConfigDedicated*:

5.6.12.3 WLAN offload RAN evaluation

The UE shall:

1> if the UE is configured with either *wlan-OffloadConfigCommon* or *wlan-OffloadConfigDedicated*:

2> provide measurement results required for the evaluation of the network selection and traffic steering rules as defined in TS 24.312 [66] to upper layers;

2> evaluate the network selection and traffic steering rules as defined in TS 36.304 [4];

5.6.12.4 T350 expiry or stop

The UE shall:

1> if T350 expires or is stopped:

2> release the *wlan-OffloadConfigDedicated* and *t350*;

2> if the *wlan-OffloadConfigCommon* corresponding to the RPLMN is broadcast by the cell:

3> apply the *wlan-OffloadConfigCommon* corresponding to the RPLMN included in *SystemInformationBlockType17*;

5.6.12.5 Cell selection/ re-selection while T350 is running

The UE shall:

1> if, while T350 is running, the UE selects/ reselects a cell which is not the PCell when the *wlan-OffloadDedicated* was configured:

2> stop timer T350;

2> perform the actions as specified in 5.6.12.4;

5.6.13 SCG failure information

5.6.13.1 General

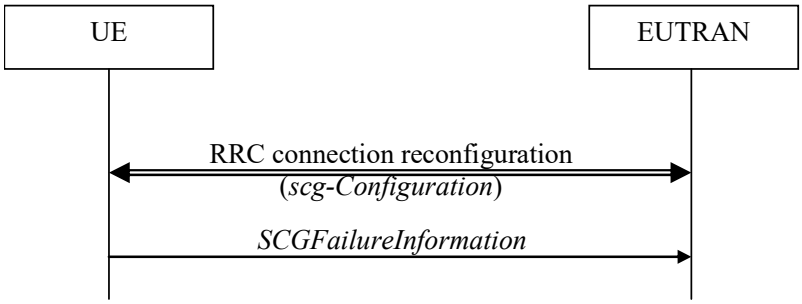


Figure 5.6.13.1-1: SCG failure information

The purpose of this procedure is to inform E-UTRAN about an SCG failure the UE has experienced i.e. SCG radio link failure, SCG change failure.

5.6.13.2 Initiation

A UE initiates the procedure to report SCG failures when SCG transmission is not suspended and when one of the following conditions is met:

1> upon detecting radio link failure for the SCG, in accordance with 5.3.11; or

1> upon SCG change failure, in accordance with 5.3.5.7a;

Upon initiating the procedure, the UE shall:

1> suspend all SCG DRBs and suspend SCG transmission for split DRBs;

1> reset SCG-MAC;

1> stop T307;

1> initiate transmission of the *SCGFailureInformation* message in accordance with 5.6.13.3;

5.6.13.3 Actions related to transmission of *SCGFailureInformation* message

The UE shall set the contents of the *SCGFailureInformation* message as follows:

1> if the UE initiates transmission of the *SCGFailureInformation* message to provide SCG radio link failure information:

2> include *failureType* and set it to the trigger for detecting SCG radio link failure;

1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide SCG change failure information:

2> include *failureType* and set it to *scg-ChangeFailure*;

1> set the *measResultServFreqList* to include for each SCG cell that is configured, if any, within *measResultSCell* the quantities of the concerned SCell, if available according to performance requirements in [16];

1> for each SCG serving frequency included in *measResultServFreqList*, include within *measResultBestNeighCell* the *physCellId* and the quantities of the best non-serving cell, based on RSRP, on the concerned serving frequency;

1> set the *measResultNeighCells* to include the best measured cells on non-serving E-UTRA frequencies, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected the failure, and set its fields as follows;

2> if the UE was configured to perform measurements for one or more non-serving EUTRA frequencies and measurement results are available, include the *measResultListEUTRA*;

2> for each neighbour cell included, include the optional fields that are available;

NOTE 2: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

The UE shall submit the *SCGFailureInformation* message to lower layers for transmission.

5.7 Generic error handling

5.7.1 General

The generic error handling defined in the subsequent sub-clauses applies unless explicitly specified otherwise e.g. within the procedure specific error handling.

The UE shall consider a value as not comprehended when it is set:

- to an extended value that is not defined in the version of the transfer syntax supported by the UE.
- to a spare or reserved value unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/ reserved value.

The UE shall consider a field as not comprehended when it is defined:

- as spare or reserved unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/ reserved field.

5.7.2 ASN.1 violation or encoding error

The UE shall:

1> when receiving an RRC message on the BCCH, PCCH, CCCH, MCCH or SBCCH for which the abstract syntax is invalid [13]:

2> ignore the message;

NOTE This section applies in case one or more fields is set to a value, other than a spare, reserved or extended value, not defined in this version of the transfer syntax. E.g. in the case the UE receives value 12 for a field defined as INTEGER (1..11). In cases like this, it may not be possible to reliably detect which field is in the error hence the error handling is at the message level.

5.7.3 Field set to a not comprehended value

The UE shall, when receiving an RRC message on any logical channel:

1> if the message includes a field that has a value that the UE does not comprehend:

2> if a default value is defined for this field:

3> treat the message while using the default value defined for this field;

2> else if the concerned field is optional:

3> treat the message as if the field were absent and in accordance with the need code for absence of the concerned field;

2> else:

3> treat the message as if the field were absent and in accordance with sub-clause 5.7.4;

5.7.4 Mandatory field missing

The UE shall:

1> if the message includes a field that is mandatory to include in the message (e.g. because conditions for mandatory presence are fulfilled) and that field is absent or treated as absent:

2> if the RRC message was received on DCCH or CCCH:

3> ignore the message;

2> else:

3> if the field concerns a (sub-field of) an entry of a list (i.e. a SEQUENCE OF):

4> treat the list as if the entry including the missing or not comprehended field was not present;

3> else if the field concerns a sub-field of another field, referred to as the 'parent' field i.e. the field that is one nesting level up compared to the erroneous field:

4> consider the 'parent' field to be set to a not comprehended value;

4> apply the generic error handling to the subsequent 'parent' field(s), until reaching the top nesting level i.e. the message level;

3> else (field at message level):

4> ignore the message;

NOTE 1: The error handling defined in these sub-clauses implies that the UE ignores a message with the message type or version set to a not comprehended value.

NOTE 2: The nested error handling for messages received on logical channels other than DCCH and CCCH applies for errors in extensions also, even for errors that can be regarded as invalid E-UTRAN operation e.g. E-UTRAN not observing conditional presence.

The following ASN.1 further clarifies the levels applicable in case of nested error handling for errors in extension fields.

```
-- /example/ ASN1START

-- Example with extension addition group

ItemInfoList ::=                    SEQUENCE (SIZE (1..max)) OF ItemInfo

ItemInfo ::=                        SEQUENCE {
    itemIdentity                        INTEGER (1..max),
    field1                              Field1,
    field2                              Field2                  OPTIONAL,           -- Need ON
    ...
    [[  field3-r9                       Field3-r9               OPTIONAL,           -- Cond Cond1
        field4-r9                       Field4-r9               OPTIONAL            -- Need ON
    ]]
}

-- Example with traditional non-critical extension (empty sequence)

BroadcastInfoBlock1 ::=             SEQUENCE {
    itemIdentity                        INTEGER (1..max),
    field1                              Field1,
    field2                              Field2                  OPTIONAL,           -- Need ON
    nonCriticalExtension                BroadcastInfoBlock1-v940-IEs    OPTIONAL
}

BroadcastInfoBlock1-v940-IEs::= SEQUENCE {
    field3-r9                           Field3-r9               OPTIONAL,           -- Cond Cond1
    field4-r9                           Field4-r9               OPTIONAL,           -- Need ON
    nonCriticalExtension                SEQUENCE {}             OPTIONAL            -- Need OP
}

-- ASN1STOP
```

The UE shall, apply the following principles regarding the levels applicable in case of nested error handling:

- an extension additon group is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire itemInfo entry to be ignored (rather than just the extension addition group containing *field3* and *field4*)

- a traditional *nonCriticalExtension* is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire *BroadcastInfoBlock1* to be ignored (rather than just the non critical extension containing *field3* and *field4*).

5.7.5 Not comprehended field

The UE shall, when receiving an RRC message on any logical channel:

1> if the message includes a field that the UE does not comprehend:

2> treat the rest of the message as if the field was absent;

NOTE: This section does not apply to the case of an extension to the value range of a field. Such cases are addressed instead by the requirements in section 5.7.3.

5.8 MBMS

5.8.1 Introduction

5.8.1.1 General

In general the control information relevant only for UEs supporting MBMS is separated as much as possible from unicast control information. Most of the MBMS control information is provided on a logical channel specific for MBMS common control information: the MCCH. E-UTRA employs one MCCH logical channel per MBSFN area. In case the network configures multiple MBSFN areas, the UE acquires the MBMS control information from the MCCHs that are configured to identify if services it is interested to receive are ongoing. The action applicable when the UE is unable to simultaneously receive MBMS and unicast services is up to UE implementation. In this release of the specification, an MBMS capable UE is only required to support reception of a single MBMS service at a time, and reception of more than one MBMS service (also possibly on more than one MBSFN area) in parallel is left for UE implementation. The MCCH carries the *MBSFNAreaConfiguration* message, which indicates the MBMS sessions that are ongoing as well as the (corresponding) radio resource configuration. The MCCH may also carry the *MBMSCountingRequest* message, when E-UTRAN wishes to count the number of UEs in RRC_CONNECTED that are receiving or interested to receive one or more specific MBMS services.

A limited amount of MBMS control information is provided on the BCCH. This primarily concerns the information needed to acquire the MCCH(s). This information is carried by means of a single MBMS specific *SystemInformationBlock*: *SystemInformationBlockType13*. An MBSFN area is identified solely by the *mbsfn-AreaId* in *SystemInformationBlockType13*. At mobility, the UE considers that the MBSFN area is continuous when the source cell and the target cell broadcast the same value in the *mbsfn-AreaId*.

5.8.1.2 Scheduling

The MCCH information is transmitted periodically, using a configurable repetition period. Scheduling information is not provided for MCCH i.e. both the time domain scheduling as well as the lower layer configuration are semi-statically configured, as defined within *SystemInformationBlockType13*.

For MBMS user data, which is carried by the MTCH logical channel, E-UTRAN periodically provides MCH scheduling information (MSI) at lower layers (MAC). This MCH information only concerns the time domain scheduling i.e. the frequency domain scheduling and the lower layer configuration are semi-statically configured. The periodicity of the MSI is configurable and defined by the MCH scheduling period.

5.8.1.3 MCCH information validity and notification of changes

Change of MCCH information only occurs at specific radio frames, i.e. the concept of a modification period is used. Within a modification period, the same MCCH information may be transmitted a number of times, as defined by its scheduling (which is based on a repetition period). The modification period boundaries are defined by SFN values for which SFN mod *m*= 0, where *m* is the number of radio frames comprising the modification period. The modification period is configured by means of *SystemInformationBlockType13*.

When the network changes (some of) the MCCH information, it notifies the UEs about the change during a first modification period. In the next modification period, the network transmits the updated MCCH information. These general principles are illustrated in figure 5.8.1.3-1, in which different colours indicate different MCCH information. Upon receiving a change notification, a UE interested to receive MBMS services acquires the new MCCH information immediately from the start of the next modification period. The UE applies the previously acquired MCCH information until the UE acquires the new MCCH information.

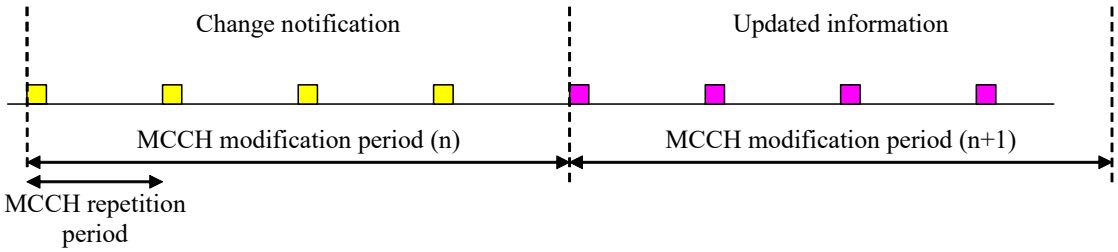


Figure 5.8.1.3-1: Change of MCCH Information

Indication of an MBMS specific RNTI, the M-RNTI (see TS 36.321 [6]), on PDCCH is used to inform UEs in RRC_IDLE and UEs in RRC_CONNECTED about an MCCH information change. When receiving an MCCH information change notification, the UE knows that the MCCH information will change at the next modification period boundary. The notification on PDCCH indicates which of the MCCHs will change, which is done by means of an 8-bit bitmap. Within this bitmap, the bit at the position indicated by the field *notificationIndicator* is used to indicate changes for that MBSFN area: if the bit is set to "1", the corresponding MCCH will change. No further details are provided e.g. regarding which MCCH information will change. The MCCH information change notification is used to inform the UE about a change of MCCH information upon session start or about the start of MBMS counting.

The MCCH information change notifications on PDCCH are transmitted periodically and are carried on MBSFN subframes only. These MCCH information change notification occasions are common for all MCCHs that are configured, and configurable by parameters included in *SystemInformationBlockType13:* a repetition coefficient, a radio frame offset and a subframe index. These common notification occasions are based on the MCCH with the shortest modification period.

NOTE 1: E-UTRAN may modify the MBMS configuration information provided on MCCH at the same time as updating the MBMS configuration information carried on BCCH i.e. at a coinciding BCCH and MCCH modification period. Upon detecting that a new MCCH is configured on BCCH, a UE interested to receive one or more MBMS services should acquire the MCCH, unless it knows that the services it is interested in are not provided by the corresponding MBSFN area.

A UE that is receiving an MBMS service shall acquire the MCCH information from the start of each modification period. A UE that is not receiving an MBMS service, as well as UEs that are receiving an MBMS service but potentially interested to receive other services not started yet in another MBSFN area, shall verify that the stored MCCH information remains valid by attempting to find the MCCH information change notification at least *notificationRepetitionCoeff* times during the modification period of the applicable MCCH(s), if no MCCH information change notification is received.

NOTE 2: In case the UE is aware which MCCH(s) E-UTRAN uses for the service(s) it is interested to receive, the UE may only need to monitor change notifications for a subset of the MCCHs that are configured, referred to as the 'applicable MCCH(s)' in the above.

5.8.2 MCCH information acquisition

5.8.2.1 General

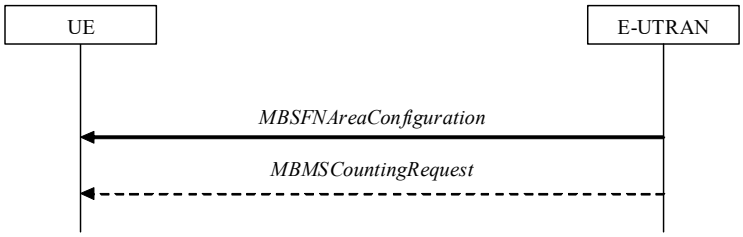


Figure 5.8.2.1-1: MCCH information acquisition

The UE applies the MCCH information acquisition procedure to acquire the MBMS control information that is broadcasted by the E-UTRAN. The procedure applies to MBMS capable UEs that are in RRC_IDLE or in RRC_CONNECTED.

5.8.2.2 Initiation

A UE interested to receive MBMS services shall apply the MCCH information acquisition procedure upon entering the corresponding MBSFN area (e.g. upon power on, following UE mobility) and upon receiving a notification that the MCCH information has changed. A UE that is receiving an MBMS service shall apply the MCCH information acquisition procedure to acquire the MCCH, that corresponds with the service that is being received, at the start of each modification period.

Unless explicitly stated otherwise in the procedural specification, the MCCH information acquisition procedure overwrites any stored MCCH information, i.e. delta configuration is not applicable for MCCH information and the UE discontinues using a field if it is absent in MCCH information unless explicitly specified otherwise.

5.8.2.3 MCCH information acquisition by the UE

An MBMS capable UE shall:

1> if the procedure is triggered by an MCCH information change notification:

2> start acquiring the *MBSFNAreaConfiguration* message and the *MBMSCountingRequest* message if present, from the beginning of the modification period following the one in which the change notification was received;

NOTE 1: The UE continues using the previously received MCCH information until the new MCCH information has been acquired.

1> if the UE enters an MBSFN area:

2> acquire the *MBSFNAreaConfiguration* message and the *MBMSCountingRequest* message if present, at the next repetition period;

1> if the UE is receiving an MBMS service:

2> start acquiring the *MBSFNAreaConfiguration* message and the *MBMSCountingRequest* message if present, that both concern the MBSFN area of the service that is being received, from the beginning of each modification period;

5.8.2.4 Actions upon reception of the *MBSFNAreaConfiguration* message

No UE requirements related to the contents of this *MBSFNAreaConfiguration* apply other than those specified elsewhere e.g. within procedures using the concerned system information, the corresponding field descriptions.

5.8.2.5 Actions upon reception of the *MBMSCountingRequest* message

Upon receiving *MBMSCountingRequest* message, the UE shall perform the MBMS Counting procedure as specified in section 5.8.4.

5.8.3 MBMS PTM radio bearer configuration

5.8.3.1 General

The MBMS PTM radio bearer configuration procedure is used by the UE to configure RLC, MAC and the physical layer upon starting and/or stopping to receive an MRB. The procedure applies to UEs interested to receive one or more MBMS services.

NOTE: In case the UE is unable to receive an MBMS service due to capability limitations, upper layers may take appropriate action e.g. terminate a lower priority unicast service.

5.8.3.2 Initiation

The UE applies the MRB establishment procedure to start receiving a session of a service it has an interest in. The procedure may be initiated e.g. upon start of the MBMS session, upon (re-)entry of the corresponding MBSFN service area, upon becoming interested in the MBMS service, upon removal of UE capability limitations inhibiting reception of the concerned service.

The UE applies the MRB release procedure to stop receiving a session. The procedure may be initiated e.g. upon stop of the MBMS session, upon leaving the corresponding MBSFN service area, upon losing interest in the MBMS service, when capability limitations start inhibiting reception of the concerned service.

5.8.3.3 MRB establishment

Upon MRB establishment, the UE shall:

1> establish an RLC entity in accordance with the configuration specified in 9.1.1.4;

1> configure an MTCH logical channel in accordance with the received *locgicalChannelIdentity*, applicable for the MRB, as included in the *MBSFNAreaConfiguration* message;

1> configure the physical layer in accordance with the *pmch-Config*, applicable for the MRB, as included in the *MBSFNAreaConfiguration* message;

1> inform upper layers about the establishment of the MRB by indicating the corresponding *tmgi* and *sessionId*;

5.8.3.4 MRB release

Upon MRB release, the UE shall:

1> release the RLC entity as well as the related MAC and physical layer configuration;

1> inform upper layers about the release of the MRB by indicating the corresponding *tmgi* and *sessionId*;

5.8.4 MBMS Counting Procedure

5.8.4.1 General

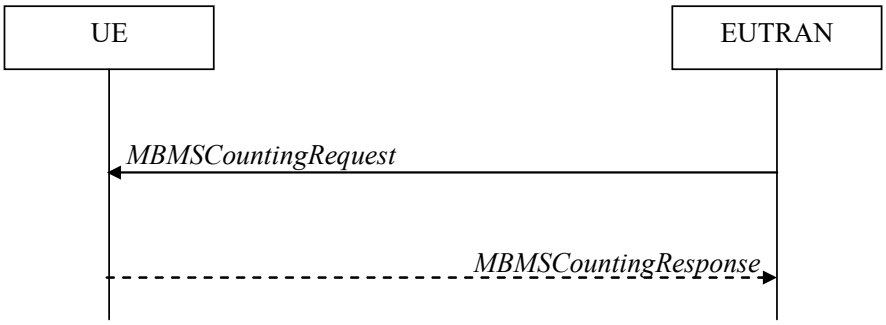


Figure 5.8.4.1-1: MBMS Counting procedure

The MBMS Counting procedure is used by the E-UTRAN to count the number of RRC_CONNECTED mode UEs which are receiving via an MRB or interested to receive via an MRB the specified MBMS services.

The UE determines interest in an MBMS service, that is identified by the TMGI, by interaction with upper layers.

5.8.4.2 Initiation

E-UTRAN initiates the procedure by sending an *MBMSCountingRequest* message.

5.8.4.3 Reception of the *MBMSCountingRequest* message by the UE

Upon receiving the *MBMSCountingRequest* message, the UE in RRC_CONNECTED mode shall:

1> if the *SystemInformationBlockType1,* that provided the scheduling information for the *systemInformationBlockType13* that included the configuration of the MCCH via which the *MBMSCountingRequest* message was received, contained the identity of the Registered PLMN; and

1> if the UE is receiving via an MRB or interested to receive via an MRB at least one of the services in the received *countingRequestList:*

2> if more than one entry is included in the *mbsfn-AreaInfoList* received in the *SystemInformationBlockType13* that included the configuration of the MCCH via which the *MBMSCountingRequest* message was received*:*

3> include the *mbsfn-AreaIndex* in the *MBMSCountingResponse* message and set it to the index of the entry in the *mbsfn-AreaInfoList* within the received *SystemInformationBlockType13* that corresponds with the MBSFN area used to transfer the received *MBMSCountingRequest* message;

2> for each MBMS service included in the received *countingRequestList*:

3> if the UE is receiving via an MRB or interested to receive via an MRB this MBMS service:

4> include an entry in the *countingResponseList* within the *MBMSCountingResponse* message with *countingResponseService* set it to the index of the entry in the *countingRequestList* within the received *MBMSCountingRequest* that corresponds with the MBMS service the UE is receiving or interested to receive;

2> submit the *MBMSCountingResponse* message to lower layers for transmission upon which the procedure ends;

NOTE 1: UEs that are receiving an MBMS User Service [56] by means of a Unicast Bearer Service [57] (i.e. via a DRB), but are interested to receive the concerned MBMS User Service [56] via an MBMS Bearer Service (i.e. via an MRB), respond to the counting request.

NOTE 2: If ciphering is used at upper layers, the UE does not respond to the counting request if it can not decipher the MBMS service for which counting is performed (see TS 22.146 [62, 5.3]).

NOTE 3: The UE treats the *MBMSCountingRequest* messages received in each modification period independently. In the unlikely case E-UTRAN would repeat an *MBMSCountingRequest* (i.e. including the same services) in a subsequent modification period, the UE responds again. The UE provides at most one *MBMSCountingResponse* message to multiple transmission attempts of an *MBMSCountingRequest* messages in a given modification period.

5.8.5 MBMS interest indication

5.8.5.1 General

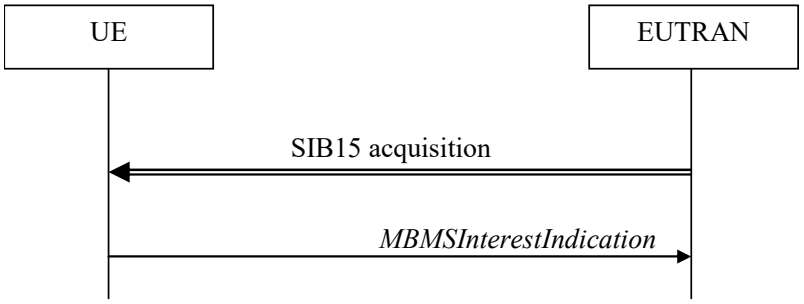


Figure 5.8.5.1-1: MBMS interest indication

The purpose of this procedure is to inform E-UTRAN that the UE is receiving or is interested to receive MBMS via an MRB, and if so, to inform E-UTRAN about the priority of MBMS versus unicast reception.

5.8.5.2 Initiation

An MBMS capable UE in RRC_CONNECTED may initiate the procedure in several cases including upon successful connection establishment, upon entering or leaving the service area, upon session start or stop, upon change of interest, upon change of priority between MBMS reception and unicast reception or upon change to a PCell broadcasting *SystemInformationBlockType15*.

Upon initiating the procedure, the UE shall:

1> if *SystemInformationBlockType15* is broadcast by the PCell:

2> ensure having a valid version of *SystemInformationBlockType15* for the PCell;

2> if the UE did not transmit an *MBMSInterestIndication* message since last entering RRC_CONNECTED state; or

2> if since the last time the UE transmitted an *MBMSInterestIndication* message, the UE connected to a PCell not broadcasting *SystemInformationBlockType15*:

3> if the set of MBMS frequencies of interest, determined in accordance with 5.8.5.3, is not empty:

4> initiate transmission of the *MBMSInterestIndication* message in accordance with 5.8.5.4;

2> else:

3> if the set of MBMS frequencies of interest, determined in accordance with 5.8.5.3, has changed since the last transmission of the *MBMSInterestIndication* message; or

3> if the prioritisation of reception of all indicated MBMS frequencies compared to reception of any of the established unicast bearers has changed since the last transmission of the *MBMSInterestIndication* message:

4> initiate transmission of the *MBMSInterestIndication* message in accordance with 5.8.5.4;

NOTE: The UE may send an *MBMSInterestIndication* even when it is able to receive the MBMS services it is interested in i.e. to avoid that the network allocates a configuration inhibiting MBMS reception.

5.8.5.3 Determine MBMS frequencies of interest

The UE shall:

1> consider a frequency to be part of the MBMS frequencies of interest if the following conditions are met:

2> at least one MBMS session the UE is receiving or interested to receive via an MRB is ongoing or about to start; and

NOTE 1: The UE may determine whether the session is ongoing from the start and stop time indicated in the User Service Description (USD), see 3GPP TS 36.300 [9] or 3GPP TS 26.346 [57].

2> for at least one of these MBMS sessions *SystemInformationBlockType15* acquired from the PCell includes for the concerned frequency one or more MBMS SAIs as indicated in the USD for this session; and

NOTE 2: The UE considers a frequency to be part of the MBMS frequencies of interest even though E-UTRAN may (temporarily) not employ an MRB for the concerned session. I.e. the UE does not verify if the session is indicated on MCCH

NOTE 3: The UE considers the frequencies of interest independently of any synchronization state, e.g. [9, Annex J.1]

2> the UE is capable of simultaneously receiving the set of MBMS frequencies of interest, regardless of whether a serving cell is configured on each of these frequencies or not; and

2> the *supportedBandCombination* the UE included in *UE-EUTRA-Capability* contains at least one band combination including the set of MBMS frequencies of interest;

NOTE 4: Indicating a frequency implies that the UE supports *SystemInformationBlockType13* acquisition for the concerned frequency i.e. the indication should be independent of whether a serving cell is configured on that frequency.

NOTE 5: When evaluating which frequencies it can receive simultaneously, the UE does not take into account the serving frequencies that are currently configured i.e. it only considers MBMS frequencies it is interested to receive.

NOTE 6: The set of MBMS frequencies of interest includes at most one frequency for a given physical frequency. The UE only considers a physical frequency to be part of the MBMS frequencies of interest if it supports at least one of the bands indicated for this physical frequency in *SystemInformationBlockType1* (for serving frequency) or *SystemInformationBlockType15* (for neighbouring frequencies). In this case, E-UTRAN may assume the UE supports MBMS reception on any of the bands supported by the UE (i.e. according to *supportedBandCombination*).

5.8.5.4 Actions related to transmission of *MBMSInterestIndication* message

The UE shall set the contents of the *MBMSInterestIndication* message as follows:

1> if the set of MBMS frequencies of interest, determined in accordance with 5.8.5.3, is not empty:

2> include *mbms-FreqList* and set it to include the MBMS frequencies of interest, using the EARFCN corresponding with *freqBandIndicator* included in *SystemInformationBlockType1* (for serving frequency), if applicable, and the EARFCN(s) as included in *SystemInformationBlockType15* (for neighbouring frequencies);

NOTE 1: The EARFCN included in *mbms-FreqList* is merely used to indicate a physical frequency the UE is interested to receive i.e. the UE may not support the band corresponding to the included EARFCN (but it does support at least one of the bands indicated in system information for the concerned physical frequency).

2> include *mbms-Priority* if the UE prioritises reception of all indicated MBMS frequencies above reception of any of the unicast bearers;

NOTE 2: If the UE prioritises MBMS reception and unicast data cannot be supported because of congestion on the MBMS carrier(s), E-UTRAN may initiate release of unicast bearers. It is up to E-UTRAN implementation whether all bearers or only GBR bearers are released. E-UTRAN does not initiate re-establishment of the released unicast bearers upon alleviation of the congestion.

The UE shall submit the *MBMSInterestIndication* message to lower layers for transmission.

5.9 RN procedures

5.9.1 RN reconfiguration

5.9.1.1 General

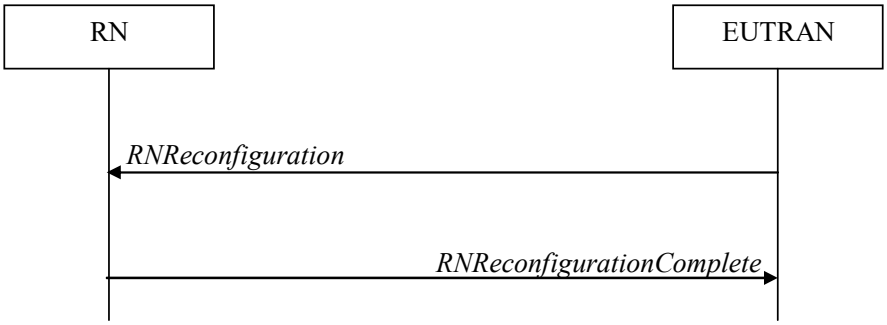


Figure 5.9.1.1-1: RN reconfiguration

The purpose of this procedure is to configure/reconfigure the RN subframe configuration and/or to update the system information relevant for the RN in RRC_CONNECTED.

5.9.1.2 Initiation

E-UTRAN may initiate the RN reconfiguration procedure to an RN in RRC_CONNECTED when AS security has been activated.

5.9.1.3 Reception of the *RNReconfiguration* by the RN

The RN shall:

1> if the *rn-SystemInfo* is included:

2> if the *systemInformationBlockType1* is included:

3> act upon the received *SystemInformationBlockType1* as specified in 5.2.2.7;

2> if the *SystemInformationBlockType2* is included:

3> act upon the received *SystemInformationBlockType2* as specified in 5.2.2.9;

1> if the *rn-SubframeConfig* is included:

2> reconfigure lower layers in accordance with the received *subframeConfigPatternFDD* or *subframeConfigPatternTDD*;

2> if the *rpdcch-Config* is included:

3> reconfigure lower layers in accordance with the received *rpdcch-Config*;

1> submit the *RNReconfigurationComplete* message to lower layers for transmission, upon which the procedure ends;

5.10 Sidelink

5.10.1 Introduction

The sidelink communication/ discovery/ synchronisation resource configuration applies for the frequency at which it was received/ acquired. Moreover, for a UE configured with one or more SCells, the sidelink communication/ discovery/ synchronisation resource configuration provided by dedicated signalling applies for the PCell/ the primary frequency. Furthermore, the UE shall not use the sidelink communication/ discovery/ synchronisation transmission resources received in one cell with the timing of another cell.

NOTE 1: Upper layers configure the UE to receive or transmit sidelink communication on a specific frequency, to monitor sidelink discovery announcements on one or more frequencies or to transmit sidelink discovery announcements on a specific frequency, but only if the UE is authorised to perform these particular ProSe related sidelink activities.

NOTE 2: It is up to UE implementation which actions to take (e.g. termination of unicast services, detach) when it is unable to perform the desired sidelink activities, e.g. due to UE capability limitations.

5.10.1a Conditions for sidelink operation

When it is specified that the UE shall perform a particular sidelink operation only if the conditions defined in this section are met, the UE shall perform the concerned sidelink operation only if:

1> if the UE's serving cell is suitable (RRC_IDLE or RRC_CONNECTED); and if either the selected cell on the frequency used for sidelink operation belongs to the registered or equivalent PLMN as specified in TS 24.334 [69] or the UE is out of coverage on the frequency used for sidelink operation as defined in TS 36.304 [4, 11.4]; or

1> if the UE is camped on a serving cell (RRC_IDLE) on which it fulfils the conditions to support sidelink communication in limited service state as specified in TS 23.303 [68, 4.5.6]; and if either the serving cell is on the frequency used for sidelink operation or the UE is out of coverage on the frequency used for sidelink operation as defined in TS 36.304 [4, 11.4]; or

1> if the UE has no serving cell (RRC_IDLE);

5.10.2 Sidelink UE information

5.10.2.1 General

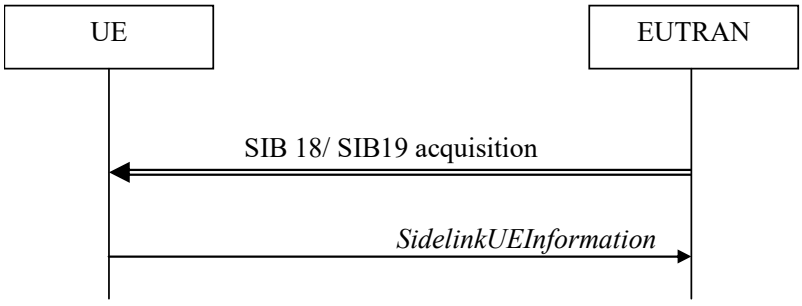


Figure 5.10.2-1: Sidelink UE information

The purpose of this procedure is to inform E-UTRAN that the UE is interested or no longer interested to receive sidelink communication or discovery, as well as to request assignment or release of transmission resources for sidelink communication or discovery announcements.

5.10.2.2 Initiation

A UE capable of sidelink communication or discovery that is in RRC_CONNECTED may initiate the procedure to indicate it is (interested in) receiving sidelink communication or discovery in several cases including upon successful connection establishment, upon change of interest, upon change to a PCell broadcasting *SystemInformationBlockType18* or *SystemInformationBlockType19*. A UE capable of sidelink communication or discovery may initiate the procedure to request assignment of dedicated resources for the concerned sidelink communication transmission or discovery announcements.

NOTE 1: A UE in RRC_IDLE that is configured to transmit sidelink communication/ discovery announcements, while *SystemInformationBlockType18*/ *SystemInformationBlockType19* does not include the resources for transmission (in normal conditions), initiates connection establishment in accordance with 5.3.3.1a.

Upon initiating the procedure, the UE shall:

1> if *SystemInformationBlockType18* is broadcast by the PCell:

2> ensure having a valid version of *SystemInformationBlockType18* for the PCell;

2> if configured by upper layers to receive sidelink communication:

3> if the UE did not transmit a *SidelinkUEInformation* message since last entering RRC_CONNECTED state; or

3> if since the last time the UE transmitted a *SidelinkUEInformation* message the UE connected to a PCell not broadcasting *SystemInformationBlockType18*; or

NOTE 2: After handover/ re-establishment from a source PCell not broadcasting *SystemInformationBlockType18* the UE repeats the same interest information that it provided previously as such a source PCell may not forward the interest information.

3> if the last transmission of the *SidelinkUEInformation* message did not include *commRxInterestedFreq*; or if the frequency configured by upper layers to receive sidelink communication on has changed since the last transmission of the *SidelinkUEInformation* message:

4> initiate transmission of the *SidelinkUEInformation* message to indicate the sidelink communication reception frequency of interest in accordance with 5.10.2.3;

2> else:

3> if the last transmission of the *SidelinkUEInformation* message included *commRxInterestedFreq*:

4> initiate transmission of the *SidelinkUEInformation* message to indicate it is no longer interested in sidelink communication reception in accordance with 5.10.2.3;

2> if configured by upper layers to transmit sidelink communication:

3> if the UE did not transmit a *SidelinkUEInformation* message since entering RRC_CONNECTED state; or

3> if since the last time the UE transmitted a *SidelinkUEInformation* message the UE connected to a PCell not broadcasting *SystemInformationBlockType18*; or

3> if the last transmission of the *SidelinkUEInformation* message did not include *commTxResourceReq*; or if the information carried by the *commTxResourceReq* has changed since the last transmission of the *SidelinkUEInformation* message:

4> initiate transmission of the *SidelinkUEInformation* message to indicate the sidelink communication transmission resources required by the UE in accordance with 5.10.2.3;

2> else:

3> if the last transmission of the *SidelinkUEInformation* message included *commTxResourceReq*:

4> initiate transmission of the *SidelinkUEInformation* message to indicate it does no longer require sidelink communication transmission resources in accordance with 5.10.2.3;

1> if *SystemInformationBlockType19* is broadcast by the PCell:

2> ensure having a valid version of *SystemInformationBlockType19* for the PCell;

2> if configured by upper layers to receive sidelink discovery announcements on a serving frequency or on one or more frequencies included in *discInterFreqList*, if included in *SystemInformationBlockType19*:

3> if the UE did not transmit a *SidelinkUEInformation* message since last entering RRC_CONNECTED state; or

3> if since the last time the UE transmitted a *SidelinkUEInformation* message the UE connected to a PCell not broadcasting *SystemInformationBlockType19*; or

3> if the last transmission of the *SidelinkUEInformation* message did not include *discRxInterest*:

4> initiate transmission of the *SidelinkUEInformation* message to indicate it is interested in sidelink discovery reception in accordance with 5.10.2.3;

2> else:

3> if the last transmission of the *SidelinkUEInformation* message included *discRxInterest*:

4> initiate transmission of the *SidelinkUEInformation* message to indicate it is no longer interested in sidelink discovery reception in accordance with 5.10.2.3;

2> if the UE is configured by upper layers to transmit sidelink discovery announcements:

3> if the UE did not transmit a *SidelinkUEInformation* message since entering RRC_CONNECTED state; or

3> if since the last time the UE transmitted a *SidelinkUEInformation* message the UE connected to a PCell not broadcasting *SystemInformationBlockType19*; or

3> if the last transmission of the *SidelinkUEInformation* message did not include *discTxResourceReq*; or if the sidelink discovery announcement resources required by the UE have changed (i.e. resulting in a change of *discTxResourceReq*) since the last transmission of the *SidelinkUEInformation* message:

4> initiate transmission of the *SidelinkUEInformation* message to indicate the sidelink discovery announcement resources required by the UE in accordance with 5.10.2.3;

2> else:

3> if the last transmission of the *SidelinkUEInformation* message included *discTxResourceReq*:

4> initiate transmission of the *SidelinkUEInformation* message to indicate it does no longer require sidelink discovery announcement resources in accordance with 5.10.2.3;

5.10.2.3 Actions related to transmission of *SidelinkUEInformation* message

The UE shall set the contents of the *SidelinkUEInformation* message as follows:

1> if *SystemInformationBlockType18* is broadcast by the PCell:

2> if configured by upper layers to receive sidelink communication:

3> include *commRxInterestedFreq* and set it to the sidelink communication frequency;

2> if configured by upper layers to transmit sidelink communication:

3> include *commTxResourceReq* and set its fields as follows:

4> set *carrierFreq* to indicate the sidelink communication frequency i.e. the same value as indicated in *commRxInterestedFreq* if included;

4> set *destinationInfoList* to include the sidelink communication transmission destination(s) for which it requests E-UTRAN to assign dedicated resources;

1> if *SystemInformationBlockType19* is broadcast by the PCell:

2> if configured by upper layers to receive sidelink discovery announcements on a serving frequency or one or more frequencies included in *discInterFreqList*, if included in *SystemInformationBlockType19*:

3> include *discRxInterest*;

2> if the UE is configured by upper layers to transmit sidelink discovery announcements:

3> include *discTxResourceReq* and set it to indicate the number of discovery messages for sidelink discovery announcement(s) for which it requests E-UTRAN to assign dedicated resources;

The UE shall submit the *SidelinkUEInformation* message to lower layers for transmission.

5.10.3 Sidelink communication monitoring

A UE capable of sidelink communication that is configured by upper layers to receive sidelink communication shall:

1> if the conditions for sidelink operation as defined in 5.10.1a are met:

2> if in coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

3> if the cell chosen for sidelink communication reception broadcasts *SystemInformationBlockType18* including *commRxPool*:

4> configure lower layers to monitor sidelink control information and the corresponding data using the pool of resources indicated by *commRxPool*;

NOTE 1: If *commRxPool* includes one or more entries including *rxParametersNCell*, the UE may only monitor such entries if the associated PSS/SSS or SLSSIDs is detected. When monitoring such pool(s), the UE applies the timing of the concerned PSS/SSS or SLSS.

2> else (i.e. out of coverage on the sidelink carrier):

3> configure lower layers to monitor sidelink control information and the corresponding data using the pool of resources that were preconfigured (i.e. *preconfigComm* in *SL-Preconfiguration* defined in 9.3);

NOTE 2: The UE may monitor in accordance with the timing of the selected SyncRef UE, or if the UE does not have a selected SyncRef UE, based on the UE's own timing.

5.10.4 Sidelink communication transmission

A UE capable of sidelink communication that is configured by upper layers to transmit sidelink communication and has related data to be transmitted shall:

1> if the conditions for sidelink operation as defined in 5.10.1a are met:

2> if in coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

3> if the UE is in RRC_CONNECTED and uses the PCell for sidelink communication:

4> if the UE is configured, by the current PCell/ the PCell in which physical layer problems or radio link failure was detected, with *commTxResources* set to *scheduled*:

5> if T310 or T311 is running; and if the PCell at which the UE detected physical layer problems or radio link failure broadcasts *SystemInformationBlockType18* including *commTxPoolExceptional*; or

5> if T301 is running and the cell on which the UE initiated connection re-establishment broadcasts *SystemInformationBlockType18* including *commTxPoolExceptional*:

6> configure lower layers to transmit the sidelink control information and the corresponding data using the pool of resources indicated by the first entry in *commTxPoolExceptional*;

5> else:

6> configure lower layers to request E-UTRAN to assign transmission resources for sidelink communication;

4> else if the UE is configured with *commTxPoolNormalDedicated*:

5> configure lower layers to transmit the sidelink control information and the corresponding data using the pool of resources indicated by the first entry in *commTxPoolNormalDedicated*;

3> else (i.e. sidelink communication in RRC_IDLE or on cell other than PCell in RRC_CONNECTED):

4> if the cell chosen for sidelink communication transmission broadcasts *SystemInformationBlockType18*:

5> if *SystemInformationBlockType18* includes *commTxPoolNormalCommon*:

6> configure lower layers to transmit the sidelink control information and the corresponding data using the pool of resources indicated by the first entry in *commTxPoolNormalCommon*;

5> else:

6> if the last connection establishment was initiated to request sidelink communication transmission resources and resulted in T300 expiry; and

6> if the cell on which the UE initiated connection establishment broadcasts *SystemInformationBlockType18* including *commTxPoolExceptional*:

7> from the moment T300 expired, as specified in 5.3.3.6, until receiving an *RRCConnectionReconfiguration* including *sl-CommConfig* or until receiving an *RRCConnectionRelease* or an *RRCConnectionReject*;

8> configure lower layers to transmit the sidelink control information and the corresponding data using the pool of resources indicated by the first entry in *commTxPoolExceptional*;

2> else (i.e. out of coverage on sidelink carrier):

3> configure lower layers to transmit the sidelink control information and the corresponding data using the pool of resources that were preconfigured i.e. indicated by the first entry in *preconfigComm* in *SL-Preconfiguration* defined in 9.3 and in accordance with the timing of the selected SyncRef UE, or if the UE does not have a selected SyncRef UE, based on the UEs own timing;

5.10.5 Sidelink discovery monitoring

A UE capable of sidelink discovery that is configured by upper layers to monitor sidelink discovery announcements shall:

1> for each frequency the UE is configured to monitor sidelink discovery announcements on, prioritising the frequencies included in *discInterFreqList*, if included in *SystemInformationBlockType19*:

2> configure lower layers to monitor sidelink discovery announcements using the pool of resources indicated by *discRxPool* in *SystemInformationBlockType19* without affecting normal operation i.e. receive during idle periods or by using a spare receiver;

NOTE 1: The requirement not to affect normal UE operation also applies for the acquisition of sidelink discovery related system and synchronisation information from inter-frequency cells.

NOTE 2: The UE is not required to monitor all pools simultaneously.

NOTE 3: It is up to UE implementation to decide whether a cell is sufficiently good to be used to monitor sidelink discovery announcements.

NOTE 4: If *discRxPool* includes one or more entries including *rxParameters*, the UE may only monitor such entries if the associated SLSSIDs are detected. When monitoring such pool(s) the UE applies the timing of the corresponding SLSS.

5.10.6 Sidelink discovery announcement

A UE capable of sidelink discovery that is configured by upper layers to transmit sidelink discovery announcements shall:

NOTE 1: In case the configured resources are insufficient it is up to UE implementation to decide which sidelink discovery announcements to transmit.

1> if the UE's serving cell (RRC_IDLE) or PCell (RRC_CONNECTED) is suitable as defined in TS 36.304 [4]:

2> if the UE is in RRC_CONNECTED (i.e. PCell is used for sidelink discovery announcement):

3> if the UE is configured with *discTxResources* set to *scheduled*:

4> configure lower layers to transmit the sidelink discovery announcement using the assigned resources indicated by *scheduled* in *discTxResources*;

3> else if the UE is configured with *discTxPoolDedicated* (i.e. *discTxResources* set to *ue-Selected*):

4> if *poolSelection* within *poolToAddModList* is set to *rsrpBased*:

5> select an entry of *poolToAddModList* for which the RSRP measurement of the PCell, after applying the layer 3 filter defined by *quantityConfig* as specified in 5.5.3.2 , is in-between *threshLow* and *threshHigh*;

4> else:

5> randomly select, using a uniform distribution, an entry of *poolToAddModList*;

4> configure lower layers to transmit the sidelink discovery announcement using the selected pool of resources:

2> else if T300 is not running (i.e. UE in RRC_IDLE, announcing via serving cell):

3> if *SystemInformationBlockType19* of the serving cell includes *discTxPoolCommon*:

4> if *poolSelection* is set to *rsrpBased*:

5> select an entry of *discTxPoolCommon* for which RSRP measurement of the serving cell is in-between *threshLow* and *threshHigh*;

4> else:

5> randomly select, using a uniform distribution, an entry of *discTxPoolCommon*;

4> configure lower layers to transmit the sidelink discovery announcement using the selected pool of resources;

NOTE 2: When performing resource pool selection based on RSRP, the UE uses the latest results of the available measurements used for cell reselection evaluation in RRC_IDLE/ for measurement report triggering evaluation in RRC_CONNECTED, which are performed in accordance with the performance requirements specified in TS 36.133 [16].

5.10.7 Sidelink synchronisation information transmission

5.10.7.1 General

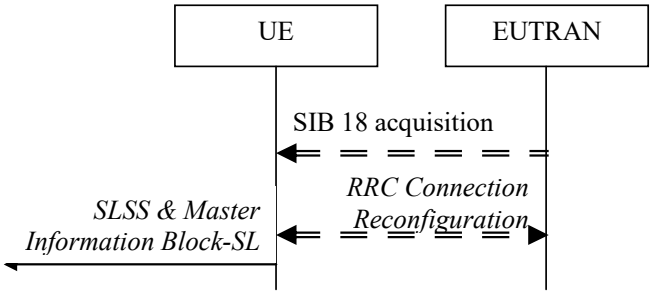


Figure 5.10.7.1-1: Synchronisation information transmission for sidelink communication, in (partial) coverage

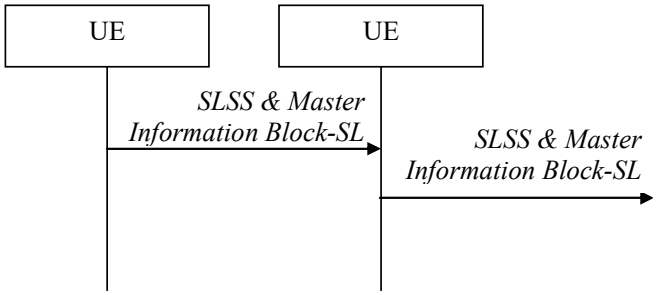


Figure 5.10.7.1-2: Synchronisation information transmission for sidelink communication, out of coverage

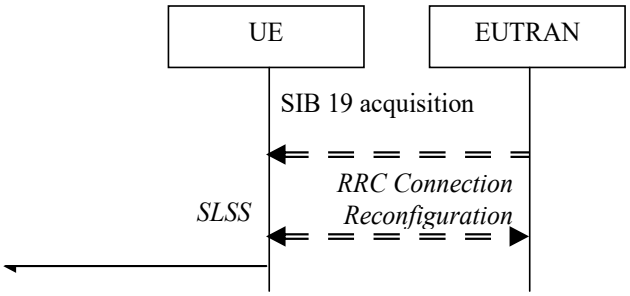


Figure 5.10.7.1-3: Synchronisation information transmission for sidelink discovery

The purpose of this procedure is to provide synchronisation information to a UE. The synchronisation information concerns a Sidelink Synchronisation Signal (SLSS) for sidelink discovery, while it concerns an SLSS, timing information and some additional configuration parameters (i.e. the *MasterInformationBlock-SL* message) for sidelink communication. A UE transmits synchronisation information either when E-UTRAN configures it to do so by dedicated signalling (i.e. network based), or when not configured by dedicated signalling (i.e. UE based) and E-UTRAN broadcasts (in coverage) or pre-configures a threshold (out of coverage).

The synchronisation information transmitted by the UE may be derived from information/ signals received from E-UTRAN (in coverage) or received from a UE acting as synchronisation reference for the transmitting UE. In the remainder, the UE acting as synchronisation reference is referred to as SyncRef UE.

5.10.7.2 Initiation

A UE capable of SLSS transmission shall, when transmitting sidelink discovery announcements in accordance with 5.10.6 and when the following conditions are met:

1> if the UE's serving cell (RRC_IDLE) or PCell (RRC_CONNECTED) is suitable as defined in TS 36.304 [4]:

2> if in RRC_CONNECTED; and if *networkControlledSyncTx* is configured and set to *on*; or

2> if *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType19*; and the RSRP measurement of the serving cell (RRC_IDLE) or PCell (RRC_CONNECTED) is below the value of *syncTxThreshIC*:

3> transmit SLSS in accordance with 5.10.7.3 and TS 36.211 [21], unless the UE uses the selected subframe for regular uplink transmission;

A UE capable of sidelink communication that is configured by upper layers to transmit sidelink communication shall, irrespective of whether or not it has data to transmit:

1> if the conditions for sidelink operation as defined in 5.10.1a are met:

2> if in RRC_CONNECTED; and if *networkControlledSyncTx* is configured and set to *on*:

3> transmit SLSS in accordance with 5.10.7.3 and TS 36.211 [21];

3> transmit the *MasterInformationBlock-SL* message, in the same subframe as SLSS, and in accordance with 5.10.7.4;

A UE shall, when transmitting sidelink communication in accordance with 5.10.4 and when the following conditions are met:

1> if in coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

2> if the UE is in RRC_CONNECTED; and *networkControlledSyncTx* is not configured; and *syncTxThreshIC* is included in *SystemInformationBlockType18*; and the RSRP measurement of the cell chosen for sidelink communication transmission is below the value of *syncTxThreshIC*; or

2> if the UE is in RRC_IDLE; and *syncTxThreshIC* is included in *SystemInformationBlockType18*; and the RSRP measurement of the cell chosen for sidelink communication transmission is below the value of *syncTxThreshIC*:

3> transmit SLSS in accordance with 5.10.7.3 and TS 36.211 [21];

3> transmit the *MasterInformationBlock-SL* message, in the same subframe as SLSS, and in accordance with 5.10.7.4;

1> else (i.e. out of coverage):

2> if *syncTxThreshOoC* is included in the preconfigured sidelink parameters (i.e. *SL-Preconfiguration* defined in 9.3); and the UE has no selected SyncRef UE or the S-RSRP measurement result of the selected SyncRef UE is below the value of *syncTxThreshOoC*:

3> transmit SLSS in accordance with 5.10.7.3 and TS 36.211 [21];

3> transmit the *MasterInformationBlock-SL* message, in the same subframe as SLSS, and in accordance with 5.10.7.4;

5.10.7.3 Transmission of SLSS

The UE shall select the SLSSID and the subframe in which to transmit SLSS as follows:

1> if triggered by sidelink discovery announcement:

2> select the SLSSID included in the entry of *discSyncConfig* included in the received *SystemInformationBlockType19*, that includes *txParameters*;

2> use *syncOffsetIndicator* corresponding to the selected SLSSID;

2> for each pool used for the transmission of discovery announcements (each corresponding to the selected SLSSID):

3> if a subframe indicated by *syncOffsetIndicator* corresponds to the first subframe of the discovery transmission pool;

4> select the concerned subframe;

3> else

4> select the subframe indicated by *syncOffsetIndicator* that precedes and which, in time domain, is nearest to the first subframe of the discovery transmission pool;

1> if triggered by sidelink communication:

2> if in coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

3> select the SLSSID included in the entry of *commSyncConfig* that is included in the received *SystemInformationBlockType18* and includes *txParameters*;

3> use *syncOffsetIndicator* corresponding to the selected SLSSID;

3> if in RRC_CONNECTED; and if *networkControlledSyncTx* is configured and set to *on*:

4> select the subframe(s) indicated by *syncOffsetIndicator*;

3> else (when transmitting communication):

4> select the subframe(s) indicated by *syncOffsetIndicator* within the SC period in which the UE intends to transmit sidelink control information or data;

2> else (i.e. out of coverage on sidelink carrier):

3> select the synchronisation reference UE (i.e. SyncRef UE) as defined in 5.10.8;

3> if the UE has a selected SyncRef UE and *inCoverage* in the *MasterInformationBlock-SL* message received from this UE is set to *TRUE*; or

3> if the UE has a selected SyncRef UE and *inCoverage* in the *MasterInformationBlock-SL* message received from this UE is set to *FALSE* while the SLSS from this UE is part of the set defined for out of coverage, see TS 36.211 [21]:

4> select the same SLSSID as the SLSSID of the selected SyncRef UE;

4> select the subframe in which to transmit the SLSS according to the *syncOffsetIndicator1* or *syncOffsetIndicator2* included in the preconfigured sidelink parameters (i.e. *preconfigSync* in *SL-Preconfiguration* defined in 9.3), such that the subframe timing is different from the SLSS of the selected SyncRef UE;

3> else if the UE has a selected SyncRef UE:

4> select the SLSSID from the set defined for out of coverage having an index that is 168 more than the index of the SLSSID of the selected SyncRef UE, see TS 36.211 [21];

4> select the subframe in which to transmit the SLSS according to *syncOffsetIndicator1* or *syncOffsetIndicator2* included in the preconfigured sidelink parameters (i.e. *preconfigSync* in *SL-Preconfiguration* defined in 9.3), such that the subframe timing is different from the SLSS of the selected SyncRef UE;

3> else (i.e. no SyncRef UE selected):

4> randomly select, using a uniform distribution, an SLSSID from the set of sequences defined for out of coverage, see TS 36.211 [21];

4> select the subframe in which to transmit the SLSS according to the *syncOffsetIndicator1* or *syncOffsetIndicator2* (arbitrary selection between these) included in the preconfigured sidelink parameters (i.e. *preconfigSync* in *SL-Preconfiguration* defined in 9.3);

5.10.7.4 Transmission of *MasterInformationBlock-SL* message

The UE shall set the contents of the *MasterInformationBlock-SL* message as follows:

1> if in coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

2> set *inCoverage* to *TRUE*;

2> set *sl-Bandwidth* to the value of *ul-Bandwidth* as included in the received *SystemInformationBlockType2* of the cell chosen for sidelink communication;

2> if *tdd-Config* is included in the received *SystemInformationBlockType1*:

3> set *subframeAssignmentSL* to the value representing the same meaning as of s*ubframeAssignment* that is included in *tdd-Config* in the received *SystemInformationBlockType1*;

2> else:

3> set *subframeAssignmentSL* to *none*;

2> if *syncInfoReserved* is included in an entry of *commSyncConfig* from the received *SystemInformationBlockType18*;

3> set *reserved* to the value of *syncInfoReserved* in the received *SystemInformationBlockType18*;

2> else:

3> set all bits in *reserved* to 0;

1> else if the UE has a selected SyncRef UE (as defined in 5.10.8):

2> set *inCoverage* to *FALSE*;

2> set *sl-Bandwidth*, *subframeAssignmentSL* and *reserved* to the value of the corresponding field included in the received *MasterInformationBlock-SL*;

1> else (i.e. no SyncRef UE selected):

2> set *inCoverage* to *FALSE*;

2> set *sl-Bandwidth*, *subframeAssignmentSL* and *reserved* to the value of the corresponding field included in the preconfigured sidelink parameters (i.e. *preconfigGeneral* in *SL-Preconfiguration* defined in 9.3);

1> set *directFrameNumber* and *directSubframeNumber* according to the subframe used to transmit the SLSS, as specified in 5.10.7.3;

1> submit the *MasterInformationBlock-SL* message to lower layers for transmission upon which the procedure ends;

5.10.7.5 Void

5.10.8 Sidelink synchronisation reference

5.10.8.1 General

The purpose of this procedure is to select a synchronisation reference and used a.o. when transmitting sidelink communication or synchronisation information.

5.10.8.2 Selection and reselection of synchronisation reference UE (SyncRef UE)

The UE shall:

1> if out of coverage on the frequency used for sidelink communication, as defined in TS 36.304 [4, 11.4]:

2> perform a full search (i.e. covering all subframes and all possible SLSSIDs) to detect candidate SLSS, in accordance with TS 36.133 [16]

2> when evaluating the one or more detected SLSSIDs, apply layer 3 filtering as specified in 5.5.3.2 using the preconfigured *filterCoefficient* as defined in 9.3, before using the S-RSRP measurement results;

2> if the UE has selected a SyncRef UE:

3> if the S-RSRP of the strongest candidate SyncRef UE exceeds the minimum requirement TS 36.133 [16] by *syncRefMinHyst* and the strongest candidate SyncRef UE belongs to the same priority group as the current SyncRef UE and the S-RSRP of the strongest candidate SyncRef UE exceeds the S-RSRP of the current SyncRef UE by *syncRefDiffHyst*; or

3> if the S-RSRP of the candidate SyncRef UE exceeds the minimum requirement TS 36.133 [16] by *syncRefMinHyst* and the candidate SyncRef UE belongs to a higher priority group than the current SyncRef UE; or

3> if the S-RSRP of the current SyncRef UE is less than the minimum requirement TS 36.133 [16]:

4> consider no SyncRef UE to be selected;

2> if the UE has not selected a SyncRef UE,

3> if the UE detects one or more SLSSIDs for which the S-RSRP exceeds the minimum requirement defined in TS 36.133 [16] by *syncRefMinHyst* and for which the UE received the corresponding *MasterInformationBlock-SL* message (candidate SyncRef UEs), select a SyncRef UE according to the following priority order:

4> UEs of which *inCoverage*, included in the *MasterInformationBlock-SL* message received from this UE, is set to *TRUE*, starting with the UE with the highest S-RSRP result (priority group 1);

4> UE which SLSSID is part of the set defined for in coverage, starting with the UE with the highest S-RSRP result (priority group 2);

4> Other UEs, starting with the UE with the highest S-RSRP result (priority group 3);

5.10.9 Sidelink common control information

5.10.9.1 General

The sidelink common control information is carried by a single message, the *MasterInformationBlock-SL* (MIB-SL) message. The MIB-SL includes timing information as well as some configuration parameters and is transmitted via SL-BCH.

The MIB-SL uses a fixed schedule with a periodicity of 40 ms without repetitions. In particular, the MIB-SL is scheduled in subframes indicated by *syncOffsetIndicator* i.e. for which (10*DFN + subframe number) mod 40 = *syncOffsetIndicator*.

The sidelink common control information may change at any transmission i.e. neither a modification period nor a change notification mechanism is used.

A UE configured to receive or transmit sidelink communication shall:

1> if the UE has a selected SyncRef UE, as specified in 5.10.8.2:

2> ensure having a valid version of the *MasterInformationBlock-SL* message of that SyncRefUE:

5.10.9.2 Actions related to reception of *MasterInformationBlock-SL* message

Upon receiving *MasterInformationBlock-SL*, the UE shall:

1> apply the values of *sl-Bandwidth*, *subframeAssignmentSL*, *directFrameNumber* and *directSubframeNumber* included in the received *MasterInformationBlock-SL* message;

6 Protocol data units, formats and parameters (tabular & ASN.1)

6.1 General

The contents of each RRC message is specified in sub-clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the fields specified in the message syntax. The syntax of the information elements that are defined as stand-alone abstract types is further specified in a similar manner in sub-clause 6.3.

The need for fields to be present in a message or an abstract type, i.e., the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. All comment text tags are available for use in the downlink direction only. The meaning of each tag is specified in table 6.1-1.

Table 6.1-1: Meaning of abbreviations used to specify the need for fields to be present

Abbreviation	Meaning
Cond *conditionTag* (Used in downlink only)	*Conditionally present* A field for which the need is specified by means of conditions. For each *conditionTag*, the need is specified in a tabular form following the ASN.1 segment. In case, according to the conditions, a field is not present, the UE takes no action and where applicable shall continue to use the existing value (and/ or the associated functionality) unless explicitly stated otherwise (e.g. in the conditional presence table or in the description of the field itself).
Need OP (Used in downlink only)	*Optionally present* A field that is optional to signal. For downlink messages, the UE is not required to take any special action on absence of the IE beyond what is specified in the procedural text or the field description table following the ASN.1 segment. The UE behaviour on absence should be captured either in the procedural text or in the field description.
Need ON (Used in downlink only)	*Optionally present, No action* A field that is optional to signal. If the message is received by the UE, and in case the information element is absent, the UE takes no action and where applicable shall continue to use the existing value (and/ or the associated functionality).
Need OR (Used in downlink only)	*Optionally present, Release* A field that is optional to signal. If the message is received by the UE, and in case the information element is absent, the UE shall discontinue/ stop using/ delete any existing value (and/ or the associated functionality).

Any field with Need ON in system information shall be interpreted as Need OR.

Need codes may not be specified for a parent extension field/ extension group, used in downlink, which includes one or more child extension fields. Upon absence of such a parent extension field/ extension group, the UE shall:

- For each individual child extension field, including extensions that are mandatory to include in the optional group, act in accordance with the need code that is defined for the extension;
- Apply this behaviour not only for child extension fields included directly within the optional parent extension field/ extension group, but also for extension fields defined at further nesting levels as long as for none of the fields in-between the concerned extension field and the parent extension field a need code is specified;

NOTE 1: The above applies for groups of non critical extensions using double brackets (referred to as extension groups), as well as non-critical extensions at the end of a message or at the end of a structure contained in a BIT STRING or OCTET STRING (referred to as parent extension fields).

Need codes, conditions and ASN.1 defaults specified for a particular (child) field only apply in case the (parent) field including the particular field is present. This rule does not apply for optional parent extension fields/ extension groups without need codes,

NOTE 2: The previous rule implies that E-UTRAN has to include such a parent extension field to release a child field that is either:

- Optional with need OR, or
- Conditional while the UE releases the child field when absent.

The handling of need codes as specified in the previous is illustrated by means of an example, as shown in the following ASN.1.

```
-- /example/ ASN1START

RRCMessage-r8-IEs ::=                   SEQUENCE {
    field1                                  InformationElement1,
    field2                                  InformationElement2             OPTIONAL,   -- Need ON
    nonCriticalExtension                    RRCMessage-v8a0-IEs             OPTIONAL
}

RRCMessage-v8a0-IEs ::=                 SEQUENCE {
    field3                                  InformationElement3             OPTIONAL,   -- Need ON
    nonCriticalExtension                    RRCMessage-v940-IEs             OPTIONAL
}

RRCMessage-v940-IEs ::=                 SEQUENCE {
    field4                                  InformationElement4             OPTIONAL,   -- Need OR
    nonCriticalExtension                    SEQUENCE {}                     OPTIONAL
}

InformationElement1 ::=         SEQUENCE {
    field11                             InformationElement11                OPTIONAL,   -- Need ON
    field12                             InformationElement12                OPTIONAL,   -- Need OR
    ...,
    [[  field13                             InformationElement13            OPTIONAL,   -- Need OR
        field14                             InformationElement14            OPTIONAL    -- Need ON
    ]]
}

InformationElement2 ::=         SEQUENCE {
    field21                             InformationElement11                OPTIONAL,   -- Need OR
    ...
}

-- ASN1STOP
```

The handling of need codes as specified in the previous implies that:

- if *field2* in *RRCMessage-r8-IEs* is absent, the UE does not modify *field21*;
- if *field2* in *RRCMessage-r8-IEs* is present but does not include *field21*, the UE releases *field21*;
- if the extension group containing *field13* is absent, the UE releases *field13* and does not modify *field14*;
- if *nonCriticalExtension* defined by IE *RRCMessage-v8a0-IEs* is absent, the UE does not modify *field3* and releases *field4*;

6.2 RRC messages

NOTE: The messages included in this section reflect the current status of the discussions. Additional messages may be included at a later stage.

6.2.1 General message structure

– *EUTRA-RRC-Definitions*

This ASN.1 segment is the start of the E-UTRA RRC PDU definitions.

```
-- ASN1START

EUTRA-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- ASN1STOP
```

– *BCCH-BCH-Message*

The *BCCH-BCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE via BCH on the BCCH logical channel.

```
-- ASN1START

BCCH-BCH-Message ::= SEQUENCE {
    message                 BCCH-BCH-MessageType
}

BCCH-BCH-MessageType ::=                        MasterInformationBlock

-- ASN1STOP
```

– *BCCH-DL-SCH-Message*

The *BCCH-DL-SCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE via DL-SCH on the BCCH logical channel.

```
-- ASN1START

BCCH-DL-SCH-Message ::= SEQUENCE {
    message                 BCCH-DL-SCH-MessageType
}

BCCH-DL-SCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        systemInformation                       SystemInformation,
        systemInformationBlockType1             SystemInformationBlockType1
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– *MCCH-Message*

The *MCCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE on the MCCH logical channel.

```
-- ASN1START

MCCH-Message ::=        SEQUENCE {
    message                 MCCH-MessageType
}

MCCH-MessageType ::= CHOICE {
    c1                          CHOICE {
        mbsfnAreaConfiguration-r9       MBSFNAreaConfiguration-r9
    },
    later                       CHOICE {
        c2                              CHOICE{
```

```
            mbmsCountingRequest-r10         MBMSCountingRequest-r10
        },
        messageClassExtension   SEQUENCE {}
    }
}

-- ASN1STOP
```

– PCCH-Message

The *PCCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE on the PCCH logical channel.

```
-- ASN1START

PCCH-Message ::= SEQUENCE {
    message                 PCCH-MessageType
}

PCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        paging                                  Paging
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– DL-CCCH-Message

The *DL-CCCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE on the downlink CCCH logical channel.

```
-- ASN1START

DL-CCCH-Message ::= SEQUENCE {
    message                 DL-CCCH-MessageType
}

DL-CCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        rrcConnectionReestablishment            RRCConnectionReestablishment,
        rrcConnectionReestablishmentReject      RRCConnectionReestablishmentReject,
        rrcConnectionReject                     RRCConnectionReject,
        rrcConnectionSetup                      RRCConnectionSetup
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– DL-DCCH-Message

The *DL-DCCH-Message* class is the set of RRC messages that may be sent from the E-UTRAN to the UE or from the E-UTRAN to the RN on the downlink DCCH logical channel.

```
-- ASN1START

DL-DCCH-Message ::= SEQUENCE {
    message                 DL-DCCH-MessageType
}

DL-DCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        csfbParametersResponseCDMA2000          CSFBParametersResponseCDMA2000,
        dlInformationTransfer                   DLInformationTransfer,
        handoverFromEUTRAPreparationRequest     HandoverFromEUTRAPreparationRequest,
        mobilityFromEUTRACommand                MobilityFromEUTRACommand,
        rrcConnectionReconfiguration            RRCConnectionReconfiguration,
```

```
        rrcConnectionRelease                    RRCConnectionRelease,
        securityModeCommand                     SecurityModeCommand,
        ueCapabilityEnquiry                     UECapabilityEnquiry,
        counterCheck                            CounterCheck,
        ueInformationRequest-r9                 UEInformationRequest-r9,
        loggedMeasurementConfiguration-r10      LoggedMeasurementConfiguration-r10,
        rnReconfiguration-r10                   RNReconfiguration-r10,
        spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– *UL-CCCH-Message*

The *UL-CCCH-Message* class is the set of RRC messages that may be sent from the UE to the E-UTRAN on the uplink CCCH logical channel.

```
-- ASN1START

UL-CCCH-Message ::= SEQUENCE {
    message                 UL-CCCH-MessageType
}

UL-CCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        rrcConnectionReestablishmentRequest     RRCConnectionReestablishmentRequest,
        rrcConnectionRequest                    RRCConnectionRequest
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

– *UL-DCCH-Message*

The *UL-DCCH-Message* class is the set of RRC messages that may be sent from the UE to the E-UTRAN or from the RN to the E-UTRAN on the uplink DCCH logical channel.

```
-- ASN1START

UL-DCCH-Message ::= SEQUENCE {
    message                 UL-DCCH-MessageType
}

UL-DCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        csfbParametersRequestCDMA2000           CSFBParametersRequestCDMA2000,
        measurementReport                       MeasurementReport,
        rrcConnectionReconfigurationComplete    RRCConnectionReconfigurationComplete,
        rrcConnectionReestablishmentComplete    RRCConnectionReestablishmentComplete,
        rrcConnectionSetupComplete              RRCConnectionSetupComplete,
        securityModeComplete                    SecurityModeComplete,
        securityModeFailure                     SecurityModeFailure,
        ueCapabilityInformation                 UECapabilityInformation,
        ulHandoverPreparationTransfer           ULHandoverPreparationTransfer,
        ulInformationTransfer                   ULInformationTransfer,
        counterCheckResponse                    CounterCheckResponse,
        ueInformationResponse-r9                UEInformationResponse-r9,
        proximityIndication-r9                  ProximityIndication-r9,
        rnReconfigurationComplete-r10           RNReconfigurationComplete-r10,
        mbmsCountingResponse-r10                MBMSCountingResponse-r10,
        interFreqRSTDMeasurementIndication-r10  InterFreqRSTDMeasurementIndication-r10
    },
    messageClassExtension   CHOICE {
        c2                          CHOICE {
            ueAssistanceInformation-r11         UEAssistanceInformation-r11,
            inDeviceCoexIndication-r11          InDeviceCoexIndication-r11,
            mbmsInterestIndication-r11          MBMSInterestIndication-r11,
            scgFailureInformation-r12           SCGFailureInformation-r12,
```

```
            sidelinkUEInformation-r12           SidelinkUEInformation-r12,
            spare11 NULL, spare10 NULL,
            spare9 NULL, spare8 NULL, spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        messageClassExtensionFuture-r11 SEQUENCE {}
    }
}

-- ASN1STOP
```

6.2.2 Message definitions

– *CounterCheck*

The *CounterCheck* message is used by the E-UTRAN to indicate the current COUNT MSB values associated to each DRB and to request the UE to compare these to its COUNT MSB values and to report the comparison results to E-UTRAN.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

CounterCheck message

```
-- ASN1START

CounterCheck ::=            SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            counterCheck-r8                     CounterCheck-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

CounterCheck-r8-IEs ::= SEQUENCE {
    drb-CountMSB-InfoList               DRB-CountMSB-InfoList,
    nonCriticalExtension                CounterCheck-v8a0-IEs               OPTIONAL
}

CounterCheck-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

DRB-CountMSB-InfoList ::=       SEQUENCE (SIZE (1..maxDRB)) OF DRB-CountMSB-Info

DRB-CountMSB-Info ::=   SEQUENCE {
    drb-Identity                    DRB-Identity,
    countMSB-Uplink                 INTEGER(0..33554431),
    countMSB-Downlink               INTEGER(0..33554431)
}

-- ASN1STOP
```

***CounterCheck* field descriptions**
count-MSB-Downlink Indicates the value of 25 MSBs from downlink COUNT associated to this DRB.
count-MSB-Uplink Indicates the value of 25 MSBs from uplink COUNT associated to this DRB.
drb-CountMSB-InfoList Indicates the MSBs of the COUNT values of the DRBs.

– *CounterCheckResponse*

The *CounterCheckResponse* message is used by the UE to respond to a *CounterCheck* message.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

CounterCheckResponse message

```
-- ASN1START

CounterCheckResponse ::=        SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        counterCheckResponse-r8             CounterCheckResponse-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

CounterCheckResponse-r8-IEs ::= SEQUENCE {
    drb-CountInfoList                   DRB-CountInfoList,
    nonCriticalExtension                CounterCheckResponse-v8a0-IEs       OPTIONAL
}

CounterCheckResponse-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

DRB-CountInfoList ::=           SEQUENCE (SIZE (0..maxDRB)) OF DRB-CountInfo

DRB-CountInfo ::=   SEQUENCE {
    drb-Identity                    DRB-Identity,
    count-Uplink                    INTEGER(0..4294967295),
    count-Downlink                  INTEGER(0..4294967295)
}

-- ASN1STOP
```

***CounterCheckResponse* field descriptions**
count-Downlink Indicates the value of downlink COUNT associated to this DRB.
count-Uplink Indicates the value of uplink COUNT associated to this DRB.
drb-CountInfoList Indicates the COUNT values of the DRBs.

– *CSFBParametersRequestCDMA2000*

The *CSFBParametersRequestCDMA2000* message is used by the UE to obtain the CDMA2000 1xRTT Parameters from the network. The UE needs these parameters to generate the CDMA2000 1xRTT Registration message used to register with the CDMA2000 1xRTT Network which is required to support CSFB to CDMA2000 1xRTT.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

CSFBParametersRequestCDMA2000 message

```
-- ASN1START

CSFBParametersRequestCDMA2000 ::= SEQUENCE {
    criticalExtensions                CHOICE {
        csfbParametersRequestCDMA2000-r8    CSFBParametersRequestCDMA2000-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

CSFBParametersRequestCDMA2000-r8-IEs ::= SEQUENCE {
    nonCriticalExtension              CSFBParametersRequestCDMA2000-v8a0-IEs  OPTIONAL
}

CSFBParametersRequestCDMA2000-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension          OCTET STRING                        OPTIONAL,
    nonCriticalExtension              SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *CSFBParametersResponseCDMA2000*

The *CSFBParametersResponseCDMA2000* message is used to provide the CDMA2000 1xRTT Parameters to the UE so the UE can register with the CDMA2000 1xRTT Network to support CSFB to CDMA2000 1xRTT.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

CSFBParametersResponseCDMA2000 message

```
-- ASN1START

CSFBParametersResponseCDMA2000 ::= SEQUENCE {
    rrc-TransactionIdentifier         RRC-TransactionIdentifier,
    criticalExtensions                   CHOICE {
        csfbParametersResponseCDMA2000-r8       CSFBParametersResponseCDMA2000-r8-IEs,
        criticalExtensionsFuture                SEQUENCE {}
    }
}

CSFBParametersResponseCDMA2000-r8-IEs ::= SEQUENCE {
    rand                              RAND-CDMA2000,
    mobilityParameters                MobilityParametersCDMA2000,
    nonCriticalExtension              CSFBParametersResponseCDMA2000-v8a0-IEs OPTIONAL
}

CSFBParametersResponseCDMA2000-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension          OCTET STRING                        OPTIONAL,
    nonCriticalExtension              SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *DLInformationTransfer*

The *DLInformationTransfer* message is used for the downlink transfer of NAS or non-3GPP dedicated information.

Signalling radio bearer: SRB2 or SRB1 (only if SRB2 not established yet. If SRB2 is suspended, E-UTRAN does not send this message until SRB2 is resumed.)

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

DLInformationTransfer message

```
-- ASN1START

DLInformationTransfer ::=           SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            dlInformationTransfer-r8            DLInformationTransfer-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

DLInformationTransfer-r8-IEs ::=    SEQUENCE {
    dedicatedInfoType                   CHOICE {
        dedicatedInfoNAS                    DedicatedInfoNAS,
        dedicatedInfoCDMA2000-1XRTT         DedicatedInfoCDMA2000,
        dedicatedInfoCDMA2000-HRPD          DedicatedInfoCDMA2000
    },
    nonCriticalExtension                DLInformationTransfer-v8a0-IEs      OPTIONAL
}

DLInformationTransfer-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *HandoverFromEUTRAPreparationRequest* (CDMA2000)

The *HandoverFromEUTRAPreparationRequest* message is used to trigger the handover preparation procedure with a CDMA2000 RAT. This message is also used to trigger a tunneled preparation procedure with a CDMA2000 1xRTT RAT to obtain traffic channel resources for the enhanced CS fallback to CDMA2000 1xRTT, which may also involve a concurrent preparation for handover to CDMA2000 HRPD. Also, this message is used to trigger the dual Rx/Tx redirection procedure with a CDMA2000 1xRTT RAT.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

HandoverFromEUTRAPreparationRequest message

```
-- ASN1START

HandoverFromEUTRAPreparationRequest ::= SEQUENCE {
    rrc-TransactionIdentifier       RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            handoverFromEUTRAPreparationRequest-r8
                                                HandoverFromEUTRAPreparationRequest-r8-IEs,
```

```
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

HandoverFromEUTRAPreparationRequest-r8-IEs ::= SEQUENCE {
    cdma2000-Type                   CDMA2000-Type,
    rand                            RAND-CDMA2000               OPTIONAL,   -- Cond cdma2000-Type
    mobilityParameters              MobilityParametersCDMA2000  OPTIONAL,   -- Cond cdma2000-Type
    nonCriticalExtension            HandoverFromEUTRAPreparationRequest-v890-IEs    OPTIONAL
}

HandoverFromEUTRAPreparationRequest-v890-IEs ::= SEQUENCE {
    lateNonCriticalExtension        OCTET STRING                OPTIONAL,
    nonCriticalExtension            HandoverFromEUTRAPreparationRequest-v920-IEs    OPTIONAL
}

HandoverFromEUTRAPreparationRequest-v920-IEs ::= SEQUENCE {
    concurrPrepCDMA2000-HRPD-r9     BOOLEAN                 OPTIONAL,   -- Cond cdma2000-Type
    nonCriticalExtension            HandoverFromEUTRAPreparationRequest-v1020-IEs   OPTIONAL
}

HandoverFromEUTRAPreparationRequest-v1020-IEs ::= SEQUENCE {
    dualRxTxRedirectIndicator-r10       ENUMERATED {true}       OPTIONAL,   -- Cond cdma2000-1XRTT
    redirectCarrierCDMA2000-1XRTT-r10   CarrierFreqCDMA2000     OPTIONAL,   -- Cond dualRxTxRedirect
    nonCriticalExtension                SEQUENCE {}             OPTIONAL
}

-- ASN1STOP
```

***HandoverFromEUTRAPreparationRequest* field descriptions**
concurrPrepCDMA2000-HRPD Value TRUE indicates that upper layers should initiate concurrent preparation for handover to CDMA2000 HRPD in addition to preparation for enhanced CS fallback to CDMA2000 1xRTT.
dualRxTxRedirectIndicator Value TRUE indicates that the second radio of the dual Rx/Tx UE is being redirected to CDMA2000 1xRTT [51].
redirectCarrierCDMA2000-1XRTT Used to indicate the CDMA2000 1xRTT carrier frequency where the UE is being redirected to.

Conditional presence	Explanation
cdma2000-1XRTT	The field is optionally present, need ON, if the *cdma2000-Type* = *type1XRTT*; otherwise it is not present.
cdma2000-Type	The field is mandatory present if the *cdma2000-Type* = *type1XRTT*; otherwise it is not present.
dualRxTxRedirect	The field is optionally present, need ON, if *dualRxTxRedirectIndicator* is present; otherwise it is not present.

– *InDeviceCoexIndication*

The *InDeviceCoexIndication* message is used to inform E-UTRAN about IDC problems which can not be solved by the UE itself, as well as to provide information that may assist E-UTRAN when resolving these problems.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

InDeviceCoexIndication message

```
-- ASN1START

InDeviceCoexIndication-r11 ::=      SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
```

```
            inDeviceCoexIndication-r11              InDeviceCoexIndication-r11-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

InDeviceCoexIndication-r11-IEs ::=  SEQUENCE {
    affectedCarrierFreqList-r11         AffectedCarrierFreqList-r11                OPTIONAL,
    tdm-AssistanceInfo-r11              TDM-AssistanceInfo-r11                     OPTIONAL,
    lateNonCriticalExtension            OCTET STRING                               OPTIONAL,
    nonCriticalExtension                InDeviceCoexIndication-v11d0-IEs           OPTIONAL
}

InDeviceCoexIndication-v11d0-IEs ::=    SEQUENCE {
    ul-CA-AssistanceInfo-r11            SEQUENCE {
        affectedCarrierFreqCombList-r11 AffectedCarrierFreqCombList-r11         OPTIONAL,
        victimSystemType-r11                VictimSystemType-r11
    }                                                                            OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                              OPTIONAL
}

AffectedCarrierFreqList-r11 ::= SEQUENCE (SIZE (1..maxFreqIDC-r11)) OF AffectedCarrierFreq-r11

AffectedCarrierFreq-r11 ::= SEQUENCE {
    carrierFreq-r11             MeasObjectId,
    interferenceDirection-r11   ENUMERATED {eutra, other, both, spare}
}

AffectedCarrierFreqCombList-r11 ::= SEQUENCE (SIZE (1..maxCombIDC-r11)) OF AffectedCarrierFreqComb-
r11

AffectedCarrierFreqComb-r11 ::= SEQUENCE (SIZE (2..maxServCell-r10)) OF MeasObjectId

TDM-AssistanceInfo-r11 ::=  CHOICE {
    drx-AssistanceInfo-r11              SEQUENCE {
        drx-CycleLength-r11                 ENUMERATED {sf40, sf64, sf80, sf128, sf160,
                                                sf256, spare2, spare1},
        drx-Offset-r11                      INTEGER (0..255)    OPTIONAL,
        drx-ActiveTime-r11                  ENUMERATED {sf20, sf30, sf40, sf60, sf80,
                                                sf100, spare2, spare1}
    },
    idc-SubframePatternList-r11         IDC-SubframePatternList-r11,
    ...
}

IDC-SubframePatternList-r11 ::= SEQUENCE (SIZE (1..maxSubframePatternIDC-r11)) OF IDC-
SubframePattern-r11

IDC-SubframePattern-r11 ::= CHOICE {
    subframePatternFDD-r11              BIT STRING (SIZE (4)),
    subframePatternTDD-r11              CHOICE {
        subframeConfig0-r11                 BIT STRING (SIZE (70)),
        subframeConfig1-5-r11               BIT STRING (SIZE (10)),
        subframeConfig6-r11                 BIT STRING (SIZE (60))
    },
    ...
}

VictimSystemType-r11 ::= SEQUENCE {
    gps-r11                             ENUMERATED {true}               OPTIONAL,
    glonass-r11                         ENUMERATED {true}               OPTIONAL,
    bds-r11                             ENUMERATED {true}               OPTIONAL,
    galileo-r11                         ENUMERATED {true}               OPTIONAL,
    wlan-r11                            ENUMERATED {true}               OPTIONAL,
    bluetooth-r11                       ENUMERATED {true}               OPTIONAL
}

-- ASN1STOP
```

InDeviceCoexIndication field descriptions
affectedCarrierFreqCombList Indicates a list of E-UTRA carrier frequencies that are affected by IDC problems due to Inter-Modulation Distortion and harmonics from E-UTRA when configured with UL CA.
affectedCarrierFreqList List of E-UTRA carrier frequencies affected by IDC problems.
drx-ActiveTime Indicates the desired active time that the E-UTRAN is recommended to configure. Value in number of subframes. Value sf20 corresponds to 20 subframes, sf30 corresponds to 30 subframes and so on.
drx-CycleLength Indicates the desired DRX cycle length that the E-UTRAN is recommended to configure. Value in number of subframes. Value sf40 corresponds to 40 subframes, sf64 corresponds to 64 subframes and so on.
drx-Offset Indicates the desired DRX starting offset that the E-UTRAN is recommended to configure. The UE shall set the value of drx-Offset smaller than the value of *drx-CycleLength*. The starting frame and subframe satisfy the relation: [(SFN * 10) + subframe number] modulo (*drx-CycleLength*) = *drx-Offset*.
idc-SubframePatternList A list of one or more subframe patterns indicating which HARQ process E-UTRAN is requested to abstain from using. Value 0 indicates that E-UTRAN is requested to abstain from using the subframe. For FDD, the radio frame in which the pattern starts (i.e. the radio frame in which the first/leftmost bit of the *subframePatternFDD* corresponds to subframe #0) occurs when SFN mod 2 = 0. For TDD, the first/leftmost bit corresponds to the subframe #0 of the radio frame satisfying SFN mod x = 0, where x is the size of the bit string divided by 10. The UE shall indicate a subframe pattern that follows HARQ time line, as specified in TS 36.213 [23], i.e, if a subframe is set to 1 in the subframe pattern, also the corresponding subframes carrying the potential UL grant [23, 8.0], the UL HARQ retransmission [23, 8.0] and the DL/UL HARQ feedback [23, 7.3, 8.3 and 9.1.2] shall be set to 1.
interferenceDirection Indicates the direction of IDC interference. Value *eutra* indicates that only E-UTRA is victim of IDC interference, value *other* indicates that only another radio is victim of IDC interference and value *both* indicates that both E-UTRA and another radio are victims of IDC interference. The other radio refers to either the ISM radio or GNSS (see 3GPP TR 36.816 [63]).
victimSystemType Indicate the list of victim system types to which IDC interference is caused from E-UTRA when configured with UL CA. Value *gps*, *glonass*, *bds* and *galileo* indicates the type of GNSS. Value *wlan* indicates WLAN and value *bluetooth* indicates Bluetooth.

– *InterFreqRSTDMeasurementIndication*

The *InterFreqRSTDMeasurementIndication* message is used to indicate that the UE is going to either start or stop OTDOA inter-frequency RSTD measurement which requires measurement gaps as specified in TS 36.133 [16, 8.1.2.6].

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

InterFreqRSTDMeasurementIndication message

```
-- ASN1START

InterFreqRSTDMeasurementIndication-r10 ::=          SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            interFreqRSTDMeasurementIndication-r10  InterFreqRSTDMeasurementIndication-r10-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

InterFreqRSTDMeasurementIndication-r10-IEs ::=      SEQUENCE {
    rstd-InterFreqIndication-r10        CHOICE {
        start                               SEQUENCE {
            rstd-InterFreqInfoList-r10              RSTD-InterFreqInfoList-r10
        },
        stop                                NULL
```

```
    },
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

RSTD-InterFreqInfoList-r10 ::=  SEQUENCE (SIZE(1..maxRSTD-Freq-r10)) OF RSTD-InterFreqInfo-r10

RSTD-InterFreqInfo-r10 ::=      SEQUENCE {
    carrierFreq-r10                 ARFCN-ValueEUTRA,
    measPRS-Offset-r10              INTEGER (0..39),
    ...,
    [[  carrierFreq-v1090           ARFCN-ValueEUTRA-v9e0               OPTIONAL
    ]]
}

-- ASN1STOP
```

***InterFreqRSTDMeasurementIndication* field descriptions**
carrierFreq The EARFCN value of the carrier received from upper layers for which the UE needs to perform the inter-frequency RSTD measurements. If the UE includes *carrierFreq-v1090*, it shall set *carrierFreq-r10* to *maxEARFCN*.
measPRS-Offset Indicates the requested gap offset for performing inter-frequency RSTD measurements. It is the smallest subframe offset from the beginning of subframe 0 of SFN=0 of the serving cell of the requested gap for measuring PRS positioning occasions in the carrier frequency *carrierFreq* for which the UE needs to perform the inter-frequency RSTD measurements. The PRS positioning occasion information is received from upper layers. The value of *measPRS-Offset* is obtained by mapping the starting subframe of the PRS positioning occasion in the measured cell onto the corresponding subframe in the serving cell and is calculated as the serving cell's number of subframes from SFN=0 mod 40. The UE shall take into account any additional time required by the UE to start PRS measurements on the other carrier when it does this mapping for determining the *measPRS-Offset*. NOTE: Figure 6.2.2-1 illustrates the *measPRS-Offset* field.
rstd-InterFreqIndication Indicates the inter-frequency RSTD measurement action, i.e. the UE is going to start or stop inter-frequency RSTD measurement.

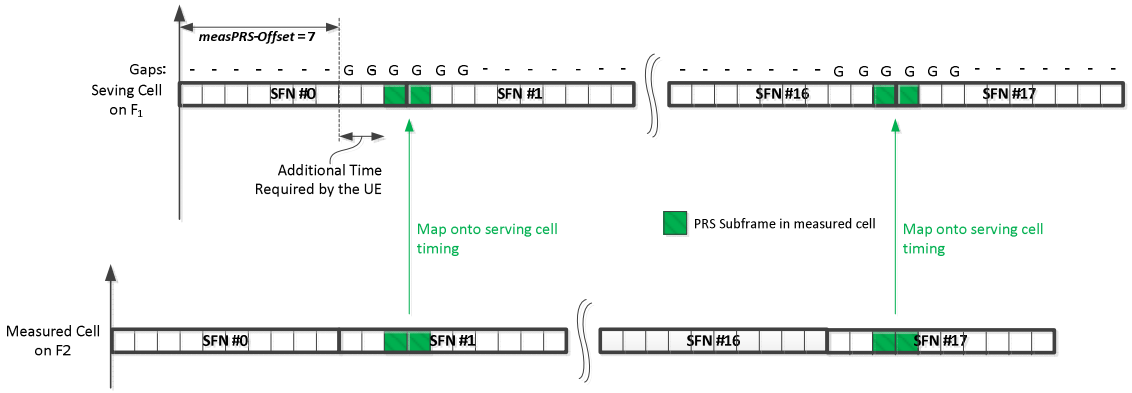


Figure 6.2.2-1 (informative): Exemplary calculation of *measPRS-Offset* field.

– *LoggedMeasurementConfiguration*

The *LoggedMeasurementConfiguration* message is used by E-UTRAN to configure the UE to perform logging of measurement results while in RRC_IDLE or to perform logging of measurement results for MBSFN while in both RRC_IDLE and RRC_CONNECTED. It is used to transfer the logged measurement configuration for network performance optimisation, see TS 37.320 [60].

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

LoggedMeasurementConfiguration message

```
-- ASN1START

LoggedMeasurementConfiguration-r10 ::=  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            loggedMeasurementConfiguration-r10      LoggedMeasurementConfiguration-r10-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture                SEQUENCE {}
    }
}


LoggedMeasurementConfiguration-r10-IEs ::= SEQUENCE {
    traceReference-r10              TraceReference-r10,
    traceRecordingSessionRef-r10    OCTET STRING (SIZE (2)),
    tce-Id-r10                      OCTET STRING (SIZE (1)),
    absoluteTimeInfo-r10            AbsoluteTimeInfo-r10,
    areaConfiguration-r10           AreaConfiguration-r10       OPTIONAL,   -- Need OR
    loggingDuration-r10             LoggingDuration-r10,
    loggingInterval-r10             LoggingInterval-r10,
    nonCriticalExtension            LoggedMeasurementConfiguration-v1080-IEs    OPTIONAL
}

LoggedMeasurementConfiguration-v1080-IEs ::= SEQUENCE {
    lateNonCriticalExtension-r10    OCTET STRING                        OPTIONAL,
    nonCriticalExtension            LoggedMeasurementConfiguration-v1130-IEs    OPTIONAL
}

LoggedMeasurementConfiguration-v1130-IEs ::= SEQUENCE {
    plmn-IdentityList-r11           PLMN-IdentityList3-r11      OPTIONAL,   -- Need OR
    areaConfiguration-v1130         AreaConfiguration-v1130     OPTIONAL,   -- Need OR
    nonCriticalExtension            LoggedMeasurementConfiguration-v1250-IEs    OPTIONAL
}

LoggedMeasurementConfiguration-v1250-IEs ::= SEQUENCE {
    targetMBSFN-AreaList-r12    TargetMBSFN-AreaList-r12        OPTIONAL,   -- Need OP
    nonCriticalExtension            SEQUENCE {}                 OPTIONAL
}

TargetMBSFN-AreaList-r12 ::=            SEQUENCE (SIZE (0..maxMBSFN-Area)) OF TargetMBSFN-Area-r12

TargetMBSFN-Area-r12 ::=                SEQUENCE {
    mbsfn-AreaId-r12                    MBSFN-AreaId-r12        OPTIONAL,   -- Need OR
    carrierFreq-r12                     ARFCN-ValueEUTRA-r9,
    ...
}

-- ASN1STOP
```

LoggedMeasurementConfiguration field descriptions
absoluteTimeInfo Indicates the absolute time in the current cell.
areaConfiguration Used to restrict the area in which the UE performs measurement logging to cells broadcasting either one of the included cell identities or one of the included tracking area codes/ identities.
plmn-IdentityList Indicates a set of PLMNs defining when the UE performs measurement logging as well as the associated status indication and information retrieval i.e. the UE performs these actions when the RPLMN is part of this set of PLMNs.
targetMBSFN-AreaList Used to indicate logging of MBSFN measurements and further restrict the area and frequencies for which the UE performs measurement logging for MBSFN. If both MBSFN area id and carrier frequency are present, a specific MBSFN area is indicated. If only carrier frequency is present, all MBSFN areas on that carrier frequency are indicated. If there is no entry in the list, any MBSFN area is indicated.
tce-Id Parameter Trace Collection Entity Id: See TS 32.422 [58].
traceRecordingSessionRef Parameter Trace Recording Session Reference: See TS 32.422 [58]

– *MasterInformationBlock*

The *MasterInformationBlock* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: E-UTRAN to UE

MasterInformationBlock

```
-- ASN1START

MasterInformationBlock ::=          SEQUENCE {
    dl-Bandwidth                        ENUMERATED {
                                            n6, n15, n25, n50, n75, n100},
    phich-Config                        PHICH-Config,
    systemFrameNumber                   BIT STRING (SIZE (8)),
    spare                               BIT STRING (SIZE (10))
}


-- ASN1STOP
```

MasterInformationBlock field descriptions
dl-Bandwidth Parameter: transmission bandwidth configuration, N_{RB} in downlink, see TS 36.101 [42, table 5.6-1]. n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on.
systemFrameNumber Defines the 8 most significant bits of the SFN. As indicated in TS 36.211 [21, 6.6.1], the 2 least significant bits of the SFN are acquired implicitly in the P-BCH decoding, i.e. timing of 40ms P-BCH TTI indicates 2 least significant bits (within 40ms P-BCH TTI, the first radio frame: 00, the second radio frame: 01, the third radio frame: 10, the last radio frame: 11). One value applies for all serving cells of a Cell Group (i.e. MCG or SCG). The associated functionality is common (i.e. not performed independently for each cell).

– *MBMSCountingRequest*

The *MBMSCountingRequest* message is used by E-UTRAN to count the UEs that are receiving or interested to receive specific MBMS services.

Signalling radio bearer: N/A

RLC-SAP: UM

Logical channel: MCCH

Direction: E-UTRAN to UE

MBMSCountingRequest message

```
-- ASN1START

MBMSCountingRequest-r10 ::=     SEQUENCE {
    countingRequestList-r10         CountingRequestList-r10,
    lateNonCriticalExtension        OCTET STRING                        OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

CountingRequestList-r10 ::= SEQUENCE (SIZE (1..maxServiceCount)) OF CountingRequestInfo-r10

CountingRequestInfo-r10 ::=     SEQUENCE {
    tmgi-r10                            TMGI-r9,
    ...
}

-- ASN1STOP
```

– *MBMSCountingResponse*

The *MBMSCountingResponse* message is used by the UE to respond to an *MBMSCountingRequest* message.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

MBMSCountingResponse message

```
-- ASN1START

MBMSCountingResponse-r10 ::=            SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            countingResponse-r10                MBMSCountingResponse-r10-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

MBMSCountingResponse-r10-IEs ::=    SEQUENCE {
    mbsfn-AreaIndex-r10             INTEGER (0..maxMBSFN-Area-1)                        OPTIONAL,
    countingResponseList-r10        CountingResponseList-r10            OPTIONAL,
    lateNonCriticalExtension        OCTET STRING                        OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

CountingResponseList-r10 ::=        SEQUENCE (SIZE (1..maxServiceCount)) OF CountingResponseInfo-r10

CountingResponseInfo-r10 ::=        SEQUENCE {
    countingResponseService-r10 INTEGER (0..maxServiceCount-1),
    ...
}

-- ASN1STOP
```

***MBMSCountingResponse* field descriptions**
countingResponseList List of MBMS services which the UE is receiving or interested to receive. Value 0 for field *countingResponseService* corresponds to the first entry in *countingRequestList* within *MBMSCountingRequest*, value 1 corresponds to the second entry in this list and so on.
mbsfn-AreaIndex Index of the entry in field *mbsfn-AreaInfoList* within *SystemInformationBlockType13*. Value 0 corresponds to the first entry in *mbsfn-AreaInfoList* within *SystemInformationBlockType13*, value 1 corresponds to the second entry in this list and so on.

– *MBMSInterestIndication*

The *MBMSInterestIndication* message is used to inform E-UTRAN that the UE is receiving/ interested to receive or no longer receiving/ interested to receive MBMS via an MRB.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

MBMSInterestIndication message

```
-- ASN1START

MBMSInterestIndication-r11 ::=      SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            interestIndication-r11              MBMSInterestIndication-r11-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

MBMSInterestIndication-r11-IEs ::=  SEQUENCE {
    mbms-FreqList-r11                   CarrierFreqListMBMS-r11         OPTIONAL,
    mbms-Priority-r11                   ENUMERATED {true}               OPTIONAL,
    lateNonCriticalExtension            OCTET STRING                    OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

***MBMSInterestIndication* field descriptions**
mbms-FreqList List of MBMS frequencies on which the UE is receiving or interested to receive MBMS via an MRB.
mbms-Priority Indicates whether the UE prioritises MBMS reception above unicast reception. The field is present (i.e. value *true*), if the UE prioritises reception of all listed MBMS frequencies above reception of any of the unicast bearers. Otherwise the field is absent.

– *MBSFNAreaConfiguration*

The *MBSFNAreaConfiguration* message contains the MBMS control information applicable for an MBSFN area. For each MBSFN area included in *SystemInformationBlockType13* E-UTRAN configures an MCCH (i.e. the MCCH identifies the MBSFN area) and signals the *MBSFNAreaConfiguration* message.

Signalling radio bearer: N/A

RLC-SAP: UM

Logical channel: MCCH

Direction: E-UTRAN to UE

MBSFNAreaConfiguration message

```
-- ASN1START

MBSFNAreaConfiguration-r9 ::=       SEQUENCE {
    commonSF-Alloc-r9                   CommonSF-AllocPatternList-r9,
    commonSF-AllocPeriod-r9             ENUMERATED {
                                                rf4, rf8, rf16, rf32, rf64, rf128, rf256},
    pmch-InfoList-r9                    PMCH-InfoList-r9,
    nonCriticalExtension                MBSFNAreaConfiguration-v930-IEs OPTIONAL
}

MBSFNAreaConfiguration-v930-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                MBSFNAreaConfiguration-v1250-IEs        OPTIONAL
}

MBSFNAreaConfiguration-v1250-IEs ::= SEQUENCE {
    pmch-InfoListExt-r12                PMCH-InfoListExt-r12                OPTIONAL,   -- Need OR
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

CommonSF-AllocPatternList-r9 ::=    SEQUENCE (SIZE (1..maxMBSFN-Allocations)) OF MBSFN-
SubframeConfig

-- ASN1STOP
```

***MBSFNAreaConfiguration* field descriptions**
commonSF-Alloc Indicates the subframes allocated to the MBSFN area. E-UTRAN always sets this field to cover at least the subframes configured by *SystemInformationBlockType13* for this MCCH, regardless of whether any MBMS sessions are ongoing.
commonSF-AllocPeriod Indicates the period during which resources corresponding with field *commonSF-Alloc* are divided between the (P)MCH that are configured for this MBSFN area. The subframe allocation patterns, as defined by *commonSF-Alloc*, repeat continously during this period. Value rf4 corresponds to 4 radio frames, rf8 corresponds to 8 radio frames and so on. The *commonSF-AllocPeriod* starts in the radio frames for which: SFN mod *commonSF-AllocPeriod* = 0.
pmch-InfoList EUTRAN may include *pmch-InfoListExt* even if *pmch-InfoList* does not include *maxPMCH-PerMBSFN* entries. EUTRAN configures at most *maxPMCH-PerMBSFN* entries i.e. across *pmch-InfoList* and *pmch-InfoListExt*.

– *MeasurementReport*

The *MeasurementReport* message is used for the indication of measurement results.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

MeasurementReport message

```
-- ASN1START

MeasurementReport ::=               SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            measurementReport-r8                MeasurementReport-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}
```

```
MeasurementReport-r8-IEs ::=        SEQUENCE {
    measResults                         MeasResults,
    nonCriticalExtension                MeasurementReport-v8a0-IEs                          OPTIONAL
}

MeasurementReport-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *MobilityFromEUTRACommand*

The *MobilityFromEUTRACommand* message is used to command handover or a cell change from E-UTRA to another RAT (3GPP or non-3GPP), or enhanced CS fallback to CDMA2000 1xRTT.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

MobilityFromEUTRACommand message

```
-- ASN1START

MobilityFromEUTRACommand ::=        SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            mobilityFromEUTRACommand-r8     MobilityFromEUTRACommand-r8-IEs,
            mobilityFromEUTRACommand-r9         MobilityFromEUTRACommand-r9-IEs,
            spare2 NULL, spare1     NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

MobilityFromEUTRACommand-r8-IEs ::= SEQUENCE {
    cs-FallbackIndicator                BOOLEAN,
    purpose                             CHOICE{
        handover                            Handover,
        cellChangeOrder                     CellChangeOrder
    },
    nonCriticalExtension                MobilityFromEUTRACommand-v8a0-IEs   OPTIONAL
}

MobilityFromEUTRACommand-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                MobilityFromEUTRACommand-v8d0-IEs   OPTIONAL
}

MobilityFromEUTRACommand-v8d0-IEs ::= SEQUENCE {
    bandIndicator                       BandIndicatorGERAN          OPTIONAL,   -- Cond GERAN
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

MobilityFromEUTRACommand-r9-IEs ::= SEQUENCE {
    cs-FallbackIndicator                BOOLEAN,
    purpose                             CHOICE{
        handover                            Handover,
        cellChangeOrder                     CellChangeOrder,
        e-CSFB-r9                           E-CSFB-r9,
        ...
    },
    nonCriticalExtension                MobilityFromEUTRACommand-v930-IEs   OPTIONAL
}

MobilityFromEUTRACommand-v930-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                MobilityFromEUTRACommand-v960-IEs   OPTIONAL
```

```
}

MobilityFromEUTRACommand-v960-IEs ::= SEQUENCE {
    bandIndicator                       BandIndicatorGERAN          OPTIONAL,   -- Cond GERAN
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

Handover ::=                            SEQUENCE {
    targetRAT-Type                          ENUMERATED {
                                                utra, geran, cdma2000-1XRTT, cdma2000-HRPD,
                                                spare4, spare3, spare2, spare1, ...},
    targetRAT-MessageContainer          OCTET STRING,
    nas-SecurityParamFromEUTRA          OCTET STRING (SIZE (1))     OPTIONAL,   -- Cond UTRAGERAN
    systemInformation                   SI-OrPSI-GERAN              OPTIONAL    -- Cond PSHO
}

CellChangeOrder ::=             SEQUENCE {
    t304                                ENUMERATED {
                                            ms100, ms200, ms500, ms1000,
                                            ms2000, ms4000, ms8000, spare1},
    targetRAT-Type                      CHOICE {
            geran                           SEQUENCE {
                physCellId                      PhysCellIdGERAN,
                carrierFreq                     CarrierFreqGERAN,
                networkControlOrder             BIT STRING (SIZE (2))       OPTIONAL,   -- Need OP
                systemInformation               SI-OrPSI-GERAN              OPTIONAL    -- Need OP
            },
            ...
    }
}

SI-OrPSI-GERAN ::=                  CHOICE {
    si                                  SystemInfoListGERAN,
    psi                                 SystemInfoListGERAN
}

E-CSFB-r9 ::=                           SEQUENCE {
    messageContCDMA2000-1XRTT-r9        OCTET STRING        OPTIONAL,   -- Need ON
    mobilityCDMA2000-HRPD-r9            ENUMERATED {
                                            handover, redirection
                                        }                   OPTIONAL,   -- Need OP
    messageContCDMA2000-HRPD-r9     OCTET STRING        OPTIONAL,   -- Cond concHO
    redirectCarrierCDMA2000-HRPD-r9 CarrierFreqCDMA2000 OPTIONAL    -- Cond concRedir
}

-- ASN1STOP
```

MobilityFromEUTRACommand field descriptions
bandIndicator Indicates how to interpret the ARFCN of the BCCH carrier.
carrierFreq contains the carrier frequency of the target GERAN cell.
cs-FallbackIndicator Value *true* indicates that the CS Fallback procedure to UTRAN or GERAN is triggered.
messageContCDMA2000-1XRTT This field contains a message specified in CDMA2000 1xRTT standard that either tells the UE to move to specific 1xRTT target cell(s) or indicates a failure to allocate resources for the enhanced CS fallback to CDMA2000 1xRTT.
messageContCDMA2000-HRPD This field contains a message specified in CDMA2000 HRPD standard that either tells the UE to move to specific HRPD target cell(s) or indicates a failure to allocate resources for the handover to CDMA2000 HRPD.
mobilityCDMA2000-HRPD This field indicates whether or not mobility to CDMA2000 HRPD is to be performed by the UE and it also indicates the type of mobility to CDMA2000 HRPD that is to be performed; If this field is not present the UE shall perform only the enhanced CS fallback to CDMA2000 1xRTT.
nas-SecurityParamFromEUTRA Used to deliver the key synchronisation and Key freshness for the E-UTRAN to UTRAN handovers as specified in TS 33.401. The content of the parameter is defined in TS24.301.
networkControlOrder Parameter NETWORK_CONTROL_ORDER in TS 44.060 [36].
purpose Indicates which type of mobility procedure the UE is requested to perform. EUTRAN always applies value *e-CSFB* in case of enhanced CS fallback to CDMA2000 (e.g. also when that procedure results in handover to CDMA2000 1XRTT only, in handover to CDMA2000 HRPD only or in redirection to CDMA2000 HRPD only),
redirectCarrierCDMA2000-HRPD The *redirectCarrierCDMA2000-HRPD* indicates a CDMA2000 carrier frequency and is used to redirect the UE to a HRPD carrier frequency.
SystemInfoListGERAN If *purpose* = *CellChangeOrder* and if the field is not present, the UE has to acquire SI/PSI from the GERAN cell.
t304 Timer T304 as described in section 7.3. Value ms100 corresponds with 100 ms, ms200 corresponds with 200 ms and so on.
targetRAT-Type Indicates the target RAT type.
targetRAT-MessageContainer The field contains a message specified in another standard, as indicated by the *targetRAT-Type*, and carries information about the target cell identifier(s) and radio parameters relevant for the target radio access technology. NOTE 1. A complete message is included, as specified in the other standard.

Conditional presence	Explanation
concHO	The field is mandatory present if the *mobilityCDMA2000-HRPD* is set to "*handover*"; otherwise the field is optional present, need ON.
concRedir	The field is mandatory present if the m*obilityCDMA2000-HRPD* is set to "*redirection*"; otherwise the field is not present.
GERAN	The field should be present if the *purpose* is set to "*handover*" and the *targetRAT-Type* is set to "*geran*"; otherwise the field is not present
PSHO	The field is mandatory present in case of PS handover toward GERAN; otherwise the field is optionally present, but not used by the UE
UTRAGERAN	The field is mandatory present if the *targetRAT-Type* is set to "*utra*" or "*geran*"; otherwise the field is not present

NOTE 1: The correspondence between the value of the *targetRAT-Type*, the standard to apply and the message contained within the *targetRAT-MessageContainer* is shown in the table below:

targetRAT-Type	Standard to apply	targetRAT-MessageContainer
cdma2000-1XRTT	C.S0001 or later, C.S0007 or later, C.S0008 or later	
cdma2000-HRPD	C.S0024 or later	
geran	GSM TS 04.18, version 8.5.0 or later, or 3GPP TS 44.018 (clause 9.1.15) 3GPP TS 44.060, version 6.13.0 or later (clause 11.2.43) 3GPP TS 44.060, version 7.6.0 or later (clause 11.2.46)	HANDOVER COMMAND PS HANDOVER COMMAND DTM HANDOVER COMMAND
utra	3GPP TS 25.331 (clause 10.2.16a)	HANDOVER TO UTRAN COMMAND

– *Paging*

The *Paging* message is used for the notification of one or more UEs.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: PCCH

Direction: E-UTRAN to UE

Paging message

```
-- ASN1START

Paging ::=                  SEQUENCE {
    pagingRecordList                PagingRecordList                    OPTIONAL,   -- Need ON
    systemInfoModification          ENUMERATED {true}                   OPTIONAL,   -- Need ON
    etws-Indication                 ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension            Paging-v890-IEs                     OPTIONAL
}

Paging-v890-IEs ::=         SEQUENCE {
    lateNonCriticalExtension        OCTET STRING                            OPTIONAL,
    nonCriticalExtension            Paging-v920-IEs                         OPTIONAL
}

Paging-v920-IEs ::=         SEQUENCE {
    cmas-Indication-r9              ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension                Paging-v1130-IEs                OPTIONAL
}

Paging-v1130-IEs ::=            SEQUENCE {
    eab-ParamModification-r11       ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

PagingRecordList ::=                SEQUENCE (SIZE (1..maxPageRec)) OF PagingRecord

PagingRecord ::=                    SEQUENCE {
    ue-Identity                         PagingUE-Identity,
    cn-Domain                           ENUMERATED  {ps, cs},
    ...
}

PagingUE-Identity ::=               CHOICE {
    s-TMSI                              S-TMSI,
    imsi                                IMSI,
    ...
}

IMSI ::=                            SEQUENCE (SIZE (6..21)) OF IMSI-Digit

IMSI-Digit ::=                      INTEGER (0..9)

-- ASN1STOP
```

Paging field descriptions
cmas-Indication If present: indication of a CMAS notification.
cn-Domain Indicates the origin of paging.
eab-ParamModification If present: indication of an EAB parameters (SIB14) modification.
etws-Indication If present: indication of an ETWS primary notification and/ or ETWS secondary notification.
imsi The International Mobile Subscriber Identity, a globally unique permanent subscriber identity, see TS 23.003 [27]. The first element contains the first IMSI digit, the second element contains the second IMSI digit and so on.
systemInfoModification If present: indication of a BCCH modification other than SIB10, SIB11, SIB12 and SIB14.
ue-Identity Provides the NAS identity of the UE that is being paged.

– *ProximityIndication*

The *ProximityIndication* message is used to indicate that the UE is entering or leaving the proximity of one or more CSG member cell(s).

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

***ProximityIndication* message**

```
-- ASN1START

ProximityIndication-r9 ::= SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            proximityIndication-r9              ProximityIndication-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
            },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

ProximityIndication-r9-IEs ::= SEQUENCE {
    type-r9                             ENUMERATED {entering, leaving},
    carrierFreq-r9                      CHOICE {
        eutra-r9                            ARFCN-ValueEUTRA,
        utra-r9                             ARFCN-ValueUTRA,
        ...,
        eutra2-v9e0                         ARFCN-ValueEUTRA-v9e0
    },
    nonCriticalExtension                ProximityIndication-v930-IEs
    OPTIONAL
}

ProximityIndication-v930-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

ProximityIndication field descriptions
carrierFreq Indicates the RAT and frequency of the CSG member cell(s), for which the proximity indication is sent. For E-UTRA and UTRA frequencies, the UE shall set the ARFCN according to a band it previously considered suitable for accessing (one of) the CSG member cell(s), for which the proximity indication is sent.
type Used to indicate whether the UE is entering or leaving the proximity of CSG member cell(s).

– *RNReconfiguration*

The *RNReconfiguration* is a command to modify the RN subframe configuration and/or to convey changed system information.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to RN

RNReconfiguration message

```
-- ASN1START

RNReconfiguration-r10 ::=       SEQUENCE {
    rrc-TransactionIdentifier       RRC-TransactionIdentifier,
    criticalExtensions              CHOICE {
        c1                              CHOICE {
            rnReconfiguration-r10       RNReconfiguration-r10-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture        SEQUENCE {}
    }
}

RNReconfiguration-r10-IEs ::=       SEQUENCE {
    rn-SystemInfo-r10                   RN-SystemInfo-r10           OPTIONAL,   -- Need ON
    rn-SubframeConfig-r10               RN-SubframeConfig-r10           OPTIONAL,   -- Need ON
    lateNonCriticalExtension            OCTET STRING                    OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

RN-SystemInfo-r10 ::=           SEQUENCE {
    systemInformationBlockType1-r10     OCTET STRING (CONTAINING SystemInformationBlockType1)
    OPTIONAL,   -- Need ON
    systemInformationBlockType2-r10     SystemInformationBlockType2     OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

– *RNReconfigurationComplete*

The *RNReconfigurationComplete* message is used to confirm the successful completion of an RN reconfiguration.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: RN to E-UTRAN

RNReconfigurationComplete message

```
-- ASN1START
```

```
RNReconfigurationComplete-r10 ::=       SEQUENCE {
    rrc-TransactionIdentifier               RRC-TransactionIdentifier,
    criticalExtensions                      CHOICE {
        c1                                      CHOICE{
            rnReconfigurationComplete-r10           RNReconfigurationComplete-r10-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture                SEQUENCE {}
    }
}

RNReconfigurationComplete-r10-IEs ::=   SEQUENCE {
    lateNonCriticalExtension                OCTET STRING                OPTIONAL,
    nonCriticalExtension                    SEQUENCE {}                 OPTIONAL
}

-- ASN1STOP
```

– *RRCConnectionReconfiguration*

The *RRCConnectionReconfiguration* message is the command to modify an RRC connection. It may convey information for measurement configuration, mobility control, radio resource configuration (including RBs, MAC main configuration and physical channel configuration) including any associated dedicated NAS information and security configuration.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

RRCConnectionReconfiguration message

```
-- ASN1START

RRCConnectionReconfiguration ::=    SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcConnectionReconfiguration-r8     RRCConnectionReconfiguration-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {
    measConfig                          MeasConfig                      OPTIONAL,   -- Need ON
    mobilityControlInfo                 MobilityControlInfo             OPTIONAL,   -- Cond HO
    dedicatedInfoNASList                SEQUENCE (SIZE(1..maxDRB)) OF
                                            DedicatedInfoNAS            OPTIONAL,   -- Cond nonHO
    radioResourceConfigDedicated        RadioResourceConfigDedicated    OPTIONAL, -- Cond HO-toEUTRA
    securityConfigHO                    SecurityConfigHO                OPTIONAL,   -- Cond HO
    nonCriticalExtension                RRCConnectionReconfiguration-v890-IEs   OPTIONAL
}

RRCConnectionReconfiguration-v890-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING RRCConnectionReconfiguration-v8m0-
IEs)    OPTIONAL,
    nonCriticalExtension                RRCConnectionReconfiguration-v920-IEs   OPTIONAL
}

-- Late non-critical extensions:
RRCConnectionReconfiguration-v8m0-IEs ::= SEQUENCE {
    -- Following field is only for pre REL-10 late non-critical extensions
    lateNonCriticalExtension            OCTET STRING                    OPTIONAL,
    nonCriticalExtension                RRCConnectionReconfiguration-v10i0-IEs      OPTIONAL
}
```

```
RRCConnectionReconfiguration-v10i0-IEs ::= SEQUENCE {
    antennaInfoDedicatedPCell-v10i0     AntennaInfoDedicated-v10i0          OPTIONAL,   -- Need ON
    -- Following field is only for late non-critical extensions from REL-10
    nonCriticalExtension                SEQUENCE {}             OPTIONAL
}

-- Regular non-critical extensions:
RRCConnectionReconfiguration-v920-IEs ::= SEQUENCE {
    otherConfig-r9                      OtherConfig-r9                  OPTIONAL,   -- Need ON
    fullConfig-r9                       ENUMERATED {true}               OPTIONAL,   -- Cond HO-
Reestab
    nonCriticalExtension                RRCConnectionReconfiguration-v1020-IEs  OPTIONAL
}

RRCConnectionReconfiguration-v1020-IEs ::= SEQUENCE {
    sCellToReleaseList-r10              SCellToReleaseList-r10          OPTIONAL,   -- Need ON
    sCellToAddModList-r10               SCellToAddModList-r10           OPTIONAL,   -- Need ON
    nonCriticalExtension                RRCConnectionReconfiguration-v1130-IEs  OPTIONAL
}

RRCConnectionReconfiguration-v1130-IEs ::= SEQUENCE {
    systemInfomationBlockType1Dedicated-r11 OCTET STRING (CONTAINING SystemInformationBlockType1)
                                                                        OPTIONAL,   -- Need ON
    nonCriticalExtension                RRCConnectionReconfiguration-v1250-IEs  OPTIONAL
}

RRCConnectionReconfiguration-v1250-IEs ::= SEQUENCE {
    wlan-OffloadInfo-r12            CHOICE {
        release                                 NULL,
        setup                                   SEQUENCE {
            wlan-OffloadConfigDedicated-r12     WLAN-OffloadConfig-r12,
            t350-r12                                ENUMERATED {min5, min10, min20, min30, min60,
                                                     min120, min180, spare1}    OPTIONAL    -- Need OR
        }
    }                                                                   OPTIONAL,       -- Need ON
    scg-Configuration-r12               SCG-Configuration-r12       OPTIONAL,   -- Cond
nonFullConfig
    sl-SyncTxControl-r12                SL-SyncTxControl-r12            OPTIONAL,   -- Need ON
    sl-DiscConfig-r12                   SL-DiscConfig-r12               OPTIONAL,   -- Need ON
    sl-CommConfig-r12                   SL-CommConfig-r12               OPTIONAL,   -- Need ON
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

SL-SyncTxControl-r12 ::=            SEQUENCE {
    networkControlledSyncTx-r12             ENUMERATED {on, off}        OPTIONAL        -- Need OP
}

PSCellToAddMod-r12 ::=              SEQUENCE {
    sCellIndex-r12                      SCellIndex-r10,
    cellIdentification-r12              SEQUENCE {
        physCellId-r12                      PhysCellId,
        dl-CarrierFreq-r12                  ARFCN-ValueEUTRA-r9
    }                                                                   OPTIONAL,   -- Cond SCellAdd
    radioResourceConfigCommonPSCell-r12     RadioResourceConfigCommonPSCell-r12 OPTIONAL,   -- Cond
SCellAdd
    radioResourceConfigDedicatedPSCell-r12  RadioResourceConfigDedicatedPSCell-r12  OPTIONAL,   --
Cond SCellAdd2
    ...,
    [[  antennaInfoDedicatedPSCell-v1280        AntennaInfoDedicated-v10i0  OPTIONAL    -- Need ON
    ]]
}

PowerCoordinationInfo-r12 ::= SEQUENCE {
    p-MeNB-r12                          INTEGER (1..16),
    p-SeNB-r12                          INTEGER (1..16),
    powerControlMode-r12                INTEGER (1..2)
}

SCellToAddModList-r10 ::=       SEQUENCE (SIZE (1..maxSCell-r10)) OF SCellToAddMod-r10

SCellToAddMod-r10 ::=           SEQUENCE {
    sCellIndex-r10                      SCellIndex-r10,
    cellIdentification-r10              SEQUENCE {
        physCellId-r10                      PhysCellId,
        dl-CarrierFreq-r10                  ARFCN-ValueEUTRA
    }                                                               OPTIONAL,   -- Cond SCellAdd
    radioResourceConfigCommonSCell-r10      RadioResourceConfigCommonSCell-r10  OPTIONAL,   -- Cond
SCellAdd
```

```
    radioResourceConfigDedicatedSCell-r10   RadioResourceConfigDedicatedSCell-r10   OPTIONAL,   --
Cond SCellAdd2
    ...,
    [[  dl-CarrierFreq-v1090                ARFCN-ValueEUTRA-v9e0   OPTIONAL    -- Cond EARFCN-max
    ]],
    [[  antennaInfoDedicatedSCell-v10i0     AntennaInfoDedicated-v10i0  OPTIONAL    -- Need ON
    ]]
}

SCellToReleaseList-r10 ::=          SEQUENCE (SIZE (1..maxSCell-r10)) OF SCellIndex-r10

SCG-Configuration-r12 ::=           CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        scg-ConfigPartMCG-r12               SEQUENCE {
            scg-Counter-r12                     INTEGER (0.. 65535)         OPTIONAL,   -- Need ON
            powerCoordinationInfo-r12           PowerCoordinationInfo-r12   OPTIONAL,   -- Need ON
            ...
        }                                                                   OPTIONAL,   -- Need ON
        scg-ConfigPartSCG-r12               SCG-ConfigPartSCG-r12       OPTIONAL    -- Need ON
    }
}

SCG-ConfigPartSCG-r12 ::=           SEQUENCE {
    radioResourceConfigDedicatedSCG-r12 RadioResourceConfigDedicatedSCG-r12 OPTIONAL,   -- Need ON
    sCellToReleaseListSCG-r12           SCellToReleaseList-r10      OPTIONAL,   -- Need ON
    pSCellToAddMod-r12                  PSCellToAddMod-r12          OPTIONAL,   -- Need ON
    sCellToAddModListSCG-r12            SCellToAddModList-r10       OPTIONAL,   -- Need ON
    mobilityControlInfoSCG-r12          MobilityControlInfoSCG-r12  OPTIONAL,   -- Need ON
    ...
}

SecurityConfigHO ::=                SEQUENCE {
    handoverType                        CHOICE {
        intraLTE                            SEQUENCE {
            securityAlgorithmConfig             SecurityAlgorithmConfig     OPTIONAL,   -- Cond
fullConfig
            keyChangeIndicator                  BOOLEAN,
            nextHopChainingCount                NextHopChainingCount
        },
        interRAT                            SEQUENCE {
            securityAlgorithmConfig             SecurityAlgorithmConfig,
            nas-SecurityParamToEUTRA            OCTET STRING (SIZE(6))
        }
    },
    ...
}


-- ASN1STOP
```

RRCConnectionReconfiguration field descriptions
dedicatedInfoNASList This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for each PDU in the list.
fullConfig Indicates the full configuration option is applicable for the RRC Connection Reconfiguration message.
keyChangeIndicator true is used only in an intra-cell handover when a K_{eNB} key is derived from a K_{ASME} key taken into use through the latest successful NAS SMC procedure, as described in TS 33.401 [32] for K_{eNB} re-keying. false is used in an intra-LTE handover when the new K_{eNB} key is obtained from the current K_{eNB} key or from the NH as described in TS 33.401 [32].
nas-securityParamToEUTRA This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for this field, although it affects activation of AS- security after inter-RAT handover to E-UTRA. The content is defined in TS 24.301.
networkControlledSyncTx This field indicates whether the UE shall transmit synchronisation information (i.e. become synchronisation source). Value *On* indicates the UE to transmit synchronisation information while value *Off* indicates the UE to not transmit such information.
nextHopChainingCount Parameter NCC: See TS 33.401 [32]
p-MeNB Indicates the guaranteed power for the MeNB, as specified in 36.213 [23].
powerControlMode Indicates the power control mode used in DC. Value 1 corresponds to DC power control mode 1 and value 2 indicates DC power control mode 2, as specified in 36.213 [23].
p-SeNB Indicates the guaranteed power for the SeNB as specified in 36.213 [23, Table 5.1.4.2-1].
sCellIndex In case of DC, the SCellIndex is unique within the scope of the UE i.e. an SCG cell can not use the same value as used for an MCG cell.
sCellToAddModListSCG Indicates the SCG cell to be added or modified. The field is used for SCG cells other than the PSCell (which is added/ modified by field *pSCellToAddMod*).
sCellToReleaseListSCG Indicates the SCG cell to be released. The field is also used to release the PSCell e.g. upon change of PSCell, upon system information change for the PSCell.
scg-Counter A counter used upon initial configuration of SCG security as well as upon refresh of S-K_{eNB}. E-UTRAN includes the field upon SCG change when one or more SCG DRBs are configured. Otherwise E-UTRAN does not include the field.
t350 Timer T350 as described in section 7.3. Value *minN* corresponds to N minutes.

Conditional presence	Explanation
EARFCN-max	The field is mandatory present if *dl-CarrierFreq-r10* is included and set to *maxEARFCN*. Otherwise the field is not present.
fullConfig	This field is mandatory present for handover within E-UTRA when the *fullConfig* is included; otherwise it is optionally present, Need OP.
HO	The field is mandatory present in case of handover within E-UTRA or to E-UTRA; otherwise the field is not present.
HO-Reestab	This field is optionally present, need ON, in case of handover within E-UTRA or upon the first reconfiguration after RRC connection re-establishment; otherwise the field is not present.
HO-toEUTRA	The field is mandatory present in case of handover to E-UTRA or for reconfigurations when *fullConfig* is included; otherwise the field is optionally present, need ON.
nonFullConfig	The field is not present in case of handover within E-UTRA when the *fullConfig* is included or in case of handover to E-UTRA; otherwise it is optional present, need ON.
nonHO	The field is not present in case of handover within E-UTRA or to E-UTRA; otherwise it is optional present, need ON.
SCellAdd	The field is mandatory present upon SCell addition; otherwise it is not present.
SCellAdd2	The field is mandatory present upon SCell addition; otherwise it is optionally present, need ON.

– *RRCConnectionReconfigurationComplete*

The *RRCConnectionReconfigurationComplete* message is used to confirm the successful completion of an RRC connection reconfiguration.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

RRCConnectionReconfigurationComplete message

```
-- ASN1START

RRCConnectionReconfigurationComplete ::= SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        rrcConnectionReconfigurationComplete-r8
                                            RRCConnectionReconfigurationComplete-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReconfigurationComplete-r8-IEs ::= SEQUENCE {
    nonCriticalExtension                RRCConnectionReconfigurationComplete-v8a0-IEs   OPTIONAL
}

RRCConnectionReconfigurationComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                RRCConnectionReconfigurationComplete-v1020-IEs  OPTIONAL
}

RRCConnectionReconfigurationComplete-v1020-IEs ::= SEQUENCE {
    rlf-InfoAvailable-r10               ENUMERATED {true}               OPTIONAL,
    logMeasAvailable-r10                ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionReconfigurationComplete-v1130-IEs  OPTIONAL
}

RRCConnectionReconfigurationComplete-v1130-IEs ::= SEQUENCE {
    connEstFailInfoAvailable-r11        ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionReconfigurationComplete-v1250-IEs  OPTIONAL
}

RRCConnectionReconfigurationComplete-v1250-IEs ::= SEQUENCE {
    logMeasAvailableMBSFN-r12           ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

– *RRCConnectionReestablishment*

The *RRCConnectionReestablishment* message is used to re-establish SRB1.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: E-UTRAN to UE

RRCConnectionReestablishment message

```
-- ASN1START

RRCConnectionReestablishment ::=    SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
```

```
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcConnectionReestablishment-r8     RRCConnectionReestablishment-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4    NULL,
            spare3 NULL, spare2 NULL, spare1    NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReestablishment-r8-IEs ::= SEQUENCE {
    radioResourceConfigDedicated        RadioResourceConfigDedicated,
    nextHopChainingCount                NextHopChainingCount,
    nonCriticalExtension                RRCConnectionReestablishment-v8a0-IEs   OPTIONAL
}

RRCConnectionReestablishment-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *RRCConnectionReestablishmentComplete*

The *RRCConnectionReestablishmentComplete* message is used to confirm the successful completion of an RRC connection reestablishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

RRCConnectionReestablishmentComplete message

```
-- ASN1START

RRCConnectionReestablishmentComplete ::= SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        rrcConnectionReestablishmentComplete-r8
                                            RRCConnectionReestablishmentComplete-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReestablishmentComplete-r8-IEs ::= SEQUENCE {
    nonCriticalExtension                RRCConnectionReestablishmentComplete-v920-IEs   OPTIONAL
}

RRCConnectionReestablishmentComplete-v920-IEs ::= SEQUENCE {
    rlf-InfoAvailable-r9                ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionReestablishmentComplete-v8a0-IEs   OPTIONAL
}

RRCConnectionReestablishmentComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                RRCConnectionReestablishmentComplete-v1020-IEs  OPTIONAL
}

RRCConnectionReestablishmentComplete-v1020-IEs ::= SEQUENCE {
    logMeasAvailable-r10                ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionReestablishmentComplete-v1130-IEs  OPTIONAL
}

RRCConnectionReestablishmentComplete-v1130-IEs ::= SEQUENCE {
    connEstFailInfoAvailable-r11        ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionReestablishmentComplete-v1250-IEs  OPTIONAL
}
```

```
RRCConnectionReestablishmentComplete-v1250-IEs ::= SEQUENCE {
    logMeasAvailableMBSFN-r12           ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

***RRCConnectionReestablishmentComplete* field descriptions**
rlf-InfoAvailable
This field is used to indicate the availability of radio link failure or handover failure related measurements

– *RRCConnectionReestablishmentReject*

The *RRCConnectionReestablishmentReject* message is used to indicate the rejection of an RRC connection reestablishment request.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: E-UTRAN to UE

RRCConnectionReestablishmentReject message

```
-- ASN1START

RRCConnectionReestablishmentReject ::= SEQUENCE {
    criticalExtensions                  CHOICE {
        rrcConnectionReestablishmentReject-r8
                                            RRCConnectionReestablishmentReject-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReestablishmentReject-r8-IEs ::= SEQUENCE {
    nonCriticalExtension                RRCConnectionReestablishmentReject-v8a0-IEs OPTIONAL
}

RRCConnectionReestablishmentReject-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *RRCConnectionReestablishmentRequest*

The *RRCConnectionReestablishmentRequest* message is used to request the reestablishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to E-UTRAN

RRCConnectionReestablishmentRequest message

```
-- ASN1START

RRCConnectionReestablishmentRequest ::= SEQUENCE {
    criticalExtensions                  CHOICE {
        rrcConnectionReestablishmentRequest-r8
                                            RRCConnectionReestablishmentRequest-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
```

```
    }
}

RRCConnectionReestablishmentRequest-r8-IEs ::= SEQUENCE {
    ue-Identity                         ReestabUE-Identity,
    reestablishmentCause                ReestablishmentCause,
    spare                               BIT STRING (SIZE (2))
}

ReestabUE-Identity ::=              SEQUENCE {
    c-RNTI                              C-RNTI,
    physCellId                          PhysCellId,
    shortMAC-I                          ShortMAC-I
}

ReestablishmentCause ::=            ENUMERATED {
                                        reconfigurationFailure, handoverFailure,
                                        otherFailure, spare1}

-- ASN1STOP
```

***RRCConnectionReestablishmentRequest* field descriptions**
physCellId The Physical Cell Identity of the PCell the UE was connected to prior to the failure.
reestablishmentCause Indicates the failure cause that triggered the re-establishment procedure.
ue-Identity UE identity included to retrieve UE context and to facilitate contention resolution by lower layers.

– *RRCConnectionReject*

The *RRCConnectionReject* message is used to reject the RRC connection establishment.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: E-UTRAN to UE

RRCConnectionReject message

```
-- ASN1START

RRCConnectionReject ::=             SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            rrcConnectionReject-r8              RRCConnectionReject-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReject-r8-IEs ::=      SEQUENCE {
    waitTime                            INTEGER (1..16),
    nonCriticalExtension                RRCConnectionReject-v8a0-IEs        OPTIONAL
}

RRCConnectionReject-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                RRCConnectionReject-v1020-IEs       OPTIONAL
}

RRCConnectionReject-v1020-IEs ::=   SEQUENCE {
    extendedWaitTime-r10                INTEGER (1..1800)                   OPTIONAL,   -- Need ON
    nonCriticalExtension                RRCConnectionReject-v1130-IEs       OPTIONAL
}

RRCConnectionReject-v1130-IEs ::=   SEQUENCE {
```

```
    deprioritisationReq-r11             SEQUENCE {
        deprioritisationType-r11            ENUMERATED {frequency, e-utra},
        deprioritisationTimer-r11           ENUMERATED {min5, min10, min15, min30}
    }                                                                   OPTIONAL,   -- Need ON
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

***RRCConnectionReject* field descriptions**
deprioritisationReq   Indicates whether the current frequency or RAT is to be de-prioritised. The UE shall be able to store a depriotisation request for up to 8 frequencies (applicable when receiving another frequency specific deprioritisation request before T325 expiry).
deprioritisationTimer   Indicates the period for which either the current carrier frequency or E-UTRA is deprioritised. Value *minN* corresponds to N minutes.
extendedWaitTime   Value in seconds for the wait time for Delay Tolerant access requests.
waitTime   Wait time value in seconds.

– *RRCConnectionRelease*

The *RRCConnectionRelease* message is used to command the release of an RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

RRCConnectionRelease message

```
-- ASN1START

RRCConnectionRelease ::=            SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            rrcConnectionRelease-r8             RRCConnectionRelease-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionRelease-r8-IEs ::=     SEQUENCE {
    releaseCause                        ReleaseCause,
    redirectedCarrierInfo               RedirectedCarrierInfo               OPTIONAL,   -- Need ON
    idleModeMobilityControlInfo         IdleModeMobilityControlInfo         OPTIONAL,   -- Need OP
    nonCriticalExtension                RRCConnectionRelease-v890-IEs       OPTIONAL
}

RRCConnectionRelease-v890-IEs ::=   SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING RRCConnectionRelease-v9e0-IEs)
    OPTIONAL,
    nonCriticalExtension                RRCConnectionRelease-v920-IEs       OPTIONAL
}

-- Late non critical extensions
RRCConnectionRelease-v9e0-IEs ::= SEQUENCE {
    redirectedCarrierInfo-v9e0          RedirectedCarrierInfo-v9e0          OPTIONAL,   -- Cond
NoRedirect-r8
    idleModeMobilityControlInfo-v9e0    IdleModeMobilityControlInfo-v9e0    OPTIONAL,   -- Cond
IdleInfoEUTRA
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}
```

```
-- Regular non critical extensions
RRCConnectionRelease-v920-IEs ::=   SEQUENCE {
    cellInfoList-r9                     CHOICE {
        geran-r9                            CellInfoListGERAN-r9,
        utra-FDD-r9                         CellInfoListUTRA-FDD-r9,
        utra-TDD-r9                         CellInfoListUTRA-TDD-r9,
        ...,
        utra-TDD-r10                        CellInfoListUTRA-TDD-r10
    }                                                       OPTIONAL,   -- Cond Redirection
    nonCriticalExtension                RRCConnectionRelease-v1020-IEs      OPTIONAL
}

RRCConnectionRelease-v1020-IEs ::=  SEQUENCE {
    extendedWaitTime-r10                INTEGER (1..1800)       OPTIONAL,   -- Need ON
    nonCriticalExtension                SEQUENCE {}             OPTIONAL
}

ReleaseCause ::=                ENUMERATED {loadBalancingTAUrequired,
                                            other, cs-FallbackHighPriority-v1020, spare1}

RedirectedCarrierInfo ::=           CHOICE {
    eutra                               ARFCN-ValueEUTRA,
    geran                               CarrierFreqsGERAN,
    utra-FDD                            ARFCN-ValueUTRA,
    utra-TDD                            ARFCN-ValueUTRA,
    cdma2000-HRPD                       CarrierFreqCDMA2000,
    cdma2000-1xRTT                      CarrierFreqCDMA2000,
    ...,
    utra-TDD-r10                        CarrierFreqListUTRA-TDD-r10
}

RedirectedCarrierInfo-v9e0 ::=          SEQUENCE {
    eutra-v9e0                          ARFCN-ValueEUTRA-v9e0
}

CarrierFreqListUTRA-TDD-r10 ::=         SEQUENCE (SIZE (1..maxFreqUTRA-TDD-r10)) OF ARFCN-ValueUTRA

IdleModeMobilityControlInfo ::=     SEQUENCE {
    freqPriorityListEUTRA               FreqPriorityListEUTRA           OPTIONAL,       -- Need ON
    freqPriorityListGERAN               FreqsPriorityListGERAN          OPTIONAL,       -- Need ON
    freqPriorityListUTRA-FDD            FreqPriorityListUTRA-FDD        OPTIONAL,       -- Need ON
    freqPriorityListUTRA-TDD            FreqPriorityListUTRA-TDD        OPTIONAL,       -- Need ON
    bandClassPriorityListHRPD           BandClassPriorityListHRPD       OPTIONAL,       -- Need ON
    bandClassPriorityList1XRTT          BandClassPriorityList1XRTT      OPTIONAL,       -- Need ON
    t320                                ENUMERATED {
                                            min5, min10, min20, min30, min60, min120, min180,
                                            spare1}                     OPTIONAL,       -- Need OR
    ...,
    [[  freqPriorityListExtEUTRA-r12        FreqPriorityListExtEUTRA-r12        OPTIONAL        --
Need ON
    ]]
}

IdleModeMobilityControlInfo-v9e0 ::=    SEQUENCE {
    freqPriorityListEUTRA-v9e0          SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityEUTRA-v9e0
}

FreqPriorityListEUTRA ::=           SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityEUTRA

FreqPriorityListExtEUTRA-r12 ::=        SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityEUTRA-r12

FreqPriorityEUTRA ::=               SEQUENCE {
    carrierFreq                         ARFCN-ValueEUTRA,
    cellReselectionPriority             CellReselectionPriority
}

FreqPriorityEUTRA-v9e0 ::=          SEQUENCE {
    carrierFreq-v9e0                    ARFCN-ValueEUTRA-v9e0       OPTIONAL    -- Cond EARFCN-max
}

FreqPriorityEUTRA-r12 ::=               SEQUENCE {
    carrierFreq-r12                     ARFCN-ValueEUTRA-r9,
    cellReselectionPriority-r12         CellReselectionPriority
}

FreqsPriorityListGERAN ::=          SEQUENCE (SIZE (1..maxGNFG)) OF FreqsPriorityGERAN

FreqsPriorityGERAN ::=              SEQUENCE {
```

```
    carrierFreqs                        CarrierFreqsGERAN,
    cellReselectionPriority             CellReselectionPriority
}

FreqPriorityListUTRA-FDD ::=        SEQUENCE (SIZE (1..maxUTRA-FDD-Carrier)) OF FreqPriorityUTRA-FDD

FreqPriorityUTRA-FDD ::=            SEQUENCE {
    carrierFreq                         ARFCN-ValueUTRA,
    cellReselectionPriority             CellReselectionPriority
}

FreqPriorityListUTRA-TDD ::=        SEQUENCE (SIZE (1..maxUTRA-TDD-Carrier)) OF FreqPriorityUTRA-TDD

FreqPriorityUTRA-TDD ::=            SEQUENCE {
    carrierFreq                         ARFCN-ValueUTRA,
    cellReselectionPriority             CellReselectionPriority
}

BandClassPriorityListHRPD ::=       SEQUENCE (SIZE (1..maxCDMA-BandClass)) OF BandClassPriorityHRPD

BandClassPriorityHRPD ::=           SEQUENCE {
    bandClass                           BandclassCDMA2000,
    cellReselectionPriority             CellReselectionPriority
}

BandClassPriorityList1XRTT ::=  SEQUENCE (SIZE (1..maxCDMA-BandClass)) OF BandClassPriority1XRTT

BandClassPriority1XRTT ::=          SEQUENCE {
    bandClass                           BandclassCDMA2000,
    cellReselectionPriority             CellReselectionPriority
}

CellInfoListGERAN-r9 ::=        SEQUENCE (SIZE (1..maxCellInfoGERAN-r9)) OF CellInfoGERAN-r9

CellInfoGERAN-r9 ::=                SEQUENCE {
    physCellId-r9                       PhysCellIdGERAN,
    carrierFreq-r9                      CarrierFreqGERAN,
    systemInformation-r9                SystemInfoListGERAN
}

CellInfoListUTRA-FDD-r9 ::=         SEQUENCE (SIZE (1..maxCellInfoUTRA-r9)) OF CellInfoUTRA-FDD-r9

CellInfoUTRA-FDD-r9 ::=             SEQUENCE {
    physCellId-r9                       PhysCellIdUTRA-FDD,
    utra-BCCH-Container-r9              OCTET STRING
}

CellInfoListUTRA-TDD-r9 ::=         SEQUENCE (SIZE (1..maxCellInfoUTRA-r9)) OF CellInfoUTRA-TDD-r9

CellInfoUTRA-TDD-r9 ::=             SEQUENCE {
    physCellId-r9                       PhysCellIdUTRA-TDD,
    utra-BCCH-Container-r9              OCTET STRING
}

CellInfoListUTRA-TDD-r10 ::=        SEQUENCE (SIZE (1..maxCellInfoUTRA-r9)) OF CellInfoUTRA-TDD-r10

CellInfoUTRA-TDD-r10 ::=            SEQUENCE {
    physCellId-r10                      PhysCellIdUTRA-TDD,
    carrierFreq-r10                     ARFCN-ValueUTRA,
    utra-BCCH-Container-r10             OCTET STRING
}

-- ASN1STOP
```

RRCConnectionRelease field descriptions
carrierFreq or bandClass The carrier frequency (UTRA and E-UTRA) and band class (HRPD and 1xRTT) for which the associated cellReselectionPriority is applied.
carrierFreqs The list of GERAN carrier frequencies organised into one group of GERAN carrier frequencies.
cellInfoList Used to provide system information of one or more cells on the redirected inter-RAT carrier frequency. The system information can be used if, upon redirection, the UE selects an inter-RAT cell indicated by the *physCellId* and *carrierFreq* (GERAN and UTRA TDD) or by the *physCellId* (other RATs). The choice shall match the *redirectedCarrierInfo*. In particular, E-UTRAN only applies value *utra-TDD-r10* in case *redirectedCarrierInfo* is set to *utra-TDD-r10*.
extendedWaitTime Value in seconds for the wait time for Delay Tolerant access requests.
freqPriorityListX Provides a cell reselection priority for each frequency, by means of separate lists for each RAT (including E-UTRA). The UE shall be able to store at least 3 occurrences of *FreqsPriorityGERAN*. If E-UTRAN includes *freqPriorityListEUTRA-v9e0* it includes the same number of entries, and listed in the same order, as in *freqPriorityListEUTRA* (i.e. without suffix). Field *freqPriorityListExt* includes additional neighbouring inter-frequencies, i.e. extending the size of the inter-frequency carrier list using the general principles specified in 5.1.2. EUTRAN only includes *freqPriorityListExtEUTRA* if *freqPriorityListEUTRA* (i.e without suffix) includes *maxFreq* entries.
idleModeMobilityControlInfo Provides dedicated cell reselection priorities. Used for cell reselection as specified in TS 36.304 [4]. For E-UTRA and UTRA frequencies, a UE that supports multi-band cells for the concerned RAT considers the dedicated priorities to be common for all overlapping bands (i.e. regardless of the ARFCN that is used).
redirectedCarrierInfo The r*edirectedCarrierInfo* indicates a carrier frequency (downlink for FDD) and is used to redirect the UE to an E-UTRA or an inter-RAT carrier frequency, by means of the cell selection upon leaving RRC_CONNECTED as specified in TS 36.304 [4].
releaseCause The *releaseCause* is used to indicate the reason for releasing the RRC Connection. The cause value *cs-FallbackHighPriority* is only applicable when *redirectedCarrierInfo* is present with the value set to *utra-FDD, utra-TDD* or *utra-TDD-r10*. E-UTRAN should not set the *releaseCause* to *loadBalancingTAURequired* or to *cs-FallbackHighPriority* if the *extendedWaitTime* is present.
systemInformation Container for system information of the GERAN cell i.e. one or more System Information (SI) messages as defined in TS 44.018 [45, table 9.1.1].
t320 Timer T320 as described in section 7.3. Value minN corresponds to N minutes.
utra-BCCH-Container Contains System Information Container message as defined in TS 25.331 [19].

Conditional presence	Explanation
EARFCN-max	The field is mandatory present if the corresponding *carrierFreq* (i.e. without suffix) is set to *maxEARFCN*. Otherwise the field is not present.
IdleInfoEUTRA	The field is optionally present, need OP, if the *IdleModeMobilityControlInfo* (i.e. without suffix) is included and includes *freqPriorityListEUTRA*; otherwise the field is not present.
NoRedirect-r8	The field is optionally present, need OP, if the *redirectedCarrierInfo* (i.e. without suffix) is not included; otherwise the field is not present.
Redirection	The field is optionally present, need ON, if the *redirectedCarrierInfo* is included and set to *geran*, *utra-FDD*, *utra-TDD* or *utra-TDD-r10*; otherwise the field is not present.

– *RRCConnectionRequest*

The *RRCConnectionRequest* message is used to request the establishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to E-UTRAN

RRCConnectionRequest message

```
-- ASN1START

RRCConnectionRequest ::=            SEQUENCE {
    criticalExtensions                  CHOICE {
        rrcConnectionRequest-r8             RRCConnectionRequest-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionRequest-r8-IEs ::=     SEQUENCE {
    ue-Identity                         InitialUE-Identity,
    establishmentCause                  EstablishmentCause,
    spare                               BIT STRING (SIZE (1))
}

InitialUE-Identity ::=              CHOICE {
    s-TMSI                              S-TMSI,
    randomValue                         BIT STRING (SIZE (40))
}

EstablishmentCause ::=              ENUMERATED {
                                        emergency, highPriorityAccess, mt-Access, mo-Signalling,
                                        mo-Data, delayTolerantAccess-v1020, mo-VoiceCall-v1280,
spare1}

-- ASN1STOP
```

***RRCConnectionRequest* field descriptions**
establishmentCause Provides the establishment cause for the RRC connection request as provided by the upper layers. W.r.t. the cause value names: highPriorityAccess concerns AC11..AC15, 'mt' stands for 'Mobile Terminating' and 'mo' for 'Mobile Originating.
randomValue Integer value in the range 0 to $2^{40} - 1$.
ue-Identity UE identity included to facilitate contention resolution by lower layers.

– *RRCConnectionSetup*

The *RRCConnectionSetup* message is used to establish SRB1.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: E-UTRAN to UE

RRCConnectionSetup message

```
-- ASN1START

RRCConnectionSetup ::=              SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            rrcConnectionSetup-r8               RRCConnectionSetup-r8-IEs,
            spare7 NULL,
```

```
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionSetup-r8-IEs ::=       SEQUENCE {
    radioResourceConfigDedicated        RadioResourceConfigDedicated,
    nonCriticalExtension                RRCConnectionSetup-v8a0-IEs         OPTIONAL
}

RRCConnectionSetup-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *RRCConnectionSetupComplete*

The *RRCConnectionSetupComplete* message is used to confirm the successful completion of an RRC connection establishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

RRCConnectionSetupComplete message

```
-- ASN1START

RRCConnectionSetupComplete ::=      SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcConnectionSetupComplete-r8       RRCConnectionSetupComplete-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionSetupComplete-r8-IEs ::= SEQUENCE {
    selectedPLMN-Identity               INTEGER (1..maxPLMN-r11),
    registeredMME                       RegisteredMME                       OPTIONAL,
    dedicatedInfoNAS                    DedicatedInfoNAS,
    nonCriticalExtension                RRCConnectionSetupComplete-v8a0-IEs OPTIONAL
}

RRCConnectionSetupComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                RRCConnectionSetupComplete-v1020-IEs    OPTIONAL
}

RRCConnectionSetupComplete-v1020-IEs ::= SEQUENCE {
    gummei-Type-r10                     ENUMERATED {native, mapped}         OPTIONAL,
    rlf-InfoAvailable-r10               ENUMERATED {true}                   OPTIONAL,
    logMeasAvailable-r10                ENUMERATED {true}                   OPTIONAL,
    rn-SubframeConfigReq-r10            ENUMERATED {required, notRequired}  OPTIONAL,
    nonCriticalExtension                RRCConnectionSetupComplete-v1130-IEs    OPTIONAL
}

RRCConnectionSetupComplete-v1130-IEs ::= SEQUENCE {
    connEstFailInfoAvailable-r11        ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                RRCConnectionSetupComplete-v1250-IEs        OPTIONAL
}

RRCConnectionSetupComplete-v1250-IEs ::= SEQUENCE {
    mobilityState-r12                   ENUMERATED {normal, medium, high, spare}    OPTIONAL,
```

```
    mobilityHistoryAvail-r12            ENUMERATED {true}               OPTIONAL,
    logMeasAvailableMBSFN-r12           ENUMERATED {true}               OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

RegisteredMME ::=                   SEQUENCE {
    plmn-Identity                       PLMN-Identity                       OPTIONAL,
    mmegi                               BIT STRING (SIZE (16)),
    mmec                                MMEC
}

-- ASN1STOP
```

***RRCConnectionSetupComplete* field descriptions**
gummei-Type This field is used to indicate whether the GUMMEI included is native (assigned by EPC) or mapped (from 2G/3G identifiers).
mmegi Provides the Group Identity of the registered MME within the PLMN, as provided by upper layers, see TS 23.003 [27].
mobilityState This field indicates the UE mobility state (as defined in TS 36.304 [4, 5.2.4.3]) just prior to UE going into RRC_CONNECTED state. The UE indicates the value of *medium* and *high* when being in Medium-mobility and High-mobility states respectively. Otherwise the UE indicates the value *normal*.
registeredMME This field is used to transfer the GUMMEI of the MME where the UE is registered, as provided by upper layers.
rn-SubframeConfigReq If present, this field indicates that the connection establishment is for an RN and whether a subframe configuration is requested or not.
selectedPLMN-Identity Index of the PLMN selected by the UE from the *plmn-IdentityList* included in SIB1. 1 if the 1st PLMN is selected from the *plmn-IdentityList* included in SIB1, 2 if the 2nd PLMN is selected from the *plmn-IdentityList* included in SIB1 and so on.

– *SCGFailureInformation*

The *SCGFailureInformation* message is used to provide information regarding failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

SCGFailureInformation message

```
-- ASN1START

SCGFailureInformation-r12 ::=       SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            scgFailureInformation-r12           SCGFailureInformation-r12-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SCGFailureInformation-r12-IEs ::=   SEQUENCE {
    failureReportSCG-r12                FailureReportSCG-r12            OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

FailureReportSCG-r12 ::=            SEQUENCE {
    failureType-r12                     ENUMERATED {t313-Expiry, randomAccessProblem,
                                                rlc-MaxNumRetx, scg-ChangeFailure },
    measResultServFreqList-r12          MeasResultServFreqList-r10      OPTIONAL,
    measResultNeighCells-r12            MeasResultList2EUTRA-r9         OPTIONAL,
    ...
```

```
}

-- ASN1STOP
```

– SecurityModeCommand

The *SecurityModeCommand* message is used to command the activation of AS security.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

SecurityModeCommand message

```
-- ASN1START

SecurityModeCommand ::=             SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            securityModeCommand-r8              SecurityModeCommand-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SecurityModeCommand-r8-IEs ::=      SEQUENCE {
    securityConfigSMC                   SecurityConfigSMC,
    nonCriticalExtension                SecurityModeCommand-v8a0-IEs        OPTIONAL
}

SecurityModeCommand-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

SecurityConfigSMC ::=                   SEQUENCE {
    securityAlgorithmConfig             SecurityAlgorithmConfig,
    ...
}

-- ASN1STOP
```

– SecurityModeComplete

The *SecurityModeComplete* message is used to confirm the successful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

SecurityModeComplete message

```
-- ASN1START

SecurityModeComplete ::=            SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        securityModeComplete-r8             SecurityModeComplete-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
```

```
}

SecurityModeComplete-r8-IEs ::=     SEQUENCE {
    nonCriticalExtension                SecurityModeComplete-v8a0-IEs
    OPTIONAL
}

SecurityModeComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *SecurityModeFailure*

The *SecurityModeFailure* message is used to indicate an unsuccessful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

SecurityModeFailure message

```
-- ASN1START

SecurityModeFailure ::=             SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        securityModeFailure-r8              SecurityModeFailure-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SecurityModeFailure-r8-IEs ::=      SEQUENCE {
    nonCriticalExtension                SecurityModeFailure-v8a0-IEs
    OPTIONAL
}

SecurityModeFailure-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *SidelinkUEInformation*

The *SidelinkUEInformation* message is used for the indication of sidelink information to the eNB.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

SidelinkUEInformation message

```
-- ASN1START

SidelinkUEInformation-r12 ::=       SEQUENCE {
    criticalExtensions              CHOICE {
        c1                              CHOICE {
            sidelinkUEInformation-r12       SidelinkUEInformation-r12-IEs,
```

```
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SidelinkUEInformation-r12-IEs ::=   SEQUENCE {
    commRxInterestedFreq-r12        ARFCN-ValueEUTRA-r9         OPTIONAL,
    commTxResourceReq-r12           SL-CommTxResourceReq-r12    OPTIONAL,
    discRxInterest-r12              ENUMERATED {true}           OPTIONAL,
    discTxResourceReq-r12           INTEGER (1..63)             OPTIONAL,
    lateNonCriticalExtension        OCTET STRING                OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                 OPTIONAL
}

SL-CommTxResourceReq-r12 ::=        SEQUENCE {
    carrierFreq-r12                 ARFCN-ValueEUTRA-r9         OPTIONAL,
    destinationInfoList-r12         SL-DestinationInfoList-r12
}

SL-DestinationInfoList-r12 ::=  SEQUENCE (SIZE (1..maxSL-Dest-r12)) OF SL-DestinationIdentity-r12

SL-DestinationIdentity-r12 ::=  BIT STRING (SIZE (24))

-- ASN1STOP
```

***SidelinkUEInformation* field descriptions**
commRxInterestedFreq Indicates the frequency on which the UE is interested to receive sidelink communication.
commTxResourceReq Indicates the frequency on which the UE is interested to transmit sidelink communication as well as the sidelink communication transmission destination(s) for which the UE requests E-UTRAN to assign dedicated resources.
destinationInfoList Indicates the destination which is identified by the ProSe Layer-2 Group ID as specified in TS 23.303 [68].
discRxInterest Indicates that the UE is interested to monitor sidelink discovery announcements.
discTxResourceReq Indicates the number of separate discovery message(s) the UE wants to transmit every discovery period. This field concerns the resources the UE requires every discovery period for transmitting sidelink discovery announcement(s).

– *SystemInformation*

The *SystemInformation* message is used to convey one or more System Information Blocks. All the SIBs included are transmitted with the same periodicity.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: E-UTRAN to UE

SystemInformation message

```
-- ASN1START

SystemInformation ::=               SEQUENCE {
    criticalExtensions                  CHOICE {
        systemInformation-r8                SystemInformation-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}
SystemInformation-r8-IEs ::=        SEQUENCE {
    sib-TypeAndInfo                     SEQUENCE (SIZE (1..maxSIB)) OF CHOICE {
        sib2                                SystemInformationBlockType2,
        sib3                                SystemInformationBlockType3,
        sib4                                SystemInformationBlockType4,
        sib5                                SystemInformationBlockType5,
        sib6                                SystemInformationBlockType6,
```

```
        sib7                                SystemInformationBlockType7,
        sib8                                SystemInformationBlockType8,
        sib9                                SystemInformationBlockType9,
        sib10                               SystemInformationBlockType10,
        sib11                               SystemInformationBlockType11,
        ...,
        sib12-v920                          SystemInformationBlockType12-r9,
        sib13-v920                          SystemInformationBlockType13-r9,
        sib14-v1130                         SystemInformationBlockType14-r11,
        sib15-v1130                         SystemInformationBlockType15-r11,
        sib16-v1130                         SystemInformationBlockType16-r11,
        sib17-v1250                         SystemInformationBlockType17-r12,
        sib18-v1250                         SystemInformationBlockType18-r12,
        sib19-v1250                         SystemInformationBlockType19-r12
    },
    nonCriticalExtension                SystemInformation-v8a0-IEs          OPTIONAL
}

SystemInformation-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

– *SystemInformationBlockType1*

SystemInformationBlockType1 contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: E-UTRAN to UE

SystemInformationBlockType1 message

```
-- ASN1START

SystemInformationBlockType1 ::=     SEQUENCE {
    cellAccessRelatedInfo               SEQUENCE {
        plmn-IdentityList                   PLMN-IdentityList,
        trackingAreaCode                    TrackingAreaCode,
        cellIdentity                        CellIdentity,
        cellBarred                          ENUMERATED {barred, notBarred},
        intraFreqReselection                ENUMERATED {allowed, notAllowed},
        csg-Indication                      BOOLEAN,
        csg-Identity                        CSG-Identity            OPTIONAL    -- Need OR
    },
    cellSelectionInfo                   SEQUENCE {
        q-RxLevMin                          Q-RxLevMin,
        q-RxLevMinOffset                    INTEGER (1..8)          OPTIONAL    -- Need OP
    },
    p-Max                               P-Max                       OPTIONAL,           -- Need OP
    freqBandIndicator                   FreqBandIndicator,
    schedulingInfoList                  SchedulingInfoList,
    tdd-Config                          TDD-Config                  OPTIONAL,   -- Cond TDD
    si-WindowLength                     ENUMERATED {
                                            ms1, ms2, ms5, ms10, ms15, ms20,
                                            ms40},
    systemInfoValueTag                  INTEGER (0..31),
    nonCriticalExtension                SystemInformationBlockType1-v890-IEs    OPTIONAL
}

SystemInformationBlockType1-v890-IEs::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING SystemInformationBlockType1-v8h0-
IEs)            OPTIONAL,
    nonCriticalExtension                SystemInformationBlockType1-v920-IEs    OPTIONAL
}

-- Late non critical extensions
```

```
SystemInformationBlockType1-v8h0-IEs ::=    SEQUENCE {
    multiBandInfoList                   MultiBandInfoList       OPTIONAL,   -- Need OR
    nonCriticalExtension                SystemInformationBlockType1-v9e0-IEs    OPTIONAL
}

SystemInformationBlockType1-v9e0-IEs ::= SEQUENCE {
    freqBandIndicator-v9e0              FreqBandIndicator-v9e0      OPTIONAL,   -- Cond FBI-max
    multiBandInfoList-v9e0              MultiBandInfoList-v9e0      OPTIONAL,   -- Cond mFBI-max
    nonCriticalExtension                SystemInformationBlockType1-v10j0-IEs   OPTIONAL
}

SystemInformationBlockType1-v10j0-IEs ::= SEQUENCE {
    freqBandInfo-r10                    NS-PmaxList-r10             OPTIONAL,   -- Need OR
    multiBandInfoList-v10j0             MultiBandInfoList-v10j0     OPTIONAL,   -- Need OR
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

-- Regular non critical extensions
SystemInformationBlockType1-v920-IEs ::=    SEQUENCE {
    ims-EmergencySupport-r9             ENUMERATED {true}           OPTIONAL,   -- Need OR
    cellSelectionInfo-v920              CellSelectionInfo-v920      OPTIONAL,   -- Cond RSRQ
    nonCriticalExtension                SystemInformationBlockType1-v1130-IEs   OPTIONAL
}

SystemInformationBlockType1-v1130-IEs ::=   SEQUENCE {
    tdd-Config-v1130                TDD-Config-v1130            OPTIONAL,   -- Cond TDD-OR
    cellSelectionInfo-v1130         CellSelectionInfo-v1130     OPTIONAL,   -- Cond WB-RSRQ
    nonCriticalExtension            SystemInformationBlockType1-v1250-IEs   OPTIONAL
}

SystemInformationBlockType1-v1250-IEs ::=   SEQUENCE {
    cellAccessRelatedInfo-v1250                 SEQUENCE {
        category0Allowed-r12                        ENUMERATED {true}       OPTIONAL    -- Need OP
    },
    cellSelectionInfo-v1250                 CellSelectionInfo-v1250     OPTIONAL,   -- Cond RSRQ2
    freqBandIndicatorPriority-r12           ENUMERATED {true}           OPTIONAL,   -- Cond mFBI
    nonCriticalExtension            SEQUENCE {}                 OPTIONAL
}

PLMN-IdentityList ::=                   SEQUENCE (SIZE (1..maxPLMN-r11)) OF PLMN-IdentityInfo

PLMN-IdentityInfo ::=                   SEQUENCE {
    plmn-Identity                           PLMN-Identity,
    cellReservedForOperatorUse              ENUMERATED {reserved, notReserved}
}

SchedulingInfoList ::= SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo

SchedulingInfo ::=  SEQUENCE {
    si-Periodicity                      ENUMERATED {
                                            rf8, rf16, rf32, rf64, rf128, rf256, rf512},
    sib-MappingInfo                     SIB-MappingInfo
}

SIB-MappingInfo ::= SEQUENCE (SIZE (0..maxSIB-1)) OF SIB-Type

SIB-Type ::=                        ENUMERATED {
                                        sibType3, sibType4, sibType5, sibType6,
                                        sibType7, sibType8, sibType9, sibType10,
                                        sibType11, sibType12-v920, sibType13-v920,
                                        sibType14-v1130, sibType15-v1130,
                                        sibType16-v1130, sibType17-v1250, sibType18-v1250,
                                        ..., sibType19-v1250}

CellSelectionInfo-v920 ::=          SEQUENCE {
    q-QualMin-r9                        Q-QualMin-r9,
    q-QualMinOffset-r9                  INTEGER (1..8)                      OPTIONAL    -- Need OP
}

CellSelectionInfo-v1130 ::=         SEQUENCE {
    q-QualMinWB-r11                     Q-QualMin-r9
}

CellSelectionInfo-v1250 ::=         SEQUENCE {
    q-QualMinRSRQ-OnAllSymbols-r12                      Q-QualMin-r9
}

-- ASN1STOP
```

***SystemInformationBlockType1* field descriptions**
category0Allowed The presence of this field indicates category 0 UEs are allowed to access the cell.
cellBarred barred means the cell is barred, as defined in TS 36.304 [4].
cellReservedForOperatorUse As defined in TS 36.304 [4].
csg-Identity Identity of the Closed Subscriber Group the cell belongs to.
csg-Indication If set to TRUE the UE is only allowed to access the cell if it is a CSG member cell, if selected during manual CSG selection or to obtain limited service, see TS 36.304 [4].
freqBandIndicatorPriority If the field is present and supported by the UE, the UE shall prioritize the frequency bands in the *multiBandInfoList* IE in decreasing priority order. Only if the UE does not support any of the frequency band in *multiBandInfoList,* the UE shall use the value in *freqBandIndicator* IE. Otherwise, the UE applies frequency band according to the rules defined in *multiBandInfoList.*
freqBandInfo A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] for the frequency band in *freqBandIndicator*.
ims-EmergencySupport Indicates whether the cell supports IMS emergency bearer services for UEs in limited service mode. If absent, IMS emergency call is not supported by the network in the cell for UEs in limited service mode.
intraFreqReselection Used to control cell reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 36.304 [4].
multiBandInfoList A list of additional frequency band indicators, as defined in TS 36.101 [42, table 5.5-1] that the cell belongs to. If the UE supports the frequency band in the *freqBandIndicator* IE it shall apply that frequency band. Otherwise, the UE shall apply the first listed band which it supports in the *multiBandInfoList* IE. If E-UTRAN includes *multiBandInfoList-v9e0* it includes the same number of entries, and listed in the same order, as in *multiBandInfoList* (i.e. without suffix). See Annex D for more descriptions. The UE shall ignore the rule defined in this field description if *freqBandIndicatorPriority* is present and supported by the UE.
multiBandInfoList-v10j0 A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] for the frequency bands in *multiBandInfoList* (i.e. without suffix) and *multiBandInfoList-v9e0*. If E-UTRAN includes *multiBandInfoList-v10j0*, it includes the same number of entries, and listed in the same order, as in *multiBandInfoList* (i.e. without suffix).
plmn-IdentityList List of PLMN identities. The first listed *PLMN-Identity* is the primary PLMN.
p-Max Value applicable for the cell. If absent the UE applies the maximum power according to the UE capability.
q-QualMin Parameter "$Q_{qualmin}$" in TS 36.304 [4]. If *cellSelectionInfo-v920* is not present, the UE applies the (default) value of negative infinity for $Q_{qualmin}$. NOTE 1.
q-QualMinRSRQ-OnAllSymbols If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, perform RSRQ measurement on all OFDM symbols in accordance with TS 36.214 [48]. NOTE 1.
q-QualMinOffset Parameter "$Q_{qualminoffset}$" in TS 36.304 [4]. Actual value $Q_{qualminoffset}$ = IE value [dB]. If *cellSelectionInfo-v920* is not present or the field is not present, the UE applies the (default) value of 0 dB for $Q_{qualminoffset}$. Affects the minimum required quality level in the cell.
q-QualMinWB If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [16]. NOTE 1.
q-RxLevMinOffset Parameter $Q_{rxlevminoffset}$ in TS 36.304 [4]. Actual value $Q_{rxlevminoffset}$ = IE value * 2 [dB]. If absent, the UE applies the (default) value of 0 dB for $Q_{rxlevminoffset}$. Affects the minimum required Rx level in the cell.
sib-MappingInfo List of the SIBs mapped to this *SystemInformation* message.There is no mapping information of SIB2; it is always present in the first *SystemInformation* message listed in the *schedulingInfoList* list.
si-Periodicity Periodicity of the SI-message in radio frames, such that rf8 denotes 8 radio frames, rf16 denotes 16 radio frames, and so on.
si-WindowLength Common SI scheduling window for all SIs. Unit in milliseconds, where ms1 denotes 1 millisecond, ms2 denotes 2 milliseconds and so on.

SystemInformationBlockType1 field descriptions
category0Allowed The presence of this field indicates category 0 UEs are allowed to access the cell.
systemInfoValueTag Common for all SIBs other than MIB, SIB1, SIB10, SIB11, SIB12 and SIB14. Change of MIB and SIB1 is detected by acquisition of the corresponding message.
trackingAreaCode A *trackingAreaCode* that is common for all the PLMNs listed.

NOTE 1: The value the UE applies for parameter "$Q_{qualmin}$" in TS 36.304 [4] depends on the *q-QualMin* fields signalled by E-UTRAN and supported by the UE. In case multiple candidate options are available, the UE shall select the highest priority candidate option according to the priority order indicated by the following table (top row is highest priority).

q-QualMinRSRQ-OnAllSymbols	q-QualMinWB	Value of parameter "$Q_{qualmin}$" in TS 36.304 [4]
Included	Included	*q-QualMinRSRQ-OnAllSymbols* – (*q-QualMin* – *q-QualMinWB*)
Included	Not included	*q-QualMinRSRQ-OnAllSymbols*
Not included	Included	*q-QualMinWB*
Not included	Not included	*q-QualMin*

Conditional presence	Explanation
FBI-max	The field is mandatory present if *freqBandIndicator* (i.e. without suffix) is set to *maxFBI*. Otherwise the field is not present.
mFBI	The field is optional present, Need OR, if *multiBandInfoList* is present. Otherwise the field is not present.
mFBI-max	The field is mandatory present if one or more entries in *multiBandInfoList* (i.e. without suffix, introduced in -v8h0) is set to *maxFBI*. Otherwise the field is not present.
RSRQ	The field is mandatory present if SIB3 is being broadcast and *threshServingLowQ* is present in SIB3; otherwise optionally present, Need OP.
RSRQ2	The field is mandatory present if *q-QualMinRSRQ-OnAllSymbols* is present in SIB3; otherwise it is not present and the UE shall delete any existing value for this field.
TDD	This field is mandatory present for TDD; it is not present for FDD and the UE shall delete any existing value for this field.
TDD-OR	The field is optional present for TDD, need OR; it is not present for FDD.
WB-RSRQ	The field is optionally present, need OP if the measurement bandwidth indicated by *allowedMeasBandwidth* in *systemInformationBlockType3* is 50 resource blocks or larger; otherwise it is not present.

– *UEAssistanceInformation*

The *UEAssistanceInformation* message is used for the indication of UE assistance information to the eNB.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

UEAssistanceInformation message

```
-- ASN1START

UEAssistanceInformation-r11 ::=             SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            ueAssistanceInformation-r11         UEAssistanceInformation-r11-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}
```

```
UEAssistanceInformation-r11-IEs ::=     SEQUENCE {
    powerPrefIndication-r11             ENUMERATED  {normal, lowPowerConsumption}   OPTIONAL,
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

***UEAssistanceInformation* field descriptions**
powerPrefIndication   Value *lowPowerConsumption* indicates the UE prefers a configuration that is primarily optimised for power saving. Otherwise the value is set to *normal*.

– *UECapabilityEnquiry*

The *UECapabilityEnquiry* message is used to request the transfer of UE radio access capabilities for E-UTRA as well as for other RATs.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

UECapabilityEnquiry message

```
-- ASN1START

UECapabilityEnquiry ::=             SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            ueCapabilityEnquiry-r8              UECapabilityEnquiry-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UECapabilityEnquiry-r8-IEs ::=      SEQUENCE {
    ue-CapabilityRequest                UE-CapabilityRequest,
    nonCriticalExtension                UECapabilityEnquiry-v8a0-IEs        OPTIONAL
}

UECapabilityEnquiry-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                UECapabilityEnquiry-v1180-IEs
    OPTIONAL
}

UECapabilityEnquiry-v1180-IEs ::= SEQUENCE {
    requestedFrequencyBands-r11         SEQUENCE (SIZE (1..16)) OF FreqBandIndicator-r11
                OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

UE-CapabilityRequest ::=        SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF RAT-Type

-- ASN1STOP
```

***UECapabilityEnquiry* field descriptions**
ue-CapabilityRequest   List of the RATs for which the UE is requested to transfer the UE radio access capabilities i.e. E-UTRA, UTRA, GERAN-CS, GERAN-PS, CDMA2000.
requestedFrequencyBands   List of frequency bands for which the UE is requested to provide supported CA band combinations and non CA bands.

– *UECapabilityInformation*

The *UECapabilityInformation* message is used to transfer of UE radio access capabilities requested by the E-UTRAN.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

UECapabilityInformation message

```
-- ASN1START

UECapabilityInformation ::=         SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            ueCapabilityInformation-r8          UECapabilityInformation-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UECapabilityInformation-r8-IEs ::=  SEQUENCE {
    ue-CapabilityRAT-ContainerList      UE-CapabilityRAT-ContainerList,
    nonCriticalExtension                UECapabilityInformation-v8a0-IEs    OPTIONAL
}

UECapabilityInformation-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                UECapabilityInformation-v1250-IEs   OPTIONAL
}

UECapabilityInformation-v1250-IEs ::= SEQUENCE {
    ue-RadioPagingInfo-r12              UE-RadioPagingInfo-r12              OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

***UECapabilityInformation* field descriptions**
ue-RadioPagingInfo This field contains information used for paging of category 0 UEs.

– *UEInformationRequest*

The *UEInformationRequest* is the command used by E-UTRAN to retrieve information from the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

UEInformationRequest message

```
-- ASN1START

UEInformationRequest-r9     ::=             SEQUENCE {
    rrc-TransactionIdentifier       RRC-TransactionIdentifier,
    criticalExtensions              CHOICE {
        c1                              CHOICE {
```

```
            ueInformationRequest-r9             UEInformationRequest-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UEInformationRequest-r9-IEs ::=     SEQUENCE {
    rach-ReportReq-r9                   BOOLEAN,
    rlf-ReportReq-r9                    BOOLEAN,
    nonCriticalExtension                UEInformationRequest-v930-IEs       OPTIONAL
}

UEInformationRequest-v930-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                UEInformationRequest-v1020-IEs      OPTIONAL
}

UEInformationRequest-v1020-IEs ::=  SEQUENCE {
    logMeasReportReq-r10                ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension                UEInformationRequest-v1130-IEs      OPTIONAL
}

UEInformationRequest-v1130-IEs ::= SEQUENCE {
    connEstFailReportReq-r11            ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension                UEInformationRequest-v1250-IEs      OPTIONAL
}

UEInformationRequest-v1250-IEs ::= SEQUENCE {
    mobilityHistoryReportReq-r12        ENUMERATED {true}                   OPTIONAL,   -- Need ON
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

***UEInformationRequest* field descriptions**
rach-ReportReq This field is used to indicate whether the UE shall report information about the random access procedure.

– *UEInformationResponse*

The *UEInformationResponse* message is used by the UE to transfer the information requested by the E-UTRAN.

Signalling radio bearer: SRB1 or SRB2 (when logged measurement information is included)

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

UEInformationResponse message

```
-- ASN1START

UEInformationResponse-r9    ::=         SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                              CHOICE {
            ueInformationResponse-r9                UEInformationResponse-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture                SEQUENCE {}
    }
}

UEInformationResponse-r9-IEs ::=        SEQUENCE {
    rach-Report-r9                          SEQUENCE {
        numberOfPreamblesSent-r9                NumberOfPreamblesSent-r11,
        contentionDetected-r9                   BOOLEAN
    }                                                           OPTIONAL,
    rlf-Report-r9                           RLF-Report-r9       OPTIONAL,
```

```
    nonCriticalExtension                    UEInformationResponse-v930-IEs              OPTIONAL
}

-- Late non critical extensions
UEInformationResponse-v9e0-IEs ::= SEQUENCE {
    rlf-Report-v9e0                     RLF-Report-v9e0                 OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- Regular non critical extensions
UEInformationResponse-v930-IEs ::=  SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING UEInformationResponse-v9e0-IEs)
    OPTIONAL,
    nonCriticalExtension                UEInformationResponse-v1020-IEs     OPTIONAL
}

UEInformationResponse-v1020-IEs ::= SEQUENCE {
    logMeasReport-r10                   LogMeasReport-r10               OPTIONAL,
    nonCriticalExtension                UEInformationResponse-v1130-IEs     OPTIONAL
}

UEInformationResponse-v1130-IEs ::= SEQUENCE {
    connEstFailReport-r11               ConnEstFailReport-r11           OPTIONAL,
    nonCriticalExtension                UEInformationResponse-v1250-IEs OPTIONAL
}

UEInformationResponse-v1250-IEs ::= SEQUENCE {
    mobilityHistoryReport-r12           MobilityHistoryReport-r12       OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

RLF-Report-r9 ::=                   SEQUENCE {
    measResultLastServCell-r9               SEQUENCE {
        rsrpResult-r9                           RSRP-Range,
        rsrqResult-r9                           RSRQ-Range          OPTIONAL
    },
    measResultNeighCells-r9             SEQUENCE {
        measResultListEUTRA-r9              MeasResultList2EUTRA-r9         OPTIONAL,
        measResultListUTRA-r9               MeasResultList2UTRA-r9          OPTIONAL,
        measResultListGERAN-r9              MeasResultListGERAN             OPTIONAL,
        measResultsCDMA2000-r9              MeasResultList2CDMA2000-r9      OPTIONAL
    }   OPTIONAL,
    ...,
    [[  locationInfo-r10                LocationInfo-r10        OPTIONAL,
        failedPCellId-r10                       CHOICE {
            cellGlobalId-r10                        CellGlobalIdEUTRA,
            pci-arfcn-r10                           SEQUENCE {
                physCellId-r10                          PhysCellId,
                carrierFreq-r10                         ARFCN-ValueEUTRA
            }
        }                                                               OPTIONAL,
        reestablishmentCellId-r10       CellGlobalIdEUTRA               OPTIONAL,
        timeConnFailure-r10             INTEGER (0..1023)               OPTIONAL,
        connectionFailureType-r10       ENUMERATED {rlf, hof}           OPTIONAL,
        previousPCellId-r10             CellGlobalIdEUTRA               OPTIONAL
    ]],
    [[  failedPCellId-v1090             SEQUENCE {
            carrierFreq-v1090               ARFCN-ValueEUTRA-v9e0
        }                                                               OPTIONAL
    ]],
    [[  basicFields-r11                 SEQUENCE {
            c-RNTI-r11                      C-RNTI,
            rlf-Cause-r11                   ENUMERATED {
                                                t310-Expiry, randomAccessProblem,
                                                rlc-MaxNumRetx, t312-Expiry-r12},
            timeSinceFailure-r11            TimeSinceFailure-r11
        }                                                               OPTIONAL,
        previousUTRA-CellId-r11         SEQUENCE {
            carrierFreq-r11                 ARFCN-ValueUTRA,
            physCellId-r11                  CHOICE {
                fdd-r11                         PhysCellIdUTRA-FDD,
                tdd-r11                         PhysCellIdUTRA-TDD
            },
            cellGlobalId-r11                CellGlobalIdUTRA            OPTIONAL
        }                                                               OPTIONAL,
        selectedUTRA-CellId-r11         SEQUENCE {
            carrierFreq-r11                 ARFCN-ValueUTRA,
            physCellId-r11                  CHOICE {
```

```
                fdd-r11                         PhysCellIdUTRA-FDD,
                tdd-r11                         PhysCellIdUTRA-TDD
            }
        }                                                               OPTIONAL
    ]],
    [[  failedPCellId-v1250             SEQUENCE {
            tac-FailedPCell-r12         TrackingAreaCode
        }                                                               OPTIONAL,
        measResultLastServCell-v1250    RSRQ-Range-v1250                OPTIONAL,
        lastServCellRSRQ-Type-r12       RSRQ-Type-r12                   OPTIONAL,
        measResultListEUTRA-v1250       MeasResultList2EUTRA-v1250      OPTIONAL
    ]]

}

RLF-Report-v9e0 ::=                 SEQUENCE {
    measResultListEUTRA-v9e0            MeasResultList2EUTRA-v9e0
}

MeasResultList2EUTRA-r9 ::=             SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2EUTRA-r9

MeasResultList2EUTRA-v9e0 ::=           SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2EUTRA-v9e0

MeasResultList2EUTRA-v1250 ::=          SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2EUTRA-v1250

MeasResult2EUTRA-r9 ::=             SEQUENCE {
    carrierFreq-r9                      ARFCN-ValueEUTRA,
    measResultList-r9                   MeasResultListEUTRA
}

MeasResult2EUTRA-v9e0 ::=               SEQUENCE {
    carrierFreq-v9e0                        ARFCN-ValueEUTRA-v9e0       OPTIONAL
}

MeasResult2EUTRA-v1250 ::=              SEQUENCE {
    rsrq-Type-r12                           RSRQ-Type-r12       OPTIONAL
}

MeasResultList2UTRA-r9 ::=          SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2UTRA-r9

MeasResult2UTRA-r9 ::=              SEQUENCE {
    carrierFreq-r9                      ARFCN-ValueUTRA,
    measResultList-r9                   MeasResultListUTRA
}

MeasResultList2CDMA2000-r9 ::=      SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2CDMA2000-r9

MeasResult2CDMA2000-r9 ::=          SEQUENCE {
    carrierFreq-r9                      CarrierFreqCDMA2000,
    measResultList-r9                   MeasResultsCDMA2000
}

LogMeasReport-r10 ::=               SEQUENCE {
    absoluteTimeStamp-r10               AbsoluteTimeInfo-r10,
    traceReference-r10                  TraceReference-r10,
    traceRecordingSessionRef-r10        OCTET STRING (SIZE (2)),
    tce-Id-r10                          OCTET STRING (SIZE (1)),
    logMeasInfoList-r10                 LogMeasInfoList-r10,
    logMeasAvailable-r10                ENUMERATED {true}               OPTIONAL,
    ...
}

LogMeasInfoList-r10 ::=         SEQUENCE (SIZE (1..maxLogMeasReport-r10)) OF LogMeasInfo-r10

LogMeasInfo-r10 ::=         SEQUENCE {
    locationInfo-r10                    LocationInfo-r10        OPTIONAL,
    relativeTimeStamp-r10               INTEGER (0..7200),
    servCellIdentity-r10                CellGlobalIdEUTRA,
    measResultServCell-r10              SEQUENCE {
        rsrpResult-r10                      RSRP-Range,
        rsrqResult-r10                      RSRQ-Range
    },
    measResultNeighCells-r10            SEQUENCE {
        measResultListEUTRA-r10             MeasResultList2EUTRA-r9     OPTIONAL,
        measResultListUTRA-r10              MeasResultList2UTRA-r9      OPTIONAL,
        measResultListGERAN-r10             MeasResultList2GERAN-r10    OPTIONAL,
        measResultListCDMA2000-r10          MeasResultList2CDMA2000-r9  OPTIONAL
    }   OPTIONAL,
```

```
    ...,
    [[  measResultListEUTRA-v1090           MeasResultList2EUTRA-v9e0   OPTIONAL
    ]],
    [[  measResultListMBSFN-r12             MeasResultListMBSFN-r12 OPTIONAL,
        measResultServCell-v1250            RSRQ-Range-v1250            OPTIONAL,
        servCellRSRQ-Type-r12               RSRQ-Type-r12               OPTIONAL,
        measResultListEUTRA-v1250           MeasResultList2EUTRA-v1250  OPTIONAL
    ]]

}

MeasResultListMBSFN-r12 ::=             SEQUENCE (SIZE (1..maxMBSFN-Area)) OF MeasResultMBSFN-r12

MeasResultMBSFN-r12 ::=             SEQUENCE {
    mbsfn-Area-r12                          SEQUENCE {
        mbsfn-AreaId-r12                        MBSFN-AreaId-r12,
        carrierFreq-r12                         ARFCN-ValueEUTRA-r9
    },
    rsrpResultMBSFN-r12                     RSRP-Range,
    rsrqResultMBSFN-r12                     MBSFN-RSRQ-Range-r12,
    signallingBLER-Result-r12               BLER-Result-r12             OPTIONAL,
    dataBLER-MCH-ResultList-r12             DataBLER-MCH-ResultList-r12 OPTIONAL,
    ...
}

DataBLER-MCH-ResultList-r12 ::=         SEQUENCE (SIZE (1.. maxPMCH-PerMBSFN)) OF DataBLER-MCH-
Result-r12

DataBLER-MCH-Result-r12 ::=             SEQUENCE {
    mch-Index-r12                           INTEGER (1..maxPMCH-PerMBSFN),
    dataBLER-Result-r12                     BLER-Result-r12
}

BLER-Result-r12 ::=                 SEQUENCE {
    bler-r12                                BLER-Range-r12,
    blocksReceived-r12                      SEQUENCE {
        n-r12                                   BIT STRING (SIZE (3)),
        m-r12                                   BIT STRING (SIZE (8))
    }
}

BLER-Range-r12 ::=                      INTEGER(0..31)

MeasResultList2GERAN-r10 ::=            SEQUENCE (SIZE (1..maxCellListGERAN)) OF MeasResultListGERAN

ConnEstFailReport-r11 ::=               SEQUENCE {
    failedCellId-r11                    CellGlobalIdEUTRA,
    locationInfo-r11                    LocationInfo-r10                OPTIONAL,
    measResultFailedCell-r11                SEQUENCE {
        rsrpResult-r11                          RSRP-Range,
        rsrqResult-r11                          RSRQ-Range              OPTIONAL
    },
    measResultNeighCells-r11                SEQUENCE {
        measResultListEUTRA-r11             MeasResultList2EUTRA-r9         OPTIONAL,
        measResultListUTRA-r11              MeasResultList2UTRA-r9          OPTIONAL,
        measResultListGERAN-r11             MeasResultListGERAN             OPTIONAL,
        measResultsCDMA2000-r11             MeasResultList2CDMA2000-r9      OPTIONAL
    }   OPTIONAL,
    numberOfPreamblesSent-r11           NumberOfPreamblesSent-r11,
    contentionDetected-r11              BOOLEAN,
    maxTxPowerReached-r11               BOOLEAN,
    timeSinceFailure-r11                TimeSinceFailure-r11,
    measResultListEUTRA-v1130           MeasResultList2EUTRA-v9e0       OPTIONAL,
    ...,
    [[  measResultFailedCell-v1250      RSRQ-Range-v1250                OPTIONAL,
        failedCellRSRQ-Type-r12         RSRQ-Type-r12                   OPTIONAL,
        measResultListEUTRA-v1250       MeasResultList2EUTRA-v1250      OPTIONAL
    ]]
}

NumberOfPreamblesSent-r11::=            INTEGER (1..200)

TimeSinceFailure-r11 ::=                INTEGER (0..172800)

MobilityHistoryReport-r12 ::=   VisitedCellInfoList-r12

-- ASN1STOP
```

UEInformationResponse field descriptions
absoluteTimeStamp Indicates the absolute time when the logged measurement configuration logging is provided, as indicated by E-UTRAN within *absoluteTimeInfo*.
bler Indicates the measured BLER value. The coding of BLER value is defined in TS 36.133 [16].
blocksReceived Indicates total number of MCH blocks, which were received by the UE and used for the corresponding BLER calculation, within the measurement period as defined in TS 36.133 [16].
carrierFreq In case the UE includes *carrierFreq-v9e0* and/ or *carrierFreq-v1090*, the UE shall set the corresponding entry of *carrierFreq-r9* and/ or *carrierFreq-r10* respectively to *maxEARFCN*. For E-UTRA and UTRA frequencies, the UE sets the ARFCN according to the band used when obtaining the concerned measurement results.
connectionFailureType This field is used to indicate whether the connection failure is due to radio link failure or handover failure.
contentionDetected This field is used to indicate that contention was detected for at least one of the transmitted preambles, see TS 36.321 [6].
c-RNTI This field indicates the C-RNTI used in the PCell upon detecting radio link failure or the C-RNTI used in the source PCell upon handover failure.
dataBLER-MCH-ResultList Includes a BLER result per MCH on subframes using *dataMCS*, with the applicable MCH(s) listed in the same order as in *pmch-InfoList* within *MBSFNAreaConfiguration*.
failedCellId This field is used to indicate the cell in which connection establishment failed.
failedPCellId This field is used to indicate the PCell in which RLF is detected or the target PCell of the failed handover. The UE sets the EARFCN according to the band used for transmission/ reception when the failure occurred.
maxTxPowerReached This field is used to indicate whether or not the maximum power level was used for the last transmitted preamble, see TS 36.321 [6].
mch-Index Indicates the MCH by referring to the entry as listed in *pmch-InfoList* within *MBSFNAreaConfiguration*.
measResultFailedCell This field refers to the last measurement results taken in the cell, where connection establishment failure happened.
measResultLastServCell This field refers to the last measurement results taken in the PCell, where radio link failure or handover failure happened.
measResultListEUTRA If *measResultListEUTRA-v9e0*, *measResultListEUTRA-v1090* or *measResultListEUTRA-v1130* is included, the UE shall include the same number of entries, and listed in the same order, as in *measResultListEUTRA-r9*, *measResultListEUTRA-r10* and/ or *measResultListEUTRA-r11* respectively.
measResultListEUTRA-v1250 If included in *RLF-Report-r9* the UE shall include the same number of entries, and listed in the same order, as in *measResultListEUTRA-r9*; If included in *LogMeasInfo-r10* the UE shall include the same number of entries, and listed in the same order, as in *measResultListEUTRA-r10*; If included in *ConnEstFailReport-r11* the UE shall include the same number of entries, and listed in the same order, as in *measResultListEUTRA-r11*;
mobilityHistoryReport This field is used to indicate the time of stay in 16 most recently visited E-UTRA cells or of stay out of E-UTRA.
numberOfPreamblesSent This field is used to indicate the number of RACH preambles that were transmitted. Corresponds to parameter PREAMBLE_TRANSMISSION_COUNTER in TS 36.321 [6].
previousPCellId This field is used to indicate the source PCell of the last handover (source PCell when the last *RRC-Connection-Reconfiguration* message including *mobilityControlInfo*was received).
previousUTRA-CellId This field is used to indicate the source UTRA cell of the last successful handover to E-UTRAN, when RLF occurred at the target PCell. The UE sets the ARFCN according to the band used for transmission/ reception on the concerned cell.
reestablishmentCellId This field is used to indicate the cell in which the re-establishment attempt was made after connection failure.
relativeTimeStamp Indicates the time of logging measurement results, measured relative to the *absoluteTimeStamp*. Value in seconds.

UEInformationResponse field descriptions
rlf-Cause This field is used to indicate the cause of the last radio link failure that was detected. In case of handover failure information reporting (i.e., the *connectionFailureType* is set to '*hof*'), the UE is allowed to set this field to any value.
selectedUTRA-CellId This field is used to indicate the UTRA cell that the UE selects after RLF is detected, while T311 is running. The UE sets the ARFCN according to the band selected for transmission/ reception on the concerned cell.
signallingBLER-Result Includes a BLER result of MBSFN subframes using *signallingMCS*.
tac-FailedPCell This field is used to indicate the Tracking Area Code of the PCell in which RLF is detected.
tce-Id Parameter Trace Collection Entity Id: See TS 32.422 [58].
timeConnFailure This field is used to indicate the time elapsed since the last HO initialization until connection failure. Actual value = IE value * 100ms. The maximum value 1023 means 102.3s or longer.
timeSinceFailure This field is used to indicate the time that elapsed since the connection (establishment) failure. Value in seconds. The maximum value 172800 means 172800s or longer.
traceRecordingSessionRef Parameter Trace Recording Session Reference: See TS 32.422 [58].

– *ULHandoverPreparationTransfer (CDMA2000)*

The *ULHandoverPreparationTransfer* message is used for the uplink transfer of handover related CDMA2000 information when requested by the higher layers.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

ULHandoverPreparationTransfer message

```
-- ASN1START

ULHandoverPreparationTransfer ::=   SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            ulHandoverPreparationTransfer-r8        ULHandoverPreparationTransfer-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture                SEQUENCE {}
    }
}

ULHandoverPreparationTransfer-r8-IEs ::= SEQUENCE {
    cdma2000-Type                       CDMA2000-Type,
    meid                                BIT STRING (SIZE (56))  OPTIONAL,
    dedicatedInfo                       DedicatedInfoCDMA2000,
    nonCriticalExtension                ULHandoverPreparationTransfer-v8a0-IEs  OPTIONAL
}

ULHandoverPreparationTransfer-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

ULHandoverPreparationTransfer field descriptions
meid The 56 bit mobile identification number provided by the CDMA2000 Upper layers.

– *ULInformationTransfer*

The *ULInformationTransfer* message is used for the uplink transfer of NAS or non-3GPP dedicated information.

Signalling radio bearer: SRB2 or SRB1(only if SRB2 not established yet). If SRB2 is suspended, the UE does not send this message until SRB2 is resumed

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

ULInformationTransfer message

```
-- ASN1START

ULInformationTransfer ::=           SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE {
            ulInformationTransfer-r8            ULInformationTransfer-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

ULInformationTransfer-r8-IEs ::=    SEQUENCE {
    dedicatedInfoType           CHOICE {
        dedicatedInfoNAS                    DedicatedInfoNAS,
        dedicatedInfoCDMA2000-1XRTT         DedicatedInfoCDMA2000,
        dedicatedInfoCDMA2000-HRPD          DedicatedInfoCDMA2000
    },
    nonCriticalExtension                ULInformationTransfer-v8a0-IEs
    OPTIONAL
}

ULInformationTransfer-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

6.3 RRC information elements

6.3.1 System information blocks

– *SystemInformationBlockType2*

The IE *SystemInformationBlockType2* contains radio resource configuration information that is common for all UEs.

NOTE: UE timers and constants related to functionality for which parameters are provided in another SIB are included in the corresponding SIB.

SystemInformationBlockType2 information element

```
-- ASN1START

SystemInformationBlockType2 ::=     SEQUENCE {
    ac-BarringInfo                      SEQUENCE {
        ac-BarringForEmergency              BOOLEAN,
        ac-BarringForMO-Signalling          AC-BarringConfig                OPTIONAL,   -- Need OP
        ac-BarringForMO-Data                AC-BarringConfig                OPTIONAL    -- Need OP
    }                                                                       OPTIONAL,   -- Need OP
    radioResourceConfigCommon           RadioResourceConfigCommonSIB,
    ue-TimersAndConstants               UE-TimersAndConstants,
    freqInfo                            SEQUENCE {
```

```
        ul-CarrierFreq                      ARFCN-ValueEUTRA               OPTIONAL,   -- Need OP
        ul-Bandwidth                        ENUMERATED {n6, n15, n25, n50, n75, n100}
                                                                           OPTIONAL,   -- Need OP
        additionalSpectrumEmission          AdditionalSpectrumEmission
    },
    mbsfn-SubframeConfigList            MBSFN-SubframeConfigList            OPTIONAL,   -- Need OR
    timeAlignmentTimerCommon            TimeAlignmentTimer,
    ...,
    lateNonCriticalExtension        OCTET STRING (CONTAINING SystemInformationBlockType2-v8h0-IEs)
                        OPTIONAL,
    [[  ssac-BarringForMMTEL-Voice-r9       AC-BarringConfig                OPTIONAL,   -- Need OP
        ssac-BarringForMMTEL-Video-r9       AC-BarringConfig                OPTIONAL    -- Need OP
    ]],
    [[  ac-BarringForCSFB-r10               AC-BarringConfig            OPTIONAL    -- Need OP
    ]],
    [[  ac-BarringSkipForMMTELVoice-r12     ENUMERATED {true}           OPTIONAL,    -- Need OP
        ac-BarringSkipForMMTELVideo-r12     ENUMERATED {true}           OPTIONAL,    -- Need OP
        ac-BarringSkipForSMS-r12            ENUMERATED {true}           OPTIONAL,    -- Need OP
        ac-BarringPerPLMN-List-r12          AC-BarringPerPLMN-List-r12  OPTIONAL    -- Need OP
    ]],
    [[  voiceServiceCauseIndication-r12     ENUMERATED {true}           OPTIONAL    -- Need OP
    ]]
}

SystemInformationBlockType2-v8h0-IEs ::=    SEQUENCE {
    multiBandInfoList               SEQUENCE (SIZE (1..maxMultiBands)) OF AdditionalSpectrumEmission
    OPTIONAL,   -- Need OR
    nonCriticalExtension            SystemInformationBlockType2-v9e0-IEs    OPTIONAL
}

SystemInformationBlockType2-v9e0-IEs ::= SEQUENCE {
    ul-CarrierFreq-v9e0                 ARFCN-ValueEUTRA-v9e0       OPTIONAL,   -- Cond ul-FreqMax
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

AC-BarringConfig ::=                SEQUENCE {
    ac-BarringFactor                    ENUMERATED {
                                            p00, p05, p10, p15, p20, p25, p30, p40,
                                            p50, p60, p70, p75, p80, p85, p90, p95},
    ac-BarringTime                      ENUMERATED {s4, s8, s16, s32, s64, s128, s256, s512},
    ac-BarringForSpecialAC              BIT STRING (SIZE(5))
}

MBSFN-SubframeConfigList ::=        SEQUENCE (SIZE (1..maxMBSFN-Allocations)) OF MBSFN-
SubframeConfig

AC-BarringPerPLMN-List-r12 ::=      SEQUENCE (SIZE (1.. maxPLMN-r11)) OF AC-BarringPerPLMN-r12

AC-BarringPerPLMN-r12 ::=           SEQUENCE {
    plmn-IdentityIndex-r12                  INTEGER (1..maxPLMN-r11),
    ac-BarringInfo-r12                      SEQUENCE {
        ac-BarringForEmergency-r12          BOOLEAN,
        ac-BarringForMO-Signalling-r12      AC-BarringConfig    OPTIONAL,   -- Need OP
        ac-BarringForMO-Data-r12            AC-BarringConfig    OPTIONAL    -- Need OP
    }                                                           OPTIONAL,   -- Need OP
    ac-BarringSkipForMMTELVoice-r12     ENUMERATED {true}       OPTIONAL,   -- Need OP
    ac-BarringSkipForMMTELVideo-r12     ENUMERATED {true}       OPTIONAL,   -- Need OP
    ac-BarringSkipForSMS-r12            ENUMERATED {true}       OPTIONAL,   -- Need OP
    ac-BarringForCSFB-r12               AC-BarringConfig        OPTIONAL,   -- Need OP
    ssac-BarringForMMTEL-Voice-r12      AC-BarringConfig        OPTIONAL,   -- Need OP
    ssac-BarringForMMTEL-Video-r12      AC-BarringConfig        OPTIONAL    -- Need OP
}

-- ASN1STOP
```

SystemInformationBlockType2 field descriptions
ac-BarringFactor If the random number drawn by the UE is lower than this value, access is allowed. Otherwise the access is barred. The values are interpreted in the range [0,1): p00 = 0, p05 = 0.05, p10 = 0.10,…, p95 = 0.95. Values other than p00 can only be set if all bits of the corresponding *ac-BarringForSpecialAC* are set to 0.
ac-BarringForCSFB Access class barring for mobile originating CS fallback.
ac-BarringForEmergency Access class barring for AC 10.
ac-BarringForMO-Data Access class barring for mobile originating calls.
ac-BarringForMO-Signalling Access class barring for mobile originating signalling.
ac-BarringForSpecialAC Access class barring for AC 11-15. The first/ leftmost bit is for AC 11, the second bit is for AC 12, and so on.
ac-BarringTime Mean access barring time value in seconds.
additionalSpectrumEmission The UE requirements related to IE *AdditionalSpectrumEmission* are defined in TS 36.101 [42, table 6.2.4.1]**.**
mbsfn-SubframeConfigList Defines the subframes that are reserved for MBSFN in downlink.
multiBandInfoList A list of *additionalSpectrumEmission* i.e. one for each additional frequency band included in *multiBandInfoList* in *SystemInformationBlockType1,* listed in the same order.
plmn-IdentityIndex Index of the PLMN in *plmn-IdentityList* included in SIB1. Value 1 indicates the PLMN listed 1st in *plmn-IdentityList* included in SIB1. Value 2 indicates the PLMN listed 2nd in *plmn-IdentityList* included in SIB1 and so on.
ssac-BarringForMMTEL-Video Service specific access class barring for MMTEL video originating calls.
ssac-BarringForMMTEL-Voice Service specific access class barring for MMTEL voice originating calls.
ul-Bandwidth Parameter: transmission bandwidth configuration, N_{RB}, in uplink, see TS 36.101 [42, table 5.6-1]. Value n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on. If for FDD this parameter is absent, the uplink bandwidth is equal to the downlink bandwidth. For TDD this parameter is absent and it is equal to the downlink bandwidth.
ul-CarrierFreq For FDD: If absent, the (default) value determined from the default TX-RX frequency separation defined in TS 36.101 [42, table 5.7.3-1] applies. For TDD: This parameter is absent and it is equal to the downlink frequency.
voiceServiceCauseIndication Indicates whether UE is requested to use the establishment cause *mo-VoiceCall* for mobile originating MMTEL voice calls.

Conditional presence	Explanation
ul-FreqMax	The field is mandatory present if *ul-CarrierFreq* (i.e. without suffix) is present and set to *maxEARFCN*. Otherwise the field is not present.

– *SystemInformationBlockType3*

The IE *SystemInformationBlockType3* contains cell re-selection information common for intra-frequency, inter-frequency and/ or inter-RAT cell re-selection (i.e. applicable for more than one type of cell re-selection but not necessarily all) as well as intra-frequency cell re-selection information other than neighbouring cell related.

SystemInformationBlockType3 information element

```
-- ASN1START

SystemInformationBlockType3 ::=     SEQUENCE {
    cellReselectionInfoCommon           SEQUENCE {
        q-Hyst                              ENUMERATED {
                                                dB0, dB1, dB2, dB3, dB4, dB5, dB6, dB8, dB10,
                                                dB12, dB14, dB16, dB18, dB20, dB22, dB24},
        speedStateReselectionPars           SEQUENCE {
            mobilityStateParameters             MobilityStateParameters,
            q-HystSF                            SEQUENCE {
```

```
                sf-Medium                       ENUMERATED {
                                                        dB-6, dB-4, dB-2, dB0},
                sf-High                         ENUMERATED {
                                                        dB-6, dB-4, dB-2, dB0}
            }
        }                                                               OPTIONAL        -- Need OP
    },
    cellReselectionServingFreqInfo      SEQUENCE {
        s-NonIntraSearch                    ReselectionThreshold        OPTIONAL,       -- Need OP
        threshServingLow                    ReselectionThreshold,
        cellReselectionPriority             CellReselectionPriority
    },
    intraFreqCellReselectionInfo        SEQUENCE {
        q-RxLevMin                          Q-RxLevMin,
        p-Max                               P-Max                       OPTIONAL,       -- Need OP
        s-IntraSearch                       ReselectionThreshold        OPTIONAL,       -- Need OP
        allowedMeasBandwidth                AllowedMeasBandwidth        OPTIONAL,       -- Need OP
        presenceAntennaPort1                PresenceAntennaPort1,
        neighCellConfig                     NeighCellConfig,
        t-ReselectionEUTRA                  T-Reselection,
        t-ReselectionEUTRA-SF               SpeedStateScaleFactors      OPTIONAL        -- Need OP
    },
    ...,
    lateNonCriticalExtension                OCTET STRING (CONTAINING SystemInformationBlockType3-
v10j0-IEs)  OPTIONAL,
    [[  s-IntraSearch-v920                  SEQUENCE {
            s-IntraSearchP-r9                   ReselectionThreshold,
            s-IntraSearchQ-r9                   ReselectionThresholdQ-r9
        }                                                               OPTIONAL,       -- Need OP
        s-NonIntraSearch-v920               SEQUENCE {
            s-NonIntraSearchP-r9                ReselectionThreshold,
            s-NonIntraSearchQ-r9                ReselectionThresholdQ-r9
        }                                                               OPTIONAL,       -- Need OP
        q-QualMin-r9                        Q-QualMin-r9                OPTIONAL,       -- Need OP
        threshServingLowQ-r9                ReselectionThresholdQ-r9    OPTIONAL        -- Need OP
    ]],
    [[  q-QualMinWB-r11                     Q-QualMin-r9                OPTIONAL    -- Cond WB-RSRQ
    ]],
    [[  q-QualMinRSRQ-OnAllSymbols-r12          Q-QualMin-r9                OPTIONAL            --
Cond RSRQ
    ]]
}

-- Late non critical extensions
SystemInformationBlockType3-v10j0-IEs ::= SEQUENCE {
    freqBandInfo-r10                    NS-PmaxList-r10             OPTIONAL,   -- Need OR
    multiBandInfoList-v10j0             MultiBandInfoList-v10j0     OPTIONAL,   -- Need OR
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

-- ASN1STOP
```

***SystemInformationBlockType3* field descriptions**
allowedMeasBandwidth If absent, the value corresponding to the downlink bandwidth indicated by the *dl-Bandwidth* included in *MasterInformationBlock* applies.
cellReselectionInfoCommon Cell re-selection information common for cells.
cellReselectionServingFreqInfo Information common for Cell re-selection to inter-frequency and inter-RAT cells.
freqBandInfo A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] applicable for the intra-frequency neighouring E-UTRA cells if the UE selects the frequenby band from *freqBandIndicator* in *SystemInformationBlockType1*.
intraFreqcellReselectionInfo Cell re-selection information common for intra-frequency cells.
multiBandInfoList-v10j0 A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] applicable for the intra-frequency neighouring E-UTRA cells if the UE selects the frequenby bands in *multiBandInfoList* (i.e. without suffix) or *multiBandInfoList-v9e0*. If E-UTRAN includes *multiBandInfoList-v10j0*, it includes the same number of entries, and listed in the same order, as in *multiBandInfoList* (i.e. without suffix).
p-Max Value applicable for the intra-frequency neighbouring E-UTRA cells. If absent the UE applies the maximum power according to the UE capability.
q-Hyst Parameter Q_{hyst} in 36.304 [4], Value in dB. Value dB1 corresponds to 1 dB, dB2 corresponds to 2 dB and so on.
q-HystSF Parameter "Speed dependent ScalingFactor for Q_{hyst}" in TS 36.304 [4]. The sf-Medium and sf-High concern the additional hysteresis to be applied, in Medium and High Mobility state respectively, to Q_{hyst} as defined in TS 36.304 [4]. In dB. Value dB-6 corresponds to -6dB, dB-4 corresponds to -4dB and so on.
q-QualMin Parameter "$Q_{qualmin}$" in TS 36.304 [4], applicable for intra-frequency neighrbour cells. If the field is not present, the UE applies the (default) value of negative infinity for $Q_{qualmin}$. NOTE 1.
q-QualMinRSRQ-OnAllSymbols If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, perform RSRQ measurement on all OFDM symbols in accordance with TS 36.214 [48]. NOTE 1.
q-QualMinWB If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [16]. NOTE 1.
q-RxLevMin Parameter "$Q_{rxlevmin}$" in TS 36.304 [4], applicable for intra-frequency neighbour cells.
s-IntraSearch Parameter "$S_{IntraSearchP}$" in TS 36.304 [4]. If the field *s-IntraSearchP* is present, the UE applies the value of *s-IntraSearchP* instead. Otherwise if neither *s-IntraSearch* nor *s-IntraSearchP* is present, the UE applies the (default) value of infinity for $S_{IntraSearchP}$.
s-IntraSearchP Parameter "$S_{IntraSearchP}$" in TS 36.304 [4]. See descriptions under *s-IntraSearch*.
s-IntraSearchQ Parameter "$S_{IntraSearchQ}$" in TS 36.304 [4]. If the field is not present, the UE applies the (default) value of 0 dB for $S_{IntraSearchQ}$.
s-NonIntraSearch Parameter "$S_{nonIntraSearchP}$" in TS 36.304 [4]. If the field *s-NonIntraSearchP* is present, the UE applies the value of *s-NonIntraSearchP* instead. Otherwise if neither *s-NonIntraSearch* nor *s-NonIntraSearchP* is present, the UE applies the (default) value of infinity for $S_{nonIntraSearchP}$.
s-NonIntraSearchP Parameter "$S_{nonIntraSearchP}$" in TS 36.304 [4]. See descriptions under *s-NonIntraSearch*.
s-NonIntraSearchQ Parameter "$S_{nonIntraSearchQ}$" in TS 36.304 [4]. If the field is not present, the UE applies the (default) value of 0 dB for $S_{nonIntraSearchQ}$.
speedStateReselectionPars Speed dependent reselection parameters, see TS 36.304 [4]. If this field is absent, i.e, *mobilityStateParameters* is also not present, UE behaviour is specified in TS 36.304 [4].
threshServingLow Parameter "$Thresh_{Serving,\ LowP}$" in TS 36.304 [4].
threshServingLowQ Parameter "$Thresh_{Serving,\ LowQ}$" in TS 36.304 [4].
t-ReselectionEUTRA Parameter "$Treselection_{EUTRA}$" in TS 36.304 [4].

***SystemInformationBlockType3* field descriptions**
t-ReselectionEUTRA-SF Parameter "Speed dependent ScalingFactor for $Treselection_{EUTRA}$" in TS 36.304 [4]. If the field is not present, the UE behaviour is specified in TS 36.304 [4].

NOTE 1: The value the UE applies for parameter "$Q_{qualmin}$" in TS 36.304 [4] depends on the *q-QualMin* fields signalled by E-UTRAN and supported by the UE. In case multiple candidate options are available, the UE shall select the highest priority candidate option according to the priority order indicated by the following table (top row is highest priority).

q-QualMinRSRQ-OnAllSymbols	q-QualMinWB	Value of parameter "$Q_{qualmin}$" in TS 36.304 [4]
Included	Included	*q-QualMinRSRQ-OnAllSymbols* – (*q-QualMin* – *q-QualMinWB*)
Included	Not included	*q-QualMinRSRQ-OnAllSymbols*
Not included	Included	*q-QualMinWB*
Not included	Not included	*q-QualMin*

Conditional presence	Explanation
RSRQ	The field is optionally present, Need OR, if *threshServingLowQ* is present in SIB3; otherwise it is not present.
WB-RSRQ	The field is optionally present, need OP if the measurement bandwidth indicated by *allowedMeasBandwidth* is 50 resource blocks or larger; otherwise it is not present.

– *SystemInformationBlockType4*

The IE *SystemInformationBlockType4* contains neighbouring cell related information relevant only for intra-frequency cell re-selection. The IE includes cells with specific re-selection parameters as well as blacklisted cells.

SystemInformationBlockType4 information element

```
-- ASN1START

SystemInformationBlockType4 ::=     SEQUENCE {
    intraFreqNeighCellList              IntraFreqNeighCellList      OPTIONAL,   -- Need OR
    intraFreqBlackCellList              IntraFreqBlackCellList              OPTIONAL,   -- Need OR
    csg-PhysCellIdRange                 PhysCellIdRange             OPTIONAL,   -- Cond CSG
    ...,
    lateNonCriticalExtension                OCTET STRING                OPTIONAL
}

IntraFreqNeighCellList ::=      SEQUENCE (SIZE (1..maxCellIntra)) OF IntraFreqNeighCellInfo

IntraFreqNeighCellInfo ::=      SEQUENCE {
    physCellId                              PhysCellId,
    q-OffsetCell                            Q-OffsetRange,
    ...
}

IntraFreqBlackCellList ::=      SEQUENCE (SIZE (1..maxCellBlack)) OF PhysCellIdRange

-- ASN1STOP
```

SystemInformationBlockType4 field descriptions
csg-PhysCellIdRange Set of physical cell identities reserved for CSG cells on the frequency on which this field was received. The received *csg-PhysCellIdRange* applies if less than 24 hours has elapsed since it was received and the UE is camped on a cell of the same primary PLMN where this field was received. The 3 hour validity restriction (section 5.2.1.3) does not apply to this field. The UE shall not apply any stored *csg-PhysCellIdRange* when it is in *any cell selection* state defined in TS 36.304 [4].
intraFreqBlackCellList List of blacklisted intra-frequency neighbouring cells.
intraFreqNeighbCellList List of intra-frequency neighbouring cells with specific cell re-selection parameters.
q-OffsetCell Parameter "$Qoffset_{s,n}$" in TS 36.304 [4].

Conditional presence	Explanation
CSG	This field is optional, need OP, for non-CSG cells, and mandatory for CSG cells.

– *SystemInformationBlockType5*

The IE *SystemInformationBlockType5* contains information relevant only for inter-frequency cell re-selection i.e. information about other E-UTRA frequencies and inter-frequency neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency as well as cell specific re-selection parameters.

SystemInformationBlockType5 information element

```
-- ASN1START

SystemInformationBlockType5 ::=     SEQUENCE {
    interFreqCarrierFreqList            InterFreqCarrierFreqList,
    ...,
    lateNonCriticalExtension                OCTET STRING    (CONTAINING SystemInformationBlockType5-
v8h0-IEs)               OPTIONAL,
    [[  interFreqCarrierFreqList-v1250  InterFreqCarrierFreqList-v1250      OPTIONAL,   -- Need OR
        interFreqCarrierFreqListExt-r12 InterFreqCarrierFreqListExt-r12     OPTIONAL    -- Need OR
    ]],
    [[  interFreqCarrierFreqListExt-v1280   InterFreqCarrierFreqListExt-v1280   OPTIONAL    -- Need
OR
    ]]
}

SystemInformationBlockType5-v8h0-IEs ::=    SEQUENCE {
    interFreqCarrierFreqList-v8h0 SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo-v8h0
         OPTIONAL,  -- Need OP
    nonCriticalExtension            SystemInformationBlockType5-v9e0-IEs
    OPTIONAL
}

SystemInformationBlockType5-v9e0-IEs ::=    SEQUENCE {
    interFreqCarrierFreqList-v9e0   SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo-v9e0
            OPTIONAL,   -- Need OR
    nonCriticalExtension            SystemInformationBlockType5-v10j0-IEs   OPTIONAL
}

SystemInformationBlockType5-v10j0-IEs ::=   SEQUENCE {
    interFreqCarrierFreqList-v10j0  SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo-v10j0
                OPTIONAL,   -- Need OR
    nonCriticalExtension            SEQUENCE {}                     OPTIONAL
}

InterFreqCarrierFreqList ::=        SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo

InterFreqCarrierFreqList-v1250 ::=  SEQUENCE (SIZE (1.. maxFreq)) OF InterFreqCarrierFreqInfo-v1250

InterFreqCarrierFreqListExt-r12 ::= SEQUENCE (SIZE (1.. maxFreq)) OF InterFreqCarrierFreqInfo-r12

InterFreqCarrierFreqListExt-v1280 ::=   SEQUENCE (SIZE (1.. maxFreq)) OF InterFreqCarrierFreqInfo-
        v10j0

InterFreqCarrierFreqInfo ::=    SEQUENCE {
    dl-CarrierFreq                      ARFCN-ValueEUTRA,
    q-RxLevMin                          Q-RxLevMin,
```

```
    p-Max                                P-Max                              OPTIONAL,       -- Need OP
    t-ReselectionEUTRA                   T-Reselection,
    t-ReselectionEUTRA-SF                SpeedStateScaleFactors             OPTIONAL,       -- Need OP
    threshX-High                         ReselectionThreshold,
    threshX-Low                          ReselectionThreshold,
    allowedMeasBandwidth                 AllowedMeasBandwidth,
    presenceAntennaPort1                 PresenceAntennaPort1,
    cellReselectionPriority              CellReselectionPriority            OPTIONAL,       -- Need OP
    neighCellConfig                      NeighCellConfig,
    q-OffsetFreq                         Q-OffsetRange                      DEFAULT dB0,
    interFreqNeighCellList               InterFreqNeighCellList             OPTIONAL,       -- Need OR
    interFreqBlackCellList               InterFreqBlackCellList             OPTIONAL,       -- Need OR
    ...,
    [[  q-QualMin-r9                     Q-QualMin-r9                       OPTIONAL,       -- Need OP
        threshX-Q-r9                     SEQUENCE {
            threshX-HighQ-r9                 ReselectionThresholdQ-r9,
            threshX-LowQ-r9                  ReselectionThresholdQ-r9
        }                                                                   OPTIONAL        -- Cond RSRQ
    ]],
    [[  q-QualMinWB-r11                  Q-QualMin-r9                       OPTIONAL    -- Cond WB-RSRQ
    ]]
}

InterFreqCarrierFreqInfo-v8h0 ::=        SEQUENCE {
    multiBandInfoList                    MultiBandInfoList                  OPTIONAL    -- Need OR
}

InterFreqCarrierFreqInfo-v9e0 ::=    SEQUENCE {
    dl-CarrierFreq-v9e0                  ARFCN-ValueEUTRA-v9e0   OPTIONAL,   -- Cond dl-FreqMax
    multiBandInfoList-v9e0               MultiBandInfoList-v9e0  OPTIONAL    -- Need OR
}

InterFreqCarrierFreqInfo-v10j0 ::=   SEQUENCE {
    freqBandInfo-r10                     NS-PmaxList-r10             OPTIONAL,   -- Need OR
    multiBandInfoList-v10j0              MultiBandInfoList-v10j0     OPTIONAL    -- Need OR
}

InterFreqCarrierFreqInfo-v1250 ::=       SEQUENCE {
    reducedMeasPerformance-r12       ENUMERATED {true}       OPTIONAL,       -- Need OP
    q-QualMinRSRQ-OnAllSymbols-r12   Q-QualMin-r9                    OPTIONAL    -- Cond RSRQ2
}

InterFreqCarrierFreqInfo-r12 ::=         SEQUENCE {
    dl-CarrierFreq-r12                   ARFCN-ValueEUTRA-r9,
    q-RxLevMin-r12                       Q-RxLevMin,
    p-Max-r12                            P-Max                              OPTIONAL,       -- Need OP
    t-ReselectionEUTRA-r12               T-Reselection,
    t-ReselectionEUTRA-SF-r12            SpeedStateScaleFactors             OPTIONAL,       -- Need OP
    threshX-High-r12                     ReselectionThreshold,
    threshX-Low-r12                      ReselectionThreshold,
    allowedMeasBandwidth-r12             AllowedMeasBandwidth,
    presenceAntennaPort1-r12             PresenceAntennaPort1,
    cellReselectionPriority-r12          CellReselectionPriority            OPTIONAL,       -- Need OP
    neighCellConfig-r12                  NeighCellConfig,
    q-OffsetFreq-r12                     Q-OffsetRange                      DEFAULT dB0,
    interFreqNeighCellList-r12           InterFreqNeighCellList             OPTIONAL,       -- Need OR
    interFreqBlackCellList-r12           InterFreqBlackCellList             OPTIONAL,       -- Need OR
    q-QualMin-r12                        Q-QualMin-r9                       OPTIONAL,       -- Need OP
    threshX-Q-r12                        SEQUENCE {
        threshX-HighQ-r12                    ReselectionThresholdQ-r9,
        threshX-LowQ-r12                     ReselectionThresholdQ-r9
    }                                                                       OPTIONAL,   -- Cond RSRQ
    q-QualMinWB-r12                      Q-QualMin-r9                       OPTIONAL,   -- Cond WB-RSRQ
    multiBandInfoList-r12                MultiBandInfoList-r11              OPTIONAL,   -- Need OR
    reducedMeasPerformance-r12           ENUMERATED {true}                  OPTIONAL,   -- Need OP
    q-QualMinRSRQ-OnAllSymbols-r12       Q-QualMin-r9                       OPTIONAL,   -- Cond RSRQ2
...
}

InterFreqNeighCellList ::=           SEQUENCE (SIZE (1..maxCellInter)) OF InterFreqNeighCellInfo

InterFreqNeighCellInfo ::=           SEQUENCE {
    physCellId                           PhysCellId,
    q-OffsetCell                         Q-OffsetRange
}

InterFreqBlackCellList ::=           SEQUENCE (SIZE (1..maxCellBlack)) OF PhysCellIdRange
```

```
-- ASN1STOP
```

***SystemInformationBlockType5* field descriptions**
freqBandInfo A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] for the frequency band represented by *dl-CarrierFreq* for which cell reselection parameters are common.
interFreqBlackCellList List of blacklisted inter-frequency neighbouring cells.
interFreqCarrierFreqList List of neighbouring inter-frequencies. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the E-ARFCN used to indicate this. If E-UTRAN includes *interFreqCarrierFreqList-v8h0*, *interFreqCarrierFreqList-v9e0* and/or *InterFreqCarrierFreqList-v1250*, it includes the same number of entries, and listed in the same order, as in *interFreqCarrierFreqList* (i.e. without suffix). See Annex D for more descriptions.
interFreqCarrierFreqListExt List of additional neighbouring inter-frequencies, i.e. extending the size of the inter-frequency carrier list using the general principles specified in 5.1.2. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the E-ARFCN used to indicate this. EUTRAN may include *interFreqCarrierFreqListExt* even if *interFreqCarrierFreqList* (i.e without suffix) does not include *maxFreq* entries.
interFreqNeighCellList List of inter-frequency neighbouring cells with specific cell re-selection parameters.
multiBandInfoList Indicates the list of frequency bands in addition to the band represented by *dl-CarrierFreq* for which cell reselection parameters are common. E-UTRAN indicates at most *maxMultiBands* frequency bands (i.e. the total number of entries across both *multiBandInfoList* and *multiBandInfoList-v9e0* is below this limit).
multiBandInfoList-v10j0 A list of *additionalPmax* and *additionalSpectrumEmission* values as defined in TS 36.101 [42, table 6.2.4-1] for the frequency bands in *multiBandInfoList* (i.e. without suffix) and *multiBandInfoList-v9e0*. If E-UTRAN includes *multiBandInfoList-v10j0*, it includes the same number of entries, and listed in the same order, as in *multiBandInfoList* (i.e. without suffix).
p-Max Value applicable for the neighbouring E-UTRA cells on this carrier frequency. If absent the UE applies the maximum power according to the UE capability.
q-OffsetCell Parameter "$Qoffset_{s,n}$" in TS 36.304 [4].
q-OffsetFreq Parameter "$Qoffset_{frequency}$" in TS 36.304 [4].
q-QualMin Parameter "$Q_{qualmin}$" in TS 36.304 [4]. If the field is not present, the UE applies the (default) value of negative infinity for $Q_{qualmin}$. NOTE 1.
q-QualMinRSRQ-OnAllSymbols If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, perform RSRQ measurement on all OFDM symbols in accordance with TS 36.214 [48]. NOTE 1.
q-QualMinWB If this field is present and supported by the UE, the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [16]. NOTE 1.
reducedMeasPerformance Value *TRUE* indicates that the neighbouring inter-frequency is configured for reduced measurement performance, see TS 36.133 [16]. If the field is not included, the neighbouring inter-frequency is configured for normal measurement performance, see TS 36.133 [16].
threshX-High Parameter "$Thresh_{X, HighP}$" in TS 36.304 [4].
threshX-HighQ Parameter "$Thresh_{X, HighQ}$" in TS 36.304 [4].
threshX-Low Parameter "$Thresh_{X, LowP}$" in TS 36.304 [4].
threshX-LowQ Parameter "$Thresh_{X, LowQ}$" in TS 36.304 [4].
t-ReselectionEUTRA Parameter "$Treselection_{EUTRA}$" in TS 36.304 [4].
t-ReselectionEUTRA-SF Parameter "Speed dependent ScalingFactor for $Treselection_{EUTRA}$" in TS 36.304 [4]. If the field is not present, the UE behaviour is specified in TS 36.304 [4].

NOTE 1: The value the UE applies for parameter "$Q_{qualmin}$" in TS 36.304 [4] depends on the *q-QualMin* fields signalled by E-UTRAN and supported by the UE. In case multiple candidate options are available, the UE shall select the highest priority candidate option according to the priority order indicated by the following table (top row is highest priority).

q-QualMinRSRQ-OnAllSymbols	q-QualMinWB	Value of parameter "$Q_{qualmin}$" in TS 36.304 [4]
Included	Included	*q-QualMinRSRQ-OnAllSymbols* – (*q-QualMin* – *q-QualMinWB*)
Included	Not included	*q-QualMinRSRQ-OnAllSymbols*
Not included	Included	*q-QualMinWB*
Not included	Not included	*q-QualMin*

Conditional presence	Explanation
dl-FreqMax	The field is mandatory present if, for the corresponding entry in *InterFreqCarrierFreqList* (i.e. without suffix), *dl-CarrierFreq* (i.e. without suffix) is set to *maxEARFCN*. Otherwise the field is not present.
RSRQ	The field is mandatory present if *threshServingLowQ* is present in *systemInformationBlockType3*; otherwise it is not present.
RSRQ2	The field is mandatory present for all EUTRA carriers listed in SIB5 if *q-QualMinRSRQ-OnAllSymbols* is present in SIB3; otherwise it is not present and the UE shall delete any existing value for this field.
WB-RSRQ	The field is optionally present, need OP if the measurement bandwidth indicated by *allowedMeasBandwidth* is 50 resource blocks or larger; otherwise it is not present.

– *SystemInformationBlockType6*

The IE *SystemInformationBlockType6* contains information relevant only for inter-RAT cell re-selection i.e. information about UTRA frequencies and UTRA neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency.

SystemInformationBlockType6 information element

```
-- ASN1START

SystemInformationBlockType6 ::=     SEQUENCE {
    carrierFreqListUTRA-FDD             CarrierFreqListUTRA-FDD         OPTIONAL,       -- Need OR
    carrierFreqListUTRA-TDD             CarrierFreqListUTRA-TDD         OPTIONAL,       -- Need OR
    t-ReselectionUTRA                   T-Reselection,
    t-ReselectionUTRA-SF                SpeedStateScaleFactors          OPTIONAL,       -- Need OP
    ...,
    lateNonCriticalExtension            OCTET STRING    (CONTAINING SystemInformationBlockType6-
v8h0-IEs)                       OPTIONAL,
    [[  carrierFreqListUTRA-FDD-v1250 SEQUENCE (SIZE (1..maxUTRA-FDD-Carrier)) OF
                                        CarrierFreqInfoUTRA-v1250       OPTIONAL,   -- Cond UTRA-FDD
        carrierFreqListUTRA-TDD-v1250 SEQUENCE (SIZE (1..maxUTRA-TDD-Carrier)) OF
                                        CarrierFreqInfoUTRA-v1250       OPTIONAL,   -- Cond UTRA-TDD
        carrierFreqListUTRA-FDD-Ext-r12 CarrierFreqListUTRA-FDD-Ext-r12 OPTIONAL,   -- Cond UTRA-FDD
        carrierFreqListUTRA-TDD-Ext-r12     CarrierFreqListUTRA-TDD-Ext-r12 OPTIONAL        -- Cond
UTRA-TDD
    ]]
}

SystemInformationBlockType6-v8h0-IEs ::=    SEQUENCE {
    carrierFreqListUTRA-FDD-v8h0 SEQUENCE (SIZE (1..maxUTRA-FDD-Carrier)) OF CarrierFreqInfoUTRA-
FDD-v8h0 OPTIONAL,  -- Cond UTRA-FDD
    nonCriticalExtension
SEQUENCE {}                         OPTIONAL
}

CarrierFreqInfoUTRA-v1250 ::=       SEQUENCE {
    reducedMeasPerformance-r12      ENUMERATED {true}       OPTIONAL        -- Need OP
}

CarrierFreqListUTRA-FDD ::=     SEQUENCE (SIZE (1..maxUTRA-FDD-Carrier)) OF CarrierFreqUTRA-FDD

CarrierFreqUTRA-FDD ::=             SEQUENCE {
    carrierFreq                         ARFCN-ValueUTRA,
    cellReselectionPriority             CellReselectionPriority         OPTIONAL,       -- Need OP
    threshX-High                        ReselectionThreshold,
```

```
    threshX-Low                         ReselectionThreshold,
    q-RxLevMin                          INTEGER (-60..-13),
    p-MaxUTRA                           INTEGER (-50..33),
    q-QualMin                           INTEGER (-24..0),
    ...,
    [[  threshX-Q-r9                    SEQUENCE {
            threshX-HighQ-r9                ReselectionThresholdQ-r9,
            threshX-LowQ-r9                 ReselectionThresholdQ-r9
        }                                                           OPTIONAL        -- Cond RSRQ
    ]]
}

CarrierFreqInfoUTRA-FDD-v8h0 ::=            SEQUENCE {
    multiBandInfoList                   SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicator-
UTRA-FDD                OPTIONAL    -- Need OR
}

CarrierFreqListUTRA-FDD-Ext-r12 ::= SEQUENCE (SIZE (1..maxUTRA-FDD-Carrier)) OF
                                    CarrierFreqUTRA-FDD-Ext-r12

CarrierFreqUTRA-FDD-Ext-r12 ::=             SEQUENCE {
    carrierFreq-r12                     ARFCN-ValueUTRA,
    cellReselectionPriority-r12         CellReselectionPriority         OPTIONAL,   -- Need OP
    threshX-High-r12                    ReselectionThreshold,
    threshX-Low-r12                     ReselectionThreshold,
    q-RxLevMin-r12                      INTEGER (-60..-13),
    p-MaxUTRA-r12                       INTEGER (-50..33),
    q-QualMin-r12                       INTEGER (-24..0),
    threshX-Q-r12                       SEQUENCE {
            threshX-HighQ-r12               ReselectionThresholdQ-r9,
            threshX-LowQ-r12                ReselectionThresholdQ-r9
    }                                                       OPTIONAL,       -- Cond RSRQ
    multiBandInfoList-r12               SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicator-
UTRA-FDD                OPTIONAL,   -- Need OR
    reducedMeasPerformance-r12          ENUMERATED {true}               OPTIONAL,   -- Need OP
    ...
}

CarrierFreqListUTRA-TDD ::=     SEQUENCE (SIZE (1..maxUTRA-TDD-Carrier)) OF CarrierFreqUTRA-TDD

CarrierFreqUTRA-TDD ::=             SEQUENCE {
    carrierFreq                         ARFCN-ValueUTRA,
    cellReselectionPriority             CellReselectionPriority         OPTIONAL,       -- Need OP
    threshX-High                        ReselectionThreshold,
    threshX-Low                         ReselectionThreshold,
    q-RxLevMin                          INTEGER (-60..-13),
    p-MaxUTRA                           INTEGER (-50..33),
    ...
}

CarrierFreqListUTRA-TDD-Ext-r12 ::= SEQUENCE (SIZE (1..maxUTRA-TDD-Carrier)) OF
                                    CarrierFreqUTRA-TDD-r12

CarrierFreqUTRA-TDD-r12 ::= SEQUENCE {
    carrierFreq-r12                     ARFCN-ValueUTRA,
    cellReselectionPriority-r12         CellReselectionPriority         OPTIONAL,       -- Need OP
    threshX-High-r12                    ReselectionThreshold,
    threshX-Low-r12                     ReselectionThreshold,
    q-RxLevMin-r12                      INTEGER (-60..-13),
    p-MaxUTRA-r12                       INTEGER (-50..33),
    reducedMeasPerformance-r12          ENUMERATED {true}               OPTIONAL,   -- Need OP
    ...
}

FreqBandIndicator-UTRA-FDD ::=              INTEGER (1..86)

-- ASN1STOP
```

SystemInformationBlockType6 field descriptions
carrierFreqListUTRA-FDD List of carrier frequencies of UTRA FDD. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the ARFCN used to indicate this. If E-UTRAN includes *carrierFreqListUTRA-FDD-v8h0* and/or *carrierFreqListUTRA-FDD-v1250*, it includes the same number of entries, and listed in the same order, as in *carrierFreqListUTRA-FDD* (i.e. without suffix). See Annex D for more descriptions.
carrierFreqListUTRA-FDD-Ext List of additional carrier frequencies of UTRA FDD. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the ARFCN used to indicate this. EUTRAN may include *carrierFreqListUTRA-FDD-Ext* even if *carrierFreqListUTRA-FDD* (i.e without suffix) does not include *maxUTRA-FDD-Carrier* entries.
carrierFreqListUTRA-TDD List of carrier frequencies of UTRA TDD. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the ARFCN used to indicate this If E-UTRAN includes *carrierFreqListUTRA-TDD-v1250*, it includes the same number of entries, and listed in the same order, as in *carrierFreqListUTRA-TDD* (i.e. without suffix).
carrierFreqListUTRA-TDD-Ext List of additional carrier frequencies of UTRA TDD. E-UTRAN does not configure more than one entry for the same physical frequency regardless of the ARFCN used to indicate this. EUTRAN may include *carrierFreqListUTRA-TDD-Ext* even if *carrierFreqListUTRA-TDD* (i.e without suffix) does not include *maxUTRA-TDD-Carrier* entries.
multiBandInfoList Indicates the list of frequency bands in addition to the band represented by *carrierFreq* in the *CarrierFreqUTRA-FDD* for which UTRA cell reselection parameters are common.
p-MaxUTRA The maximum allowed transmission power on the (uplink) carrier frequency, see TS 25.304 [40]. In dBm
q-QualMin Parameter "$Q_{qualmin}$" in TS 25.304 [40]. Actual value = IE value [dB].
q-RxLevMin Parameter "$Q_{rxlevmin}$" in TS 25.304 [40]. Actual value = IE value * 2+1 [dBm].
reducedMeasPerformance Value *TRUE* indicates that the UTRA carrier frequency is configured for reduced measurement performance, see TS 36.133 [16]. If the field is not included, the UTRA carrier frequency is configured for normal measurement performance, see TS 36.133 [16].
t-ReselectionUTRA Parameter "$Treselection_{UTRAN}$" in TS 36.304 [4].
t-ReselectionUTRA-SF Parameter "Speed dependent ScalingFactor for $Treselection_{UTRA}$" in TS 36.304 [4]. If the field is not present, the UE behaviour is specified in TS 36.304 [4].
threshX-High Parameter "$Thresh_{X, HighP}$" in TS 36.304 [4].
threshX-HighQ Parameter "$Thresh_{X, HighQ}$" in TS 36.304 [4].
threshX-Low Parameter "$Thresh_{X, LowP}$" in TS 36.304 [4].
threshX-LowQ Parameter "$Thresh_{X, LowQ}$" in TS 36.304 [4].

Conditional presence	Explanation
RSRQ	The field is mandatory present if the *threshServingLowQ* is present in *systemInformationBlockType3*; otherwise it is not present.
UTRA-FDD	The field is optionally present, need OR, if the *carrierFreqListUTRA-FDD* is present. Otherwise it is not present.
UTRA-TDD	The field is optionally present, need OR, if the *carrierFreqListUTRA-TDD* is present. Otherwise it is not present.

– *SystemInformationBlockType7*

The IE *SystemInformationBlockType7* contains information relevant only for inter-RAT cell re-selection i.e. information about GERAN frequencies relevant for cell re-selection. The IE includes cell re-selection parameters for each frequency.

SystemInformationBlockType7 information element

```
-- ASN1START

SystemInformationBlockType7 ::=     SEQUENCE {
    t-ReselectionGERAN                  T-Reselection,
```

```
    t-ReselectionGERAN-SF               SpeedStateScaleFactors              OPTIONAL,   -- Need OR
    carrierFreqsInfoList                CarrierFreqsInfoListGERAN           OPTIONAL,   -- Need OR
    ...,
    lateNonCriticalExtension                OCTET STRING                OPTIONAL
}

CarrierFreqsInfoListGERAN ::=           SEQUENCE (SIZE (1..maxGNFG)) OF CarrierFreqsInfoGERAN

CarrierFreqsInfoGERAN ::=           SEQUENCE {
    carrierFreqs                        CarrierFreqsGERAN,
    commonInfo                          SEQUENCE {
        cellReselectionPriority             CellReselectionPriority         OPTIONAL,   -- Need OP
        ncc-Permitted                       BIT STRING (SIZE (8)),
        q-RxLevMin                          INTEGER (0..45),
        p-MaxGERAN                          INTEGER (0..39)                 OPTIONAL,   -- Need OP
        threshX-High                        ReselectionThreshold,
        threshX-Low                         ReselectionThreshold
    },
    ...
}

-- ASN1STOP
```

***SystemInformationBlockType7* field descriptions**
carrierFreqs The list of GERAN carrier frequencies organised into one group of GERAN carrier frequencies.
carrierFreqsInfoList Provides a list of neighbouring GERAN carrier frequencies, which may be monitored for neighbouring GERAN cells. The GERAN carrier frequencies are organised in groups and the cell reselection parameters are provided per group of GERAN carrier frequencies.
commonInfo Defines the set of cell reselection parameters for the group of GERAN carrier frequencies.
ncc-Permitted Field encoded as a bit map, where bit N is set to "0" if a BCCH carrier with NCC = N-1 is not permitted for monitoring and set to "1" if the BCCH carrier with NCC = N-1 is permitted for monitoring; N = 1 to 8; bit 1 of the bitmap is the leading bit of the bit string.
p-MaxGERAN Maximum allowed transmission power for GERAN on an uplink carrier frequency, see TS 45.008 [28]. Value in dBm. Applicable for the neighbouring GERAN cells on this carrier frequency. If *pmaxGERAN* is absent, the maximum power according to the UE capability is used.
q-RxLevMin Parameter "$Q_{rxlevmin}$" in TS 36.304 [1], minimum required RX level in the GSM cell. The actual value of $Q_{rxlevmin}$ in dBm = (IE value * 2) – 115.
threshX-High Parameter "$Thresh_{X, HighP}$" in TS 36.304 [4].
threshX-Low Parameter "$Thresh_{X, LowP}$" in TS 36.304 [4].
t-ReselectionGERAN Parameter "$Treselection_{GERAN}$" in TS 36.304 [4].
t-ReselectionGERAN-SF Parameter "Speed dependent ScalingFactor for $Treselection_{GERAN}$" in TS 36.304 [4]. If the field is not present, the UE behaviour is specified in TS 36.304 [4].

– *SystemInformationBlockType8*

The IE *SystemInformationBlockType8* contains information relevant only for inter-RAT cell re-selection i.e. information about CDMA2000 frequencies and CDMA2000 neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency as well as cell specific re-selection parameters.

SystemInformationBlockType8 information element

```
-- ASN1START

SystemInformationBlockType8 ::=     SEQUENCE {
    systemTimeInfo                      SystemTimeInfoCDMA2000              OPTIONAL,   -- Need OR
    searchWindowSize                    INTEGER (0..15)                     OPTIONAL,   -- Need OR
    parametersHRPD                      SEQUENCE {
        preRegistrationInfoHRPD             PreRegistrationInfoHRPD,
```

```
        cellReselectionParametersHRPD       CellReselectionParametersCDMA2000   OPTIONAL -- Need OR
    }                                                                           OPTIONAL,   -- Need OR
    parameters1XRTT                     SEQUENCE {
        csfb-RegistrationParam1XRTT         CSFB-RegistrationParam1XRTT     OPTIONAL,   -- Need OP
        longCodeState1XRTT                  BIT STRING (SIZE (42))          OPTIONAL,   -- Need OR
        cellReselectionParameters1XRTT      CellReselectionParametersCDMA2000   OPTIONAL -- Need OR
    }                                                                           OPTIONAL,   -- Need OR
    ...,
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    [[  csfb-SupportForDualRxUEs-r9         BOOLEAN                         OPTIONAL,   -- Need OR
        cellReselectionParametersHRPD-v920  CellReselectionParametersCDMA2000-v920  OPTIONAL,   --
Cond NCL-HRPD
        cellReselectionParameters1XRTT-v920 CellReselectionParametersCDMA2000-v920  OPTIONAL,   --
Cond NCL-1XRTT
        csfb-RegistrationParam1XRTT-v920    CSFB-RegistrationParam1XRTT-v920        OPTIONAL,   --
Cond REG-1XRTT
        ac-BarringConfig1XRTT-r9            AC-BarringConfig1XRTT-r9    OPTIONAL    -- Cond REG-
1XRTT
    ]],
    [[  csfb-DualRxTxSupport-r10            ENUMERATED {true}           OPTIONAL    -- Cond REG-
1XRTT
    ]],
    [[  sib8-PerPLMN-List-r11               SIB8-PerPLMN-List-r11       OPTIONAL    -- Need OR
    ]]
}

CellReselectionParametersCDMA2000 ::= SEQUENCE {
    bandClassList                       BandClassListCDMA2000,
    neighCellList                       NeighCellListCDMA2000,
    t-ReselectionCDMA2000           T-Reselection,
    t-ReselectionCDMA2000-SF            SpeedStateScaleFactors              OPTIONAL    -- Need OP
}

CellReselectionParametersCDMA2000-r11 ::= SEQUENCE {
    bandClassList                       BandClassListCDMA2000,
    neighCellList-r11                   SEQUENCE (SIZE (1..16)) OF NeighCellCDMA2000-r11,
    t-ReselectionCDMA2000               T-Reselection,
    t-ReselectionCDMA2000-SF            SpeedStateScaleFactors              OPTIONAL    -- Need OP
}

CellReselectionParametersCDMA2000-v920 ::= SEQUENCE {
    neighCellList-v920                      NeighCellListCDMA2000-v920
}

NeighCellListCDMA2000 ::=           SEQUENCE (SIZE (1..16)) OF NeighCellCDMA2000

NeighCellCDMA2000 ::=   SEQUENCE {
    bandClass                           BandclassCDMA2000,
    neighCellsPerFreqList               NeighCellsPerBandclassListCDMA2000
}

NeighCellCDMA2000-r11 ::=   SEQUENCE {
    bandClass                           BandclassCDMA2000,
    neighFreqInfoList-r11               SEQUENCE (SIZE (1..16)) OF NeighCellsPerBandclassCDMA2000-
r11
}

NeighCellsPerBandclassListCDMA2000 ::= SEQUENCE (SIZE (1..16)) OF NeighCellsPerBandclassCDMA2000

NeighCellsPerBandclassCDMA2000 ::=  SEQUENCE {
    arfcn                               ARFCN-ValueCDMA2000,
    physCellIdList                      PhysCellIdListCDMA2000
}

NeighCellsPerBandclassCDMA2000-r11 ::=  SEQUENCE {
    arfcn                               ARFCN-ValueCDMA2000,
    physCellIdList-r11                  SEQUENCE (SIZE (1..40)) OF PhysCellIdCDMA2000
}

NeighCellListCDMA2000-v920 ::=      SEQUENCE (SIZE (1..16)) OF NeighCellCDMA2000-v920

NeighCellCDMA2000-v920 ::=          SEQUENCE {
    neighCellsPerFreqList-v920          NeighCellsPerBandclassListCDMA2000-v920
}

NeighCellsPerBandclassListCDMA2000-v920 ::= SEQUENCE (SIZE (1..16)) OF
NeighCellsPerBandclassCDMA2000-v920
```

```
NeighCellsPerBandclassCDMA2000-v920 ::= SEQUENCE {
    physCellIdList-v920                 PhysCellIdListCDMA2000-v920
}

PhysCellIdListCDMA2000 ::=          SEQUENCE (SIZE (1..16)) OF PhysCellIdCDMA2000

PhysCellIdListCDMA2000-v920 ::=     SEQUENCE (SIZE (0..24)) OF PhysCellIdCDMA2000

BandClassListCDMA2000 ::=           SEQUENCE (SIZE (1..maxCDMA-BandClass)) OF BandClassInfoCDMA2000

BandClassInfoCDMA2000 ::=   SEQUENCE {
    bandClass                           BandclassCDMA2000,
    cellReselectionPriority             CellReselectionPriority             OPTIONAL,   -- Need OP
    threshX-High                        INTEGER (0..63),
    threshX-Low                         INTEGER (0..63),
    ...
}

AC-BarringConfig1XRTT-r9 ::=        SEQUENCE {
    ac-Barring0to9-r9                   INTEGER (0..63),
    ac-Barring10-r9                     INTEGER (0..7),
    ac-Barring11-r9                     INTEGER (0..7),
    ac-Barring12-r9                     INTEGER (0..7),
    ac-Barring13-r9                     INTEGER (0..7),
    ac-Barring14-r9                     INTEGER (0..7),
    ac-Barring15-r9                     INTEGER (0..7),
    ac-BarringMsg-r9                    INTEGER (0..7),
    ac-BarringReg-r9                    INTEGER (0..7),
    ac-BarringEmg-r9                    INTEGER (0..7)
}

SIB8-PerPLMN-List-r11 ::=           SEQUENCE (SIZE (1..maxPLMN-r11)) OF SIB8-PerPLMN-r11

SIB8-PerPLMN-r11 ::=                SEQUENCE {
    plmn-Identity-r11                   INTEGER (1..maxPLMN-r11),
    parametersCDMA2000-r11              CHOICE {
        explicitValue                       ParametersCDMA2000-r11,
        defaultValue                        NULL
    }
}

ParametersCDMA2000-r11 ::=          SEQUENCE {
    systemTimeInfo-r11                  CHOICE  {
        explicitValue                       SystemTimeInfoCDMA2000,
        defaultValue                        NULL
    }                                                           OPTIONAL,   -- Need OR
    searchWindowSize-r11                INTEGER (0..15),
    parametersHRPD-r11                  SEQUENCE {
        preRegistrationInfoHRPD-r11         PreRegistrationInfoHRPD,
        cellReselectionParametersHRPD-r11   CellReselectionParametersCDMA2000-r11   OPTIONAL -- Need
OR
    }       OPTIONAL,   -- Need OR
    parameters1XRTT-r11                 SEQUENCE {
        csfb-RegistrationParam1XRTT-r11     CSFB-RegistrationParam1XRTT         OPTIONAL, -- Need OP
        csfb-RegistrationParam1XRTT-Ext-r11 CSFB-RegistrationParam1XRTT-v920    OPTIONAL, -- Cond
REG-1XRTT-PerPLMN
        longCodeState1XRTT-r11              BIT STRING (SIZE (42))  OPTIONAL, -- Cond PerPLMN-LC
        cellReselectionParameters1XRTT-r11  CellReselectionParametersCDMA2000-r11   OPTIONAL, --
Need OR
        ac-BarringConfig1XRTT-r11           AC-BarringConfig1XRTT-r9            OPTIONAL, -- Cond
REG-1XRTT-PerPLMN
        csfb-SupportForDualRxUEs-r11        BOOLEAN                             OPTIONAL, -- Need OR
        csfb-DualRxTxSupport-r11            ENUMERATED {true}          OPTIONAL -- Cond REG-1XRTT-
PerPLMN
    }       OPTIONAL,   -- Need OR
    ...
}

-- ASN1STOP
```

***SystemInformationBlockType8* field descriptions**
ac-BarringConfig1XRTT Contains the access class barring parameters the UE uses to calculate the access class barring factor, see C.S0097 [53].
ac-Barring0to9 Parameter used for calculating the access class barring factor for access overload classes 0 through 9. It is the parameter "PSIST" in C.S0004 [34] for access overload classes 0 through 9.
ac-BarringEmg Parameter used for calculating the access class barring factor for emergency calls and emergency message transmissions for access overload classes 0 through 9. It is the parameter "PSIST_EMG" in C.S0004 [34].
ac-BarringMsg Parameter used for modifying the access class barring factor for message transmissions. It is the parameter "MSG_PSIST" in C.S0004 [34].
ac-BarringN Parameter used for calculating the access class barring factor for access overload class N (N = 10 to 15). It is the parameter "PSIST" in C.S0004 [34] for access overload class N.
ac-BarringReg Parameter used for modifying the access class barring factor for autonomous registrations. It is the parameter "REG_PSIST" in C.S0004 [34].
bandClass Identifies the Frequency Band in which the Carrier can be found. Details can be found in C.S0057 [24, Table 1.5].
bandClassList List of CDMA2000 frequency bands.
cellReselectionParameters1XRTT Cell reselection parameters applicable only to CDMA2000 1xRTT system.
cellReselectionParameters1XRTT-Ext Cell reselection parameters applicable for cell reselection to CDMA2000 1XRTT system.
cellReselectionParameters1XRTT-v920 Cell reselection parameters applicable for cell reselection to CDMA2000 1XRTT system. The field is not present if *cellReselectionParameters1XRTT* is not present; otherwise it is optionally present.
cellReselectionParametersHRPD Cell reselection parameters applicable for cell reselection to CDMA2000 HRPD system
cellReselectionParametersHRPD-Ext Cell reselection parameters applicable for cell reselection to CDMA2000 HRPD system.
cellReselectionParametersHRPD-v920 Cell reselection parameters applicable for cell reselection to CDMA2000 HRPD system. The field is not present if *cellReselectionParametersHRPD* is not present; otherwise it is optionally present.
csfb-DualRxTxSupport Value TRUE indicates that the network supports dual Rx/Tx enhanced 1xCSFB, which enables UEs capable of dual Rx/Tx enhanced 1xCSFB to switch off their 1xRTT receiver/transmitter while camped in E-UTRAN [51].
csfb-RegistrationParam1XRTT Contains the parameters the UE will use to determine if it should perform a CDMA2000 1xRTT Registration/Re-Registration. This field is included if either CSFB or enhanced CS fallback to CDMA2000 1xRTT is supported.
csfb-SupportForDualRxUEs Value TRUE indicates that the network supports dual Rx CSFB [51].
longCodeState1XRTT The state of long code generation registers in CDMA2000 1XRTT system as defined in C.S0002 [12, Section 1.3] at $\lceil t/10 \rceil \times 10 + 320$ ms, where *t* equals to the *cdma-SystemTime*. This field is required for 1xRTT Inter-RAT ANR, SRVCC handover and enhanced CS fallback to CDMA2000 1xRTT operation. Otherwise this IE is not needed. This field is excluded when estimating changes in system information, i.e. changes of *longCodeState1XRTT* should neither result in system information change notifications nor in a modification of *systemInfoValueTag* in SIB1.
neighCellList List of CDMA2000 neighbouring cells. The total number of neighbouring cells in neighCellList for each RAT (1XRTT or HRPD) is limited to 32.
neighCellList-v920 Extended List of CDMA2000 neighbouring cells. The combined total number of CDMA2000 neighbouring cells in both *neighCellList* and *neighCellList-v920* is limited to 32 for HRPD and 40 for 1xRTT.

***SystemInformationBlockType8* field descriptions**
neighCellsPerFreqList
List of carrier frequencies and neighbour cell ids in each frequency within a CDMA2000 Band, see C.S0002 [12] or C.S0024 [26].
neighCellsPerFreqList-v920
Extended list of neighbour cell ids, in the same CDMA2000 Frequency Band as the corresponding instance in "NeighCellListCDMA2000".
parameters1XRTT
Parameters applicable for interworking with CDMA2000 1XRTT system.
parametersCDMA2000
Provides the corresponding SIB8 parameters for the CDMA2000 network associated with the PLMN indicated in *plmn-Identity*. A choice is used to indicate whether for this PLMN the parameters are signalled explicitly or set to the (default) values common for all PLMNs i.e. the values not included in *sib8-PerPLMN-List*.
parametersHRPD
Parameters applicable only for interworking with CDMA2000 HRPD systems.
physCellIdList
Identifies the list of CDMA2000 cell ids, see C.S0002 [12] or C.S0024 [26].
physCellIdList-v920
Extended list of CDMA2000 cell ids, in the same CDMA2000 ARFCN as the corresponding instance in "NeighCellsPerBandclassCDMA2000".
plmn-Identity
Indicates the PLMN associated with this CDMA2000 network. Value 1 indicates the PLMN listed 1st in *plmn-IdentityList* included in SIB1, value 2 indicates the PLMN listed 2nd in *plmn-IdentityList* included in SIB1 and so on. A PLMN which identity is not indicated in the *sib8-PerPLMN-List*, does not support inter-working with CDMA2000.
preRegistrationInfoHRPD
The CDMA2000 HRPD Pre-Registration Information tells the UE if it should pre-register with the CDMA2000 HRPD network and identifies the Pre-registration zone to the UE.
searchWindowSize
The search window size is a CDMA2000 parameter to be used to assist in searching for the neighbouring pilots. For values see C.S0005 [25, Table 2.6.6.2.1-1] and C.S0024 [26, Table 8.7.6.2-4]. This field is required for a UE with *rx-ConfigHRPD= single* and/ or *rx-Config1XRTT= single* to perform handover, cell re-selection, UE measurement based redirection and enhanced 1xRTT CS fallback from E-UTRAN to CDMA2000 according to this specification and TS 36.304 [4].
sib8-PerPLMN-List
This field provides the values for the interworking CDMA2000 networks corresponding, if any, to the UE's RPLMN.
systemTimeInfo
Information on CDMA2000 system time. This field is required for a UE with *rx-ConfigHRPD= single* and/ or *rx-Config1XRTT= single* to perform handover, cell re-selection, UE measurement based redirection and enhanced 1xRTT CS fallback from E-UTRAN to CDMA2000 according to this specification and TS 36.304 [4]. This field is excluded when estimating changes in system information, i.e. changes of *systemTimeInfo* should neither result in system information change notifications nor in a modification of *systemInfoValueTag* in SIB1. For the field included in *ParametersCDMA2000*, a choice is used to indicate whether for this PLMN the parameters are signalled explicitly or set to the (default) value common for all PLMNs i.e. the value not included in *sib8-PerPLMN-List*.
threshX-High
Parameter "$Thresh_{X, HighP}$" in TS 36.304 [4]. This specifies the high threshold used in reselection towards this CDMA2000 band class expressed as an unsigned binary number equal to FLOOR (-2 x 10 x $\log_{10}$ E_c/I_o) in units of 0.5 dB, as defined in C.S0005 [25].
threshX-Low
Parameter "$Thresh_{X, LowP}$" in TS 36.304 [4]. This specifies the low threshold used in reselection towards this CDMA2000 band class expressed as an unsigned binary number equal to FLOOR (-2 x 10 x $\log_{10}$ E_c/I_o) in units of 0.5 dB, as defined in C.S0005 [25].
t-ReselectionCDMA2000
Parameter "$Treselection_{CDMA\_HRPD}$" or "$Treselection_{CDMA\_1xRTT}$" in TS 36.304 [4].
t-ReselectionCDMA2000-SF
Parameter "Speed dependent ScalingFactor for $Treselection_{CDMA-HRPD}$" or "$Treselection_{CDMA-1xRTT}$" in TS 36.304 [4]. If the field is not present, the UE behaviour is specified in TS 36.304 [4].

Conditional presence	Explanation
NCL-1XRTT	The field is optional present, need OR, if *cellReselectionParameters1xRTT* is present; otherwise it is not present.
NCL-HRPD	The field is optional present, need OR, if *cellReselectionParametersHRPD* is present; otherwise it is not present.
PerPLMN-LC	The field is optional present, need OR, when *systemTimeInfo* is included in *SIB8PerPLMN* for this CDMA2000 network; otherwise it is not present.
REG-1XRTT	The field is optional present, need OR, if *csfb-RegistrationParam1XRTT* is present; otherwise it is not present.
REG-1XRTT-PerPLMN	The field is optional present, need OR, if *csfb-RegistrationParam1XRTT* is included in *SIB8PerPLMN* for this CDMA2000 network; otherwise it is not present.

– *SystemInformationBlockType9*

The IE *SystemInformationBlockType9* contains a home eNB name (HNB Name).

SystemInformationBlockType9 information element

```
-- ASN1START

SystemInformationBlockType9 ::=     SEQUENCE {
    hnb-Name                            OCTET STRING (SIZE(1..48))      OPTIONAL,   -- Need OR
    ...,
    lateNonCriticalExtension                OCTET STRING                OPTIONAL
}

-- ASN1STOP
```

***SystemInformationBlockType9* field descriptions**
hnb-Name
Carries the name of the home eNB, coded in UTF-8 with variable number of bytes per character, see TS 22.011 [10].

– *SystemInformationBlockType10*

The IE *SystemInformationBlockType10* contains an ETWS primary notification.

SystemInformationBlockType10 information element

```
-- ASN1START

SystemInformationBlockType10 ::=    SEQUENCE {
    messageIdentifier                   BIT STRING (SIZE (16)),
    serialNumber                        BIT STRING (SIZE (16)),
    warningType                         OCTET STRING (SIZE (2)),
    dummy                               OCTET STRING (SIZE (50))    OPTIONAL,       -- Need OP
    ...,
    lateNonCriticalExtension            OCTET STRING                OPTIONAL
}

-- ASN1STOP
```

***SystemInformationBlockType10* field descriptions**
messageIdentifier
Identifies the source and type of ETWS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.44]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.1], while the trailing bit contains bit 0 of the second octet of the same equivalent IE.
serialNumber
Identifies variations of an ETWS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.45]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.2], while the trailing bit contains bit 0 of the second octet of the same equivalent IE.
dummy
This field is not used in the specification. If received it shall be ignored by the UE.
warningType
Identifies the warning type of the ETWS primary notification and provides information on emergency user alert and UE popup. The first octet (which is equivalent to the first octet of the equivalent IE defined in TS 36.413 [39, 9.2.1.50]) contains the first octet of the equivalent IE defined in and encoded according to TS 23.041 [37, 9.3.24], and so on.

– *SystemInformationBlockType11*

The IE *SystemInformationBlockType11* contains an ETWS secondary notification.

SystemInformationBlockType11 information element

```
-- ASN1START

SystemInformationBlockType11 ::=    SEQUENCE {
    messageIdentifier                   BIT STRING (SIZE (16)),
    serialNumber                        BIT STRING (SIZE (16)),
    warningMessageSegmentType           ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegmentNumber         INTEGER (0..63),
    warningMessageSegment               OCTET STRING,
    dataCodingScheme                    OCTET STRING (SIZE (1))         OPTIONAL,   -- Cond Segment1
    ...,
    lateNonCriticalExtension                OCTET STRING                OPTIONAL
}

-- ASN1STOP
```

***SystemInformationBlockType11* field descriptions**
dataCodingScheme
Identifies the alphabet/coding and the language applied variations of an ETWS notification. The octet (which is equivalent to the octet of the equivalent IE defined in TS 36.413 [39, 9.2.1.52]) contains the octet of the equivalent IE defined in TS 23.041 [37, 9.4.3.2.3] and encoded according to TS 23.038 [38].
messageIdentifier
Identifies the source and type of ETWS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.44]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.1], while the trailing bit contains bit 0 of second octet of the same equivalent IE.
serialNumber
Identifies variations of an ETWS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.45]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.2], while the trailing bit contains bit 0 of second octet of the same equivalent IE.
warningMessageSegment
Carries a segment of the *Warning Message Contents* IE defined in TS 36.413 [39, 9.2.1.53]. The first octet of the *Warning Message Contents* IE is equivalent to the first octet of the *CB data* IE defined in and encoded according to TS 23.041 [37, 9.4.2.2.5] and so on.
warningMessageSegmentNumber
Segment number of the ETWS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, one corresponds to the second segment, and so on.
warningMessageSegmentType
Indicates whether the included ETWS warning message segment is the last segment or not.

Conditional presence	Explanation
Segment1	The field is mandatory present in the first segment of SIB11, otherwise it is not present.

– *SystemInformationBlockType12*

The IE *SystemInformationBlockType12* contains a CMAS notification.

SystemInformationBlockType12 information element

```
-- ASN1START

SystemInformationBlockType12-r9 ::= SEQUENCE {
    messageIdentifier-r9               BIT STRING (SIZE (16)),
    serialNumber-r9                    BIT STRING (SIZE (16)),
    warningMessageSegmentType-r9       ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegmentNumber-r9     INTEGER (0..63),
    warningMessageSegment-r9           OCTET STRING,
    dataCodingScheme-r9                OCTET STRING (SIZE (1))         OPTIONAL,   -- Cond Segment1
    lateNonCriticalExtension           OCTET STRING                    OPTIONAL,
    ...
}

-- ASN1STOP
```

***SystemInformationBlockType12* field descriptions**
dataCodingScheme Identifies the alphabet/coding and the language applied variations of a CMAS notification. The octet (which is equivalent to the octet of the equivalent IE defined in TS 36.413 [39, 9.2.1.52]) contains the octet of the equivalent IE defined in TS 23.041 [37, 9.4.3.2.3] and encoded according to TS 23.038 [38].
messageIdentifier Identifies the source and type of CMAS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.44]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.1], while the trailing bit contains bit 0 of second octet of the same equivalent IE.
serialNumber Identifies variations of a CMAS notification. The leading bit (which is equivalent to the leading bit of the equivalent IE defined in TS 36.413 [39, 9.2.1.45]) contains bit 7 of the first octet of the equivalent IE, defined in and encoded according to TS 23.041 [37, 9.4.3.2.2], while the trailing bit contains bit 0 of second octet of the same equivalent IE.
warningMessageSegment Carries a segment of the *Warning Message Contents* IE defined in TS 36.413 [39]. The first octet of the *Warning Message Contents* IE is equivalent to the first octet of the *CB data* IE defined in and encoded according to TS 23.041 [37, 9.4.2.2.5] and so on.
warningMessageSegmentNumber Segment number of the CMAS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, one corresponds to the second segment, and so on.
warningMessageSegmentType Indicates whether the included CMAS warning message segment is the last segment or not.

Conditional presence	Explanation
Segment1	The field is mandatory present in the first segment of SIB12, otherwise it is not present.

– *SystemInformationBlockType13*

The IE *SystemInformationBlockType13* contains the information required to acquire the MBMS control information associated with one or more MBSFN areas.

SystemInformationBlockType13 information element

```
-- ASN1START

SystemInformationBlockType13-r9 ::= SEQUENCE {
    mbsfn-AreaInfoList-r9              MBSFN-AreaInfoList-r9,
```

```
    notificationConfig-r9               MBMS-NotificationConfig-r9,
    lateNonCriticalExtension            OCTET STRING                    OPTIONAL,
    ...
}

-- ASN1STOP
```

– SystemInformationBlockType14

The IE *SystemInformationBlockType14* contains the EAB parameters.

SystemInformationBlockType14 information element

```
-- ASN1START

SystemInformationBlockType14-r11 ::=    SEQUENCE {
    eab-Param-r11                           CHOICE {
        eab-Common-r11                          EAB-Config-r11,
        eab-PerPLMN-List-r11                    SEQUENCE (SIZE (1..maxPLMN-r11)) OF EAB-ConfigPLMN-
r11
    }                                                       OPTIONAL, -- Need OR
    lateNonCriticalExtension                OCTET STRING            OPTIONAL,
    ...
}

EAB-ConfigPLMN-r11 ::=              SEQUENCE {
    eab-Config-r11                      EAB-Config-r11              OPTIONAL -- Need OR
}

EAB-Config-r11 ::=                  SEQUENCE {
    eab-Category-r11                    ENUMERATED {a, b, c},
    eab-BarringBitmap-r11               BIT STRING (SIZE (10))
}

-- ASN1STOP
```

***SystemInformationBlockType14* field descriptions**
eab-BarringBitmap Extended access class barring for AC 0-9. The first/ leftmost bit is for AC 0, the second bit is for AC 1, and so on.
eab-Category Indicates the category of UEs for which EAB applies. Value *a* corresponds to all UEs, value *b* corresponds to the UEs that are neither in their HPLMN nor in a PLMN that is equivalent to it, and value *c* corresponds to the UEs that are neither in the PLMN listed as most preferred PLMN of the country where the UEs are roaming in the operator-defined PLMN selector list on the USIM, nor in their HPLMN nor in a PLMN that is equivalent to their HPLMN, see TS 22.011 [10].
eab-Common The EAB parameters applicable for all PLMN(s).
eab-PerPLMN-List The EAB parameters per PLMN, listed in the same order as the PLMN(s) occur in *plmn-IdentityList* in *SystemInformationBlockType1*.

– SystemInformationBlockType15

The IE *SystemInformationBlockType15* contains the MBMS Service Area Identities (SAI) of the current and/ or neighbouring carrier frequencies.

SystemInformationBlockType15 information element

```
-- ASN1START

SystemInformationBlockType15-r11 ::=    SEQUENCE {
    mbms-SAI-IntraFreq-r11                  MBMS-SAI-List-r11               OPTIONAL,   -- Need OR
    mbms-SAI-InterFreqList-r11              MBMS-SAI-InterFreqList-r11      OPTIONAL,   -- Need OR
    lateNonCriticalExtension                OCTET STRING                    OPTIONAL,
    ...,
    [[  mbms-SAI-InterFreqList-v1140        MBMS-SAI-InterFreqList-v1140    OPTIONAL    -- Cond
InterFreq
    ]]
}
```

```
MBMS-SAI-List-r11 ::=                   SEQUENCE (SIZE (1..maxSAI-MBMS-r11)) OF MBMS-SAI-r11

MBMS-SAI-r11 ::=                        INTEGER (0..65535)

MBMS-SAI-InterFreqList-r11 ::=          SEQUENCE (SIZE (1..maxFreq)) OF MBMS-SAI-InterFreq-r11

MBMS-SAI-InterFreqList-v1140 ::=        SEQUENCE (SIZE (1..maxFreq)) OF MBMS-SAI-InterFreq-v1140

MBMS-SAI-InterFreq-r11 ::=              SEQUENCE {
    dl-CarrierFreq-r11                      ARFCN-ValueEUTRA-r9,
    mbms-SAI-List-r11                       MBMS-SAI-List-r11
}

MBMS-SAI-InterFreq-v1140 ::=            SEQUENCE {
        multiBandInfoList-r11               MultiBandInfoList-r11           OPTIONAL    -- Need OR
}


-- ASN1STOP
```

***SystemInformationBlockType15* field descriptions**
mbms-SAI-InterFreqList Contains a list of neighboring frequencies including additional bands, if any, that provide MBMS services and the corresponding MBMS SAIs.
mbms-SAI-IntraFreq Contains the list of MBMS SAIs for the current frequency. A duplicate MBMS SAI indicates that this and all following SAIs are not offered by this cell but only by neighbour cells on the current frequency. For MBMS service continuity, the UE shall use all MBMS SAIs listed in *mbms-SAI-IntraFreq* to derive the MBMS frequencies of interest.
mbms-SAI-List Contains a list of MBMS SAIs for a specific frequency.
multiBandInfoList A list of additional frequency bands applicable for the cells participating in the MBSFN transmission.

Conditional presence	Explanation
InterFreq	The field is optionally present, need OR, if the *mbms-SAI-InterFreqList-r11* is present. Otherwise it is not present.

– *SystemInformationBlockType16*

The IE *SystemInformationBlockType16* contains information related to GPS time and Coordinated Universal Time (UTC). The UE may use the parameters provided in this system information block to obtain the UTC, the GPS and the local time.

NOTE: The UE may use the time information for numerous purposes, possibly involving upper layers e.g. to assist GPS initialisation, to synchronise the UE clock (a.o. to determine MBMS session start/ stop).

SystemInformationBlockType16 information element

```
-- ASN1START

SystemInformationBlockType16-r11 ::=        SEQUENCE {
    timeInfo-r11                            SEQUENCE {
        timeInfoUTC-r11                     INTEGER (0..549755813887),
        dayLightSavingTime-r11              BIT STRING (SIZE (2))       OPTIONAL,   -- Need OR
        leapSeconds-r11                     INTEGER (-127..128)         OPTIONAL,   -- Need OR
        localTimeOffset-r11                 INTEGER (-63..64)           OPTIONAL    -- Need OR
    }                                                                   OPTIONAL,   -- Need OR
    lateNonCriticalExtension            OCTET STRING                OPTIONAL,
    ...
}

-- ASN1STOP
```

SystemInformationBlockType16 field descriptions
dayLightSavingTime
It indicates if and how daylight saving time (DST) is applied to obtain the local time. The semantics is the same as the semantics of the *Daylight Saving Time* IE in TS 24.301 [35] and TS 24.008 [49]. The first/leftmost bit of the bit string contains the b2 of octet 3, i.e. the value part of the *Daylight Saving Time* IE, and the second bit of the bit string contains b1 of octet 3.
leapSeconds
Number of leap seconds offset between GPS Time and UTC. UTC and GPS time are related i.e. GPS time - *leapSeconds* = UTC time.
localTimeOffset
Offset between UTC and local time in units of 15 minutes. Actual value = IE value * 15 minutes. Local time of the day is calculated as UTC time + *localTimeOffset.*
timeInfoUTC
Coordinated Universal Time corresponding to the SFN boundary at or immediately after the ending boundary of the SI-window in which *SystemInformationBlockType16* is transmitted. The field counts the number of UTC seconds in 10 ms units since 00:00:00 on Gregorian calendar date 1 January, 1900 (midnight between Sunday, December 31, 1899 and Monday, January 1, 1900), including leap seconds and other additions prior to 1972. NOTE 1. This field is excluded when estimating changes in system information, i.e. changes of *timeInfoUTC* should neither result in system information change notifications nor in a modification of *systemInfoValueTag* in SIB1.

NOTE 1: For the sake of the field definition, it is assumed UTC existed prior to 1 January 1972. As this field counts total elapsed time, conversion to calendar UTC time needs to allow for leap second and other calendar adjustments since 1 January 1900. For example, time 00:00 on 1 January 1972 UTC corresponds to a *timeInfoUTC* of 2,272,060,800 seconds.

– *SystemInformationBlockType17*

The IE *SystemInformationBlockType17* contains information relevant for traffic steering between E-UTRAN and WLAN.

SystemInformationBlockType17 information element

```
-- ASN1START

SystemInformationBlockType17-r12 ::=    SEQUENCE {
    wlan-OffloadInfoPerPLMN-List-r12        SEQUENCE (SIZE (1..maxPLMN-r11)) OF
                                         WLAN-OffloadInfoPerPLMN-r12        OPTIONAL, -- Need OR
    lateNonCriticalExtension                OCTET STRING                OPTIONAL,
    ...
}

WLAN-OffloadInfoPerPLMN-r12 ::=             SEQUENCE {
        wlan-OffloadConfigCommon-r12        WLAN-OffloadConfig-r12      OPTIONAL,   -- Need OR
        wlan-Id-List-r12                    WLAN-Id-List-r12            OPTIONAL,   -- Need OR
        ...
}

WLAN-Id-List-r12 ::=                SEQUENCE (SIZE (1..maxWLAN-Id-r12)) OF WLAN-Identifiers-r12

WLAN-Identifiers-r12 ::=            SEQUENCE {
    ssid-r12                    OCTET STRING (SIZE (1..32))     OPTIONAL,   -- Need OR
    bssid-r12                       OCTET STRING (SIZE (6))             OPTIONAL,   -- Need OR
    hessid-r12                      OCTET STRING (SIZE (6))             OPTIONAL,   -- Need OR
    ...
}

-- ASN1STOP
```

SystemInformationBlockType17 field descriptions
bssid
Basic Service Set Identifier (BSSID) defined in IEEE 802.11-2012 [67].
hessid
Homogenous Extended Service Set Identifier (HESSID) defined in IEEE 802.11-2012 [67].
ssid
Service Set Identifier (SSID) defined in IEEE 802.11-2012 [67].

SystemInformationBlockType17 field descriptions
wlan-OffloadInfoPerPLMN-List The WLAN offload configuration per PLMN includes the same number of entries, listed in the same order as the PLMN(s) in *plmn-IdentityList* in *SystemInformationBlockType1*.

– SystemInformationBlockType18

The IE *SystemInformationBlockType18* indicates E-UTRAN supports the Sidelink UE information procedure and may contain sidelink communication related resource configuration information.

SystemInformationBlockType18 information element

```
-- ASN1START

SystemInformationBlockType18-r12 ::= SEQUENCE {
    commConfig-r12                      SEQUENCE {
        commRxPool-r12                      SL-CommRxPoolList-r12,
        commTxPoolNormalCommon-r12          SL-CommTxPoolList-r12           OPTIONAL,   -- Need OR
        commTxPoolExceptional-r12           SL-CommTxPoolList-r12           OPTIONAL,   -- Need OR
        commSyncConfig-r12                  SL-SyncConfigList-r12       OPTIONAL    -- Need OR
    }                                                                       OPTIONAL,   -- Need OR
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    ...
}

-- ASN1STOP
```

SystemInformationBlockType18 field descriptions
commRxPool Indicates the resources by which the UE is allowed to receive sidelink communication while in RRC_IDLE and while in RRC_CONNECTED.
commSyncConfig Indicates the configuration by which the UE is allowed to receive and transmit synchronisation information. E-UTRAN configures *commSyncConfig* including *txParameters* when configuring UEs by dedicated signalling to transmit synchronisation information.
commTxPoolExceptional Indicates the resources by which the UE is allowed to transmit sidelink communication in exceptional conditions, as specified in 5.10.4.
commTxPoolNormalCommon Indicates the resources by which the UE is allowed to transmit sidelink communication while in RRC_IDLE or when in RRC_CONNECTED while transmitting sidelink via a frequency other than the primary.

– SystemInformationBlockType19

The IE *SystemInformationBlockType19* indicates E-UTRAN supports the sidelink UE information procedure and may contain sidelink discovery related resource configuration information.

SystemInformationBlockType19 information element

```
-- ASN1START

SystemInformationBlockType19-r12 ::= SEQUENCE {
    discConfig-r12                      SEQUENCE {
        discRxPool-r12                      SL-DiscRxPoolList-r12,
        discTxPoolCommon-r12                SL-DiscTxPoolList-r12           OPTIONAL,   -- Need OR
        discTxPowerInfo-r12             SL-DiscTxPowerInfoList-r12  OPTIONAL,   -- Cond Tx
        discSyncConfig-r12                  SL-SyncConfigList-r12       OPTIONAL    -- Need OR
    }                                                                       OPTIONAL,   -- Need OR
    discInterFreqList-r12               SL-CarrierFreqInfoList-r12      OPTIONAL,   -- Need OR
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,
    ...
}

SL-CarrierFreqInfoList-r12 ::=  SEQUENCE (SIZE (1..maxFreq)) OF SL-CarrierFreqInfo-r12

SL-CarrierFreqInfo-r12::=       SEQUENCE {
    carrierFreq-r12                     ARFCN-ValueEUTRA-r9,
```

```
    plmn-IdentityList-r12           PLMN-IdentityList4-r12          OPTIONAL    -- Need OP
}

PLMN-IdentityList4-r12 ::=  SEQUENCE (SIZE (1..maxPLMN-r11)) OF PLMN-IdentityInfo2-r12

PLMN-IdentityInfo2-r12 ::=      CHOICE  {
    plmn-Index-r12                  INTEGER (1..maxPLMN-r11),
    plmnIdentity-r12                PLMN-Identity
}

-- ASN1STOP
```

***SystemInformationBlockType19* field descriptions**
discInterFreqList Indicates the neighbouring frequencies on which sidelink discovery announcement is supported.
discRxPool Indicates the resources by which the UE is allowed to receive sidelink discovery announcements while in RRC_IDLE and while in RRC_CONNECTED.
discSyncConfig Indicates the configuration by which the UE is allowed to receive and transmit synchronisation information. E-UTRAN configures *discSyncConfig* including *txParameters* when configuring UEs by dedicated signalling to transmit synchronisation information.
discTxPoolCommon Indicates the resources by which the UE is allowed to transmit sidelink discovery announcements while in RRC_IDLE.
plmn-IdentityList List of PLMN identities for the neighbouring frequency indicated by *carrierFreq*. Absence of the field indicates the same PLMN identities as listed in *plmn-IdentityList* (without suffix) in *SystemInformationBlockType1*.
plmn-Index Index of the corresponding entry in field *plmn-IdentityList* (without suffix) within *SystemInformationBlockType1*.

Conditional presence	Explanation
Tx	The field is mandatory present if *discTxPoolCommon* is included. Otherwise the field is optional present, need OR.

6.3.2 Radio resource control information elements

– *AntennaInfo*

The IE *AntennaInfoCommon* and the *AntennaInfoDedicated* are used to specify the common and the UE specific antenna configuration respectively.

AntennaInfo information elements

```
-- ASN1START

AntennaInfoCommon ::=               SEQUENCE {
    antennaPortsCount                   ENUMERATED {an1, an2, an4, spare1}
}

AntennaInfoDedicated ::=            SEQUENCE {
    transmissionMode                    ENUMERATED {
                                            tm1, tm2, tm3, tm4, tm5, tm6,
                                            tm7, tm8-v920},
    codebookSubsetRestriction           CHOICE {
        n2TxAntenna-tm3                     BIT STRING (SIZE (2)),
        n4TxAntenna-tm3                     BIT STRING (SIZE (4)),
        n2TxAntenna-tm4                     BIT STRING (SIZE (6)),
        n4TxAntenna-tm4                     BIT STRING (SIZE (64)),
        n2TxAntenna-tm5                     BIT STRING (SIZE (4)),
        n4TxAntenna-tm5                     BIT STRING (SIZE (16)),
        n2TxAntenna-tm6                     BIT STRING (SIZE (4)),
        n4TxAntenna-tm6                     BIT STRING (SIZE (16))
    }       OPTIONAL,                                                   -- Cond TM
    ue-TransmitAntennaSelection         CHOICE{
            release                         NULL,
            setup                           ENUMERATED {closedLoop, openLoop}
    }
```

```
}

AntennaInfoDedicated-v920 ::=       SEQUENCE {
    codebookSubsetRestriction-v920      CHOICE {
        n2TxAntenna-tm8-r9                  BIT STRING (SIZE (6)),
        n4TxAntenna-tm8-r9                  BIT STRING (SIZE (32))
    }       OPTIONAL                                                    -- Cond TM8
}

AntennaInfoDedicated-r10 ::=        SEQUENCE {
    transmissionMode-r10                ENUMERATED {
                                            tm1, tm2, tm3, tm4, tm5, tm6, tm7, tm8-v920,
                                            tm9-v1020, tm10-v1130, spare6, spare5, spare4,
                                            spare3, spare2, spare1},
    codebookSubsetRestriction-r10       BIT STRING          OPTIONAL,           -- Cond TMX
    ue-TransmitAntennaSelection     CHOICE{
        release                         NULL,
        setup                           ENUMERATED {closedLoop, openLoop}
    }
}

AntennaInfoDedicated-v10i0::=   SEQUENCE {
    maxLayersMIMO-r10           ENUMERATED {twoLayers, fourLayers, eightLayers}     OPTIONAL    --
Need OR
}

AntennaInfoDedicated-v1250 ::=      SEQUENCE {
    alternativeCodebookEnabledFor4TX-r12    BOOLEAN
}

-- ASN1STOP
```

***AntennaInfo* field descriptions**
alternativeCodebookEnabledFor4TX Indicates whether code book in TS 36.213 [23] Table 7.2.4-0A to Table 7.2.4-0D is being used for deriving CSI feedback and reporting. E-UTRAN only configures the field if the UE is configured with a) *tm8* or *tm9*, b) PMI/RI reporting and c) 4 CRS ports.
antennaPortsCount Parameter represents the number of cell specific antenna ports where an1 corresponds to 1, an2 to 2 antenna ports etc. see TS 36.211 [21, 6.2.1].
codebookSubsetRestriction Parameter: *codebookSubsetRestriction,* see TS 36.213 [23, 7.2] and TS 36.211 [21, 6.3.4.2.3]. The number of bits in the *codebookSubsetRestriction* for applicable transmission modes is defined in TS 36.213 [23, Table 7.2-1b]. If the UE is configured with *transmissionMode* tm8, E-UTRAN configures the field *codebookSubsetRestriction* if PMI/RI reporting is configured. If the UE is configured with *transmissionMode* tm9, E-UTRAN configures the field *codebookSubsetRestriction* if PMI/RI reporting is configured and if the number of CSI-RS ports is greater than 1. E-UTRAN does not configure the field *codebookSubsetRestriction* in other cases where the UE is configured with *transmissionMode* tm8 or tm9.
maxLayersMIMO Indicates the maximum number of layers for spatial multiplexing used to determine the rank indication bit width and Kc determination of the soft buffer size for the corresponding serving cell according to TS 36.212 [22]. EUTRAN configures this field only when *transmissionMode* is set to *tm3*, *tm4*, *tm9* or *tm10* for the corresponding serving cell. When configuring the field for a serving cell which *transmissionMode* is set to *tm3* or *tm4*, EUTRAN only configures value *fourLayers*: For a serving cell which *transmissionMode* is set to *tm9* or *tm10*, EUTRAN only configures the field only if *intraBandContiguousCC-InfoList* is indicated for the band and the band combination of the corresponding serving cell.
transmissionMode Points to one of Transmission modes defined in TS 36.213 [23, 7.1] where tm1 refers to transmission mode 1, tm2 to transmission mode 2 etc.
ue-TransmitAntennaSelection For value *setup* the field indicates whether UE transmit antenna selection control is closed-loop or open-loop as described in TS 36.213 [23, 8.7]. EUTRAN configures the same value for all serving cells.

Conditional presence	Explanation
TM	The field is mandatory present if the *transmissionMode* is set to tm3, tm4, tm5 or tm6. Otherwise the field is not present and the UE shall delete any existing value for this field.
TM8	The field is optional present, need OR, if *AntennaInfoDedicated* is included and *transmissionMode* is set to *tm8*. If *AntennaInfoDedicated* is included and *transmissionMode* is set to a value other than *tm8*, the field is not present and the UE shall delete any existing value for this field. Otherwise the field is not present.
TMX	The field is mandatory present if the *transmissionMode-r10* is set to *tm3*, *tm4*, *tm5* or *tm6*. The field is optionally present, need OR, if the *transmissionMode-r10* is set to *tm8* or *tm9*. Otherwise the field is not present and the UE shall delete any existing value for this field.

– *AntennaInfoUL*

The IE *AntennaInfoUL* is used to specify the UL antenna configuration.

AntennaInfoUL information elements

```
-- ASN1START

AntennaInfoUL-r10 ::=       SEQUENCE {
    transmissionModeUL-r10              ENUMERATED {tm1, tm2, spare6, spare5,
                                                    spare4, spare3, spare2, spare1} OPTIONAL,   --
Need OR
    fourAntennaPortActivated-r10            ENUMERATED {setup}          OPTIONAL        -- Need OR
}

-- ASN1STOP
```

***AntennaInfoUL* field descriptions**
fourAntennaPortActivated Parameter indicates if four antenna ports are used. See TS 36.213 [23, 8.2]. E-UTRAN optionally configures *fourAntennaPortActivated* only if *transmissionModeUL* is set to *tm2*.
transmissionModeUL Points to one of UL Transmission modes defined in TS 36.213 [23, 8.0] where tm1 refers to transmission mode 1, tm2 to transmission mode 2 etc.

– *CQI-ReportConfig*

The IE *CQI-ReportConfig* is used to specify the CQI reporting configuration.

CQI-ReportConfig information elements

```
-- ASN1START

CQI-ReportConfig ::=                SEQUENCE {
    cqi-ReportModeAperiodic         CQI-ReportModeAperiodic OPTIONAL,           -- Need OR
    nomPDSCH-RS-EPRE-Offset             INTEGER (-1..6),
    cqi-ReportPeriodic              CQI-ReportPeriodic  OPTIONAL                -- Need ON
}

CQI-ReportConfig-v920 ::=       SEQUENCE {
    cqi-Mask-r9                     ENUMERATED {setup}      OPTIONAL,       -- Cond cqi-Setup
    pmi-RI-Report-r9                ENUMERATED {setup}      OPTIONAL        -- Cond PMIRI
}

CQI-ReportConfig-r10 ::=    SEQUENCE {
    cqi-ReportAperiodic-r10             CQI-ReportAperiodic-r10         OPTIONAL,   -- Need ON
    nomPDSCH-RS-EPRE-Offset         INTEGER (-1..6),
    cqi-ReportPeriodic-r10              CQI-ReportPeriodic-r10          OPTIONAL,   -- Need ON
    pmi-RI-Report-r9                    ENUMERATED {setup}              OPTIONAL,   -- Cond
PMIRIPCell
    csi-SubframePatternConfig-r10       CHOICE {
        release                         NULL,
        setup                           SEQUENCE {
            csi-MeasSubframeSet1-r10            MeasSubframePattern-r10,
            csi-MeasSubframeSet2-r10            MeasSubframePattern-r10
        }
```

```
    }                                                                   OPTIONAL    -- Need ON
}

CQI-ReportConfig-v1130 ::=  SEQUENCE {
    cqi-ReportPeriodic-v1130            CQI-ReportPeriodic-v1130,
    cqi-ReportBoth-r11                  CQI-ReportBoth-r11
}

CQI-ReportConfig-v1250 ::=      SEQUENCE {
    csi-SubframePatternConfig-r12       CHOICE {
        release                         NULL,
        setup                           SEQUENCE {
            csi-MeasSubframeSets-r12            BIT STRING (SIZE (10))
        }
    }                                                               OPTIONAL,   -- Need ON
    cqi-ReportBoth-v1250                    CQI-ReportBoth-v1250        OPTIONAL,   -- Need ON
    cqi-ReportAperiodic-v1250   CQI-ReportAperiodic-v1250       OPTIONAL,   -- Need ON
    altCQI-Table-r12            ENUMERATED {
                                    allSubframes, csi-SubframeSet1,
                                    csi-SubframeSet2, spare1}       OPTIONAL        -- Need OP
}

CQI-ReportConfigSCell-r10 ::=               SEQUENCE {
    cqi-ReportModeAperiodic-r10         CQI-ReportModeAperiodic OPTIONAL,           -- Need OR
    nomPDSCH-RS-EPRE-Offset-r10             INTEGER (-1..6),
    cqi-ReportPeriodicSCell-r10         CQI-ReportPeriodic-r10          OPTIONAL,   -- Need ON
    pmi-RI-Report-r10                   ENUMERATED {setup}              OPTIONAL    -- Cond
PMIRISCell
}

CQI-ReportPeriodic ::=      CHOICE {
    release                         NULL,
    setup                           SEQUENCE {
        cqi-PUCCH-ResourceIndex             INTEGER (0..1185),
        cqi-pmi-ConfigIndex                 INTEGER (0..1023),
        cqi-FormatIndicatorPeriodic         CHOICE {
            widebandCQI                         NULL,
            subbandCQI                          SEQUENCE {
                k                                   INTEGER (1..4)
            }
        },
        ri-ConfigIndex                      INTEGER (0..1023)   OPTIONAL,               -- Need OR
        simultaneousAckNackAndCQI           BOOLEAN
    }
}

CQI-ReportPeriodic-r10 ::=      CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        cqi-PUCCH-ResourceIndex-r10         INTEGER (0..1184),
        cqi-PUCCH-ResourceIndexP1-r10       INTEGER (0..1184)               OPTIONAL,   -- Need OR
        cqi-pmi-ConfigIndex             INTEGER (0..1023),
        cqi-FormatIndicatorPeriodic-r10     CHOICE {
            widebandCQI-r10                     SEQUENCE {
                csi-ReportMode-r10      ENUMERATED {submode1, submode2}     OPTIONAL    -- Need OR
            },
            subbandCQI-r10                      SEQUENCE {
                k                               INTEGER (1..4),
                periodicityFactor-r10               ENUMERATED {n2, n4}
            }
        },
        ri-ConfigIndex                  INTEGER (0..1023)       OPTIONAL,               -- Need OR
        simultaneousAckNackAndCQI       BOOLEAN,
        cqi-Mask-r9                     ENUMERATED {setup}      OPTIONAL,               -- Need OR
        csi-ConfigIndex-r10             CHOICE {
            release                         NULL,
            setup                           SEQUENCE {
                cqi-pmi-ConfigIndex2-r10        INTEGER (0..1023),
                ri-ConfigIndex2-r10             INTEGER (0..1023)       OPTIONAL        -- Need OR
            }
        }       OPTIONAL                                                            -- Need ON
    }
}

CQI-ReportPeriodic-v1130 ::=    SEQUENCE {
    simultaneousAckNackAndCQI-Format3-r11       ENUMERATED {setup}      OPTIONAL,   -- Need OR
    cqi-ReportPeriodicProcExtToReleaseList-r11  CQI-ReportPeriodicProcExtToReleaseList-r11
    OPTIONAL,   -- Need ON
```

```
    cqi-ReportPeriodicProcExtToAddModList-r11   CQI-ReportPeriodicProcExtToAddModList-r11   OPTIONAL
    -- Need ON
}

CQI-ReportPeriodicProcExtToAddModList-r11 ::=       SEQUENCE (SIZE (1..maxCQI-ProcExt-r11)) OF CQI-
ReportPeriodicProcExt-r11

CQI-ReportPeriodicProcExtToReleaseList-r11 ::=  SEQUENCE (SIZE (1..maxCQI-ProcExt-r11)) OF CQI-
ReportPeriodicProcExtId-r11

CQI-ReportPeriodicProcExt-r11 ::=       SEQUENCE {
    cqi-ReportPeriodicProcExtId-r11 CQI-ReportPeriodicProcExtId-r11,
    cqi-pmi-ConfigIndex-r11         INTEGER (0..1023),
    cqi-FormatIndicatorPeriodic-r11 CHOICE {
        widebandCQI-r11             SEQUENCE {
            csi-ReportMode-r11          ENUMERATED {submode1, submode2} OPTIONAL    -- Need OR
        },
        subbandCQI-r11              SEQUENCE {
            k                           INTEGER (1..4),
            periodicityFactor-r11       ENUMERATED {n2, n4}
        }
    },
    ri-ConfigIndex-r11              INTEGER (0..1023)                   OPTIONAL,   -- Need OR
    csi-ConfigIndex-r11             CHOICE {
        release                         NULL,
        setup                           SEQUENCE {
            cqi-pmi-ConfigIndex2-r11        INTEGER (0..1023),
            ri-ConfigIndex2-r11             INTEGER (0..1023)       OPTIONAL        -- Need OR
        }
    }                                                               OPTIONAL,       -- Need ON
    ...
}

CQI-ReportAperiodic-r10 ::=     CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        cqi-ReportModeAperiodic-r10         CQI-ReportModeAperiodic,
        aperiodicCSI-Trigger-r10            SEQUENCE {
            trigger1-r10                    BIT STRING (SIZE (8)),
            trigger2-r10                    BIT STRING (SIZE (8))
        }                                                               OPTIONAL   -- Need OR
    }
}

CQI-ReportAperiodic-v1250   ::=     CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        aperiodicCSI-Trigger-v1250          SEQUENCE {
            trigger-SubframeSetIndicator-r12    ENUMERATED {s1, s2},
            trigger1-SubframeSetIndicator-r12   BIT STRING (SIZE (8)),
            trigger2-SubframeSetIndicator-r12   BIT STRING (SIZE (8))
        }
    }
}

CQI-ReportAperiodicProc-r11 ::=     SEQUENCE {
    cqi-ReportModeAperiodic-r11         CQI-ReportModeAperiodic,
    trigger01-r11                       BOOLEAN,
    trigger10-r11                       BOOLEAN,
    trigger11-r11                       BOOLEAN
}

CQI-ReportModeAperiodic ::=             ENUMERATED {
                                            rm12, rm20, rm22, rm30, rm31,
                                            rm32-v1250, spare2, spare1
}

CQI-ReportBoth-r11 ::=          SEQUENCE {
    csi-IM-ConfigToReleaseList-r11      CSI-IM-ConfigToReleaseList-r11  OPTIONAL,   -- Need ON
    csi-IM-ConfigToAddModList-r11       CSI-IM-ConfigToAddModList-r11   OPTIONAL,   -- Need ON
    csi-ProcessToReleaseList-r11        CSI-ProcessToReleaseList-r11    OPTIONAL,   -- Need ON
    csi-ProcessToAddModList-r11         CSI-ProcessToAddModList-r11     OPTIONAL    -- Need ON
}

CQI-ReportBoth-v1250 ::=            SEQUENCE {
    csi-IM-ConfigToReleaseListExt-r12       CSI-IM-ConfigId-v1250   OPTIONAL,   -- Need ON
    csi-IM-ConfigToAddModListExt-r12        CSI-IM-ConfigExt-r12    OPTIONAL    -- Need ON
}
```

```
CSI-IM-ConfigToAddModList-r11 ::=       SEQUENCE (SIZE (1..maxCSI-IM-r11)) OF CSI-IM-Config-r11

CSI-IM-ConfigToReleaseList-r11 ::=      SEQUENCE (SIZE (1..maxCSI-IM-r11)) OF CSI-IM-ConfigId-r11

CSI-ProcessToAddModList-r11 ::=     SEQUENCE (SIZE (1..maxCSI-Proc-r11)) OF CSI-Process-r11

CSI-ProcessToReleaseList-r11 ::=    SEQUENCE (SIZE (1..maxCSI-Proc-r11)) OF CSI-ProcessId-r11

CQI-ReportBothProc-r11 ::=          SEQUENCE {
    ri-Ref-CSI-ProcessId-r11            CSI-ProcessId-r11               OPTIONAL,       -- Need OR
    pmi-RI-Report-r11                   ENUMERATED {setup}              OPTIONAL        -- Need OR
}


-- ASN1STOP
```

CQI-ReportConfig field descriptions
altCQI-Table Indicates the applicability of the alternative CQI table (i.e. Table 7.2.3-2 in TS 36.213 [23]) for both aperiodic and periodic CSI reporting for the concerned serving cell. Value *allSubframes* means the alternative CQI table applies to all the subframes and CSI processes, if configured, and value *csi-SubframeSet1* means the alternative CQI table applies to CSI subframe set1, and value *csi-SubframeSet2* means the alternative CQI table applies to CSI subframe set2. EUTRAN sets the value to *csi-SubframeSet1* or *csi-SubframeSet2* only if *transmissionMode* is set in range *tm1* to *tm9* and *csi-SubframePatternConfig-r10* is configured for the concerned serving cell and different CQI tables apply to the two CSI subframe sets; otherwise EUTRAN sets the value to *allSubframes*. If this field is not present, the UE shall use Table 7.2.3-1 in TS 36.213 [23] for all subframes and CSI processes, if configured.
aperiodicCSI-Trigger Indicates for which serving cell(s) the aperiodic CSI report is triggered when one or more SCells are configured. *trigger1* corresponds to the CSI request field 10 and *trigger2* corresponds to the CSI request field 11, see TS 36.213 [23, table 7.2.1-1A]. The leftmost bit, bit 0 in the bit string corresponds to the cell with *ServCellIndex*=0 and bit 1 in the bit string corresponds to the cell with *ServCellIndex*=1 etc. Each bit has either value 0 (means no aperiodic CSI report is triggered) or value 1 (means the aperiodic CSI report is triggered). At most 5 bits can be set to value 1 in the bit string. E-UTRAN configures value 1 only for cells configured with *transmissionMode* set in range *tm1 to tm9*. One value applies for all serving cells configured with *transmissionMode* set in range *tm1 to tm9* (the associated functionality is common i.e. not performed independently for each cell).
cqi-Mask Limits CQI/PMI/PTI/RI reports to the on-duration period of the DRX cycle, see TS 36.321 [6]. One value applies for all CSI processes and all serving cells (the associated functionality is common i.e. not performed independently for each cell).
cqi-FormatIndicatorPeriodic Parameter: *PUCCH CQI Feedback Type,* see TS 36.213 [23, table 7.2.2-1]. Depending on transmissionMode, reporting mode is implicitly given from the table.
cqi-pmi-ConfigIndex Parameter: *CQI/PMI Periodicity and Offset Configuration Index* $I_{CQI/PMI}$, see TS 36.213 [23, tables 7.2.2-1A and 7.2.2-1C]. If subframe patterns for CSI (CQI/PMI/PTI/RI) reporting are configured (i.e. *csi-SubframePatternConfig* is configured), the parameter applies to the subframe pattern corresponding to *csi-MeasSubframeSet1* or corresponding to the CSI subframe set 1 indicated by *csi-MeasSubframeSets-r12*.
cqi-pmi-ConfigIndex2 Parameter: *CQI/PMI Periodicity and Offset Configuration Index* $I_{CQI/PMI}$, see TS 36.213 [23, tables 7.2.2-1A and 7.2.2-1C]. The parameter applies to the subframe pattern corresponding to *csi-MeasSubframeSet2* or corresponding to the CSI subframe set 2 indicated by *csi-MeasSubframeSets-r12.*
cqi-PUCCH-ResourceIndex, cqi-PUCCH-ResourceIndexP1 Parameter $n_{\mathrm{PUCCH}}^{(2,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 7.2]. E-UTRAN does not apply value 1185. One value applies for all CSI processes.
cqi-ReportAperiodic E-UTRAN does not configure *CQI-ReportAperiodic* when transmission mode 10 is configured for all serving cells. E-UTRAN configures *cqi-ReportAperiodic-v1250* only if *cqi-ReportAperiodic-r10* and *csi-MeasSubframeSets-r12* are configured.
cqi-ReportModeAperiodic Parameter: *reporting mode.* Value rm12 corresponds to Mode 1-2, rm20 corresponds to Mode 2-0, rm22 corresponds to Mode 2-2 etc. PUSCH reporting modes are described in TS 36.213 [23, 7.2.1]. The UE shall ignore *cqi-ReportModeAperiodic-r10* when transmission mode 10 is configured for the serving cell on this carrier frequency. The UE shall ignore *cqi-ReportModeAperiodic-r10* configured for the PCell/ PSCell when the transmission bandwidth of the PCell/PSCell in downlink is 6 resource blocks.
CQI-ReportPeriodicProcExt A set of periodic CQI related parameters for which E-UTRAN may configure different values for each CSI process. For a serving frequency E-UTRAN configures one or more *CQI-ReportPeriodicProcExt* only when transmission mode 10 is configured for the serving cell on this carrier frequency.
csi-ConfigIndex E-UTRAN configures *csi-ConfigIndex* only for PCell and only if *csi-SubframePatternConfig* is configured. The UE shall release *csi-ConfigIndex* if *csi-SubframePatternConfig* is released.
csi-IM-ConfigToAddModList For a serving frequency E-UTRAN configures one or more *CSI-IM-Config* only when transmission mode 10 is configured for the serving cell on this carrier frequency.
csi-MeasSubframeSets Indicates the two CSI subframe sets. Value 0 means the subframe belongs to CSI subframe set 1 and value 1 means the subframe belongs to CSI subframe set 2. CSI subframe set 1 refers to $C_{CSI,0}$ in TS 36.213 [23, 7.2] and CSI subframe set 2 refers to $C_{CSI,1}$ in TS 36.213 [23, 7.2]. EUTRAN does not configure *csi-MeasSubframeSet1-r10* and *csi-MeasSubframeSet2-r10* if either *csi-MeasSubframeSets-r12* for PCell or *eimta-MainConfigPCell-r12* is configured.
csi-MeasSubframeSet1*, *csi-MeasSubframeSet2 Indicates the CSI measurement subframe sets. *csi-MeasSubframeSet1* refers to $C_{CSI,0}$ in TS 36.213 [23, 7.2] and *csi-MeasSubframeSet2* refers to $C_{CSI,1}$ in TS 36.213 [23, 7.2]. E-UTRAN only configures the two CSI measurement subframe sets for the PCell.

CQI-ReportConfig field descriptions
csi-ProcessToAddModList For a serving frequency E-UTRAN configures one or more *CSI-Process* only when transmission mode 10 is configured for the serving cell on this carrier frequency.
csi-ReportMode Parameter: *PUCCH_format1-1_CSI_reporting_mode,* see TS 36.213 [23, 7.2.2].
K Parameter: K, see TS 36.213 [23, 7.2.2].
nomPDSCH-RS-EPRE-Offset Parameter: Δ_{offset} *see* TS 36.213 [23, 7.2.3]. Actual value = IE value * 2 [dB].
periodicityFactor Parameter: H', see TS 36.213 [23, 7.2.2].
pmi-RI-Report See TS 36.213 [23, 7.2]. The presence of this field means PMI/RI reporting is configured; otherwise the PMI/RI reporting is not configured. EUTRAN configures this field only when *transmissionMode* is set to *tm8, tm9* or *tm10*. The UE shall ignore *pmi-RI-Report-r9*/ *pmi-RI-Report-r10* when transmission mode 10 is configured for the serving cell on this carrier frequency.
ri-ConfigIndex Parameter: *RI Config Index* I_{RI}, see TS 36.213 [23, 7.2.2-1B]. If subframe patterns for CSI (CQI/PMI/PTI/RI) reporting are configured (i.e. *csi-SubframePatternConfig* is configured), the parameter applies to the subframe pattern corresponding to *csi-MeasSubframeSet1.*
ri-ConfigIndex2 Parameter: *RI Config Index* I_{RI}, see TS 36.213 [23, 7.2.2-1B]. The parameter applies to the subframe pattern corresponding to *csi-MeasSubframeSet2* or corresponding to the CSI subframe set 2 indicated by *csi-MeasSubframeSets-r12.* E-UTRAN configures *ri-ConfigIndex2* only if *ri-ConfigIndex* is configured.
ri-Ref-CSI-ProcessId CSI process whose RI value the UE inherits when reporting RI, in the same subframe, for CSI reporting. E-UTRAN ensures that the CSI process that inherits the RI value is configured in accordance with the conditions specified in 36.213 [23, 7.2.1, 7.2.2].
simultaneousAckNackAndCQI Parameter: *Simultaneous-AN-and-CQI*, see TS 36.213 [23, 10.1]. TRUE indicates that simultaneous transmission of ACK/NACK and CQI is allowed. One value applies for all CSI processes. For SCells except for the PSCell this field is not applicable and the UE shall ignore the value.
simultaneousAckNackAndCQI-Format3 Indicates that the UE shall perform simultaneous transmission of HARQ A/N and periodic CQI report multiplexing on PUCCH format 3, see TS 36.213 [23, 7.2, 10.1.1]. E-UTRAN configures this information only when *pucch-Format* is set to *format3.* One value applies for all CSI processes. For SCells except for the PSCell this field is not applicable and the UE shall ignore the value.
trigger01 Indicates whether or not reporting for this CSI-process or reporting for this CSI-process corresponding to a CSI subframe set is triggered by CSI request field set to 01, for a CSI request applicable for the serving cell on the same frequency as the CSI process, see TS 36.213 [23, table 7.2.1-1B].
trigger10, trigger11 Indicates whether or not reporting for this CSI-process or reporting for this CSI-process corresponding to a CSI subframe set is triggered by CSI request field set to 10 or 11, see TS 36.213 [23, table 7.2.1-1B]. EUTRAN configures at most 5 CSI processes, across all serving frequencies within each CG, to be triggered by a CSI request field set to value 10. The same restriction applies for value 11. In case E-UTRAN simultaneously triggers CSI requests for more than 5 CSI processes some limitations apply, see TS 36.213 [23].
trigger-SubframeSetIndicator For a serving cell configured with *csi-MeasSubframeSets-r12,* indicates for which CSI subframe set the aperiodic CSI report is triggered for the serving cell if the aperiodic CSI is triggered by the CSI request field 01, see TS 36.213 [23, table 7.2.1-1C]. Value s1 corresponds to CSI subframe set 1 and value s2 corresponds to CSI subframe set 2.
trigger1-SubframeSetIndicator Indicates for which CSI subframe set the aperiodic CSI report is triggered when aperiodic CSI is triggered by the CSI request field 10, see TS 36.213 [23, table 7.2.1-1C].The leftmost bit, bit 0 in the bit string corresponds to the cell with *ServCellIndex*=0 and bit 1 in the bit string corresponds to the cell with *ServCellIndex*=1 etc. Each bit has either value 0 (means that aperiodic CSI report is triggered for CSI subframe set 1) or value 1 (means that aperiodic CSI report is triggered for CSI subframe set 2).
trigger2-SubframeSetIndicator Indicates for which CSI subframe set the aperiodic CSI report is triggered when aperiodic CSI is triggered by the CSI request field 11, see TS 36.213 [23, table 7.2.1-1C].The leftmost bit, bit 0 in the bit string corresponds to the cell with *ServCellIndex*=0 and bit 1 in the bit string corresponds to the cell with *ServCellIndex*=1 etc. Each bit has either value 0 (means that aperiodic CSI report is triggered for CSI subframe set 1) or value 1 (means that aperiodic CSI report is triggered for CSI subframe set 2).

Conditional presence	Explanation
cqi-Setup	This field is not present for an Scell except for the PSCell, while it is conditionally present for the PCell and the PSCell according to the following. The field is optional present, need OR, if the *cqi-ReportPeriodic* in the *cqi-ReportConfig* is set to *setup*. If the field *cqi-ReportPeriodic* is present and set to *release*, the field is not present and the UE shall delete any existing value for this field. Otherwise the field is not present.
PMIRI	The field is optional present, need OR, if *cqi-ReportPeriodic* is included and set to *setup*, or *cqi-ReportModeAperiodic* is included. If the field *cqi-ReportPeriodic* is present and set to *release* and *cqi-ReportModeAperiodic* is absent, the field is not present and the UE shall delete any existing value for this field. Otherwise the field is not present.
PMIRIPCell	The field is optional present, need OR, if *cqi-ReportPeriodic* is included in the *CQI-ReportConfig-r10* and set to *setup*, or *cqi-ReportAperiodic* is included in the *CQI-ReportConfig-r10* and set to *setup*. If the field *cqi-ReportPeriodic* is present in the *CQI-ReportConfig-r10* and set to *release* and *cqi-ReportAperiodic* is included in the *CQI-ReportConfig-r10* and set to *release*, the field is not present and the UE shall delete any existing value for this field. Otherwise the field is not present.
PMIRISCell	The field is optional present, need OR, if *cqi-ReportPeriodicSCell* is included and set to *setup*, or *cqi-ReportModeAperiodic-r10* is included in the *CQI-ReportConfigSCell*. If the field *cqi-ReportPeriodicSCell* is present and set to *release* and *cqi-ReportModeAperiodic*-r10 is absent in the *CQI-ReportConfigSCell*, the field is not present and the UE shall delete any existing value for this field. Otherwise the field is not present.

– *CQI-ReportPeriodicProcExtId*

The IE *CQI-ReportPeriodicProcExtId* is used to identify a periodic CQI reporting configuration that E-UTRAN may configure in addition to the configuration specified by the IE *CQI-ReportPeriodic-r10*. These additional configurations are specified by the IE *CQI-ReportPeriodicProcExt-r11*. The identity is unique within the scope of a carrier frequency.

CQI-ReportPeriodicProcExtId information elements

```
-- ASN1START

CQI-ReportPeriodicProcExtId-r11 ::=                INTEGER (1..maxCQI-ProcExt-r11)

-- ASN1STOP
```

– *CrossCarrierSchedulingConfig*

The IE *CrossCarrierSchedulingConfig* is used to specify the configuration when the cross carrier scheduling is used in a cell.

CrossCarrierSchedulingConfig information elements

```
-- ASN1START

CrossCarrierSchedulingConfig-r10 ::=        SEQUENCE {
    schedulingCellInfo-r10              CHOICE {
        own-r10                             SEQUENCE {                  -- No cross carrier
scheduling
            cif-Presence-r10                        BOOLEAN
        },
        other-r10                               SEQUENCE {                  -- Cross carrier
scheduling
            schedulingCellId-r10                ServCellIndex-r10,
            pdsch-Start-r10                     INTEGER (1..4)
        }
    }
}

-- ASN1STOP
```

CrossCarrierSchedulingConfig field descriptions
cif-Presence The field is used to indicate whether carrier indicator field is present (value TRUE) or not (value FALSE) in PDCCH/ EPDCCH DCI formats, see TS 36.212 [22, 5.3.3.1].
pdsch-Start The starting OFDM symbol of PDSCH for the concerned SCell, see TS 36.213 [23. 7.1.6.4]. Values 1, 2, 3 are applicable when *dl-Bandwidth* for the concerned SCell is greater than 10 resource blocks, values 2, 3, 4 are applicable when *dl-Bandwidth* for the concerned SCell is less than or equal to 10 resource blocks, see TS 36.211 [21, Table 6,7-1].
schedulingCellId Indicates which cell signals the downlink allocations and uplink grants, if applicable, for the concerned SCell. In case the UE is configured with DC, the scheduling cell is part of the same cell group (i.e. MCG or SCG) as the scheduled cell.

– *CSI-IM-Config*

The IE *CSI-IM-Config* is the CSI Interference Measurement (IM) configuration that E-UTRAN may configure on a serving frequency, see TS 36.213 [23, 7.2.6].

CSI-IM-Config information elements

```
-- ASN1START

CSI-IM-Config-r11 ::=       SEQUENCE {
    csi-IM-ConfigId-r11         CSI-IM-ConfigId-r11,
    resourceConfig-r11          INTEGER (0..31),
    subframeConfig-r11          INTEGER (0..154),
    ...
}

CSI-IM-ConfigExt-r12 ::=        SEQUENCE {
    csi-IM-ConfigId-v1250           CSI-IM-ConfigId-v1250,
    resourceConfig-r12          INTEGER (0..31),
    subframeConfig-r12          INTEGER (0..154),
    ...
}

-- ASN1STOP
```

CSI-IM-Config field descriptions
resourceConfig Parameter: CSI reference signal configuration, see TS 36.213 [23, 7.2.6] and TS 36.211 [21, table 6.10.5.2-1 and 6.10.5.2-2] for 4 REs.
subframeConfig Parameter: $I_{\mathrm{CSI-RS}}$, see TS 36.213 [23, 7.2.6] and TS 36.211 [21, table 6.10.5.3-1].

– *CSI-IM-ConfigId*

The IE *CSI-IM-ConfigId* is used to identify a CSI-IM configuration that is configured by the IE *CSI-IM-Config*. The identity is unique within the scope of a carrier frequency.

CSI-IM-ConfigId information elements

```
-- ASN1START

CSI-IM-ConfigId-r11 ::=                 INTEGER (1..maxCSI-IM-r11)
CSI-IM-ConfigId-r12 ::=                 INTEGER (1..maxCSI-IM-r12)
CSI-IM-ConfigId-v1250 ::=               INTEGER (maxCSI-IM-r12)

-- ASN1STOP
```

– *CSI-Process*

The IE *CSI-Process* is the CSI process configuration that E-UTRAN may configure on a serving frequency.

CSI-Process information elements

```
-- ASN1START

CSI-Process-r11 ::=     SEQUENCE {
    csi-ProcessId-r11           CSI-ProcessId-r11,
    csi-RS-ConfigNZPId-r11      CSI-RS-ConfigNZPId-r11,
    csi-IM-ConfigId-r11         CSI-IM-ConfigId-r11,
    p-C-AndCBSRList-r11 SEQUENCE (SIZE (1..2)) OF P-C-AndCBSR-r11,
    cqi-ReportBothProc-r11      CQI-ReportBothProc-r11          OPTIONAL,       -- Need OR
    cqi-ReportPeriodicProcId-r11    INTEGER (0..maxCQI-ProcExt-r11)     OPTIONAL,       -- Need OR
    cqi-ReportAperiodicProc-r11 CQI-ReportAperiodicProc-r11     OPTIONAL,       -- Need OR
    ...,
    [[  alternativeCodebookEnabledFor4TXProc-r12    ENUMERATED {true}   OPTIONAL,   -- Need ON
        csi-IM-ConfigIdList-r12     CHOICE {
            release                     NULL,
            setup                       SEQUENCE (SIZE (1..2)) OF CSI-IM-ConfigId-r12
        }                                                       OPTIONAL,   -- Need ON
        cqi-ReportAperiodicProc2-r12    CHOICE {
            release                     NULL,
            setup                       CQI-ReportAperiodicProc-r11
        }                                                       OPTIONAL    -- Need ON
    ]]
}

P-C-AndCBSR-r11 ::= SEQUENCE {
    p-C-r11                     INTEGER (-8..15),
    codebookSubsetRestriction-r11   BIT STRING
}

-- ASN1STOP
```

***CSI-Process* field descriptions**
alternativeCodebookEnabledFor4TXProc Indicates whether code book in TS 36.213 [23] Table 7.2.4-0A to Table 7.2.4-0D is being used for deriving CSI feedback and reporting for a CSI process. EUTRAN may configure the field only if the number of CSI-RS ports for non-zero power transmission CSI-RS configuration is 4.
cqi-ReportAperiodicProc If *csi-MeasSubframeSets-r12* is configured for the same frequency as the CSI process, *cqi-ReportAperiodicProc* applies for CSI subframe set 1. If *csi-MeasSubframeSet1-r10* or *csi-MeasSubframeSet2-r10* are configured for the same frequency as the CSI process, *cqi-ReportAperiodicProc* applies for CSI subframe set 1 or CSI subframe set 2. Otherwise, *cqi-ReportAperiodicProc* applies for all subframes
cqi-ReportAperiodicProc2 *cqi-ReportAperiodicProc2* is configured only if *csi-MeasSubframeSets-r12* is configured for the same frequency as the CSI process. *cqi-ReportAperiodicProc2* is for CSI subframe set 2. E-UTRAN shall set *cqi-ReportModeAperiodic-r11* in *cqi-ReportAperiodicProc2* the same as in *cqi-ReportAperiodicProc*.
cqi-ReportBothProc Includes CQI configuration parameters applicable for both aperiodic and periodic CSI reporting, for which CSI process specific values may be configured. E-UTRAN configures the field if and only if *cqi-ReportPeriodicProcId* is included and/ or if *cqi-ReportAperiodicProc* is included.
cqi-ReportPeriodicProcId Refers to a periodic CQI reporting configuration that is configured for the same frequency as the CSI process. Value 0 refers to the set of parameters defined by the REL-10 CQI reporting configuration fields, while the other values refer to the additional configurations E-UTRAN assigns by *CQI-ReportPeriodicProcExt-r11* (and as covered by *CQI-ReportPeriodicProcExtId*).
csi-IM-ConfigId Refers to a CSI-IM configuration that is configured for the same frequency as the CSI process.
csi-IM-ConfigIdList Refers to one or two CSI-IM configurations that are configured for the same frequency as the CSI process. *csi-IM-ConfigIdList* can include 2 entries only if *csi-MeasSubframeSets-r12* is configured for the same frequency as the CSI process. UE shall ignore *csi-IM-ConfigId-r11* if *csi-IM-ConfigIdList-r12* is configured.
csi-RS-ConfigNZPId Refers to a CSI RS configuration using non-zero power transmission that is configured for the same frequency as the CSI process.
p-C Parameter: P_C , see TS 36.213 [23, 7.2.5].
p-C-AndCBSRList A *p-C-AndCBSRList* including 2 entries indicates that the subframe patterns configured for CSI (CQI/PMI/PTI/RI) reporting (i.e. as defined by field *csi-MeasSubframeSet1* and *csi-MeasSubframeSet2*, or as defined by *csi-MeasSubframeSets-r12*) are to be used for this CSI process, while a single entry indicates that the subframe patterns are not to be used for this CSI process. E-UTRAN does not include 2 entries in *p-C-AndCBSRList* with *csi-MeasSubframeSet1* and *csi-MeasSubframeSet2* for CSI processes concerning a secondary frequency. E-UTRAN includes 2 entries in *p-C-AndCBSRList* when configuring both *cqi-pmi-ConfigIndex* and *cqi-pmi-ConfigIndex2*.

– *CSI-ProcessId*

The IE *CSI-ProcessId* is used to identify a CSI process that is configured by the IE *CSI-Process*. The identity is unique within the scope of a carrier frequency.

CSI-ProcessId information elements

```
-- ASN1START

CSI-ProcessId-r11 ::=       INTEGER (1..maxCSI-Proc-r11)

-- ASN1STOP
```

– *CSI-RS-Config*

The IE *CSI-RS-Config* is used to specify the CSI (Channel-State Information) reference signal configuration.

CSI-RS-Config information elements

```
-- ASN1START

CSI-RS-Config-r10 ::=       SEQUENCE {
```

```
    csi-RS-r10                  CHOICE {
        release                     NULL,
        setup                       SEQUENCE {
            antennaPortsCount-r10           ENUMERATED {an1, an2, an4, an8},
            resourceConfig-r10              INTEGER (0..31),
            subframeConfig-r10              INTEGER (0..154),
            p-C-r10                         INTEGER (-8..15)
        }
    }                                                               OPTIONAL,           -- Need ON
    zeroTxPowerCSI-RS-r10       ZeroTxPowerCSI-RS-Conf-r12          OPTIONAL            -- Need ON
}

CSI-RS-Config-v1250 ::=     SEQUENCE {
    zeroTxPowerCSI-RS2-r12      ZeroTxPowerCSI-RS-Conf-r12          OPTIONAL,           -- Need ON
    ds-ZeroTxPowerCSI-RS-r12        CHOICE {
        release                         NULL,
        setup                           SEQUENCE {
            zeroTxPowerCSI-RS-List-r12      SEQUENCE (SIZE (1..maxDS-ZTP-CSI-RS-r12)) OF
ZeroTxPowerCSI-RS-r12
        }
    }                                                               OPTIONAL                -- Need
ON
}

ZeroTxPowerCSI-RS-Conf-r12 ::=  CHOICE {
        release                         NULL,
        setup                           ZeroTxPowerCSI-RS-r12
}

ZeroTxPowerCSI-RS-r12 ::=   SEQUENCE {
    zeroTxPowerResourceConfigList-r12       BIT STRING (SIZE (16)),
    zeroTxPowerSubframeConfig-r12           INTEGER (0..154)
}

-- ASN1STOP
```

***CSI-RS-Config* field descriptions**
antennaPortsCount Parameter represents the number of antenna ports used for transmission of CSI reference signals where value an1 corresponds to 1 antenna port, an2 to 2 antenna ports and so on, see TS 36.211 [21, 6.10.5].
ds-ZeroTxPowerCSI-RS Parameter for additional *zeroTxPowerCSI-RS* for a serving cell, concerning the CSI-RS included in discovery signals.
zeroTxPowerCSI-RS2 Parameter for additional *zeroTxPowerCSI-RS* for a serving cell. E-UTRAN configures the field only if *csi-MeasSubframeSets-r12* and *TM 1 – 9* are configured for the serving cell.
p-C Parameter: P_c , see TS 36.213 [23, 7.2.5].
resourceConfig Parameter: CSI reference signal configuration, see TS 36.211 [21, table 6.10.5.2-1 and 6.10.5.2-2].
subframeConfig Parameter: $I_{\mathrm{CSI-RS}}$, see TS 36.211 [21, table 6.10.5.3-1].
zeroTxPowerResourceConfigList Parameter: *ZeroPowerCSI-RS,* see TS 36.213 [23, 7.2.7].
zeroTxPowerSubframeConfig Parameter: $I_{\mathrm{CSI-RS}}$, see TS 36.211 [21, table 6.10.5.3-1].

– *CSI-RS-ConfigNZP*

The IE *CSI-RS-ConfigNZP* is the CSI-RS resource configuration using non-zero power transmission that E-UTRAN may configure on a serving frequency.

***CSI-RS-ConfigNZP* information elements**

```
-- ASN1START

CSI-RS-ConfigNZP-r11 ::=        SEQUENCE {
    csi-RS-ConfigNZPId-r11          CSI-RS-ConfigNZPId-r11,
    antennaPortsCount-r11           ENUMERATED {an1, an2, an4, an8},
    resourceConfig-r11              INTEGER (0..31),
```

```
    subframeConfig-r11              INTEGER (0..154),
    scramblingIdentity-r11          INTEGER (0..503),
    qcl-CRS-Info-r11                SEQUENCE {
        qcl-ScramblingIdentity-r11      INTEGER (0..503),
        crs-PortsCount-r11              ENUMERATED {n1, n2, n4, spare1},
        mbsfn-SubframeConfigList-r11    CHOICE {
                release                     NULL,
                setup                       SEQUENCE {
                    subframeConfigList          MBSFN-SubframeConfigList
                }
        }                                                               OPTIONAL    -- Need ON
    }                                                                   OPTIONAL,   -- Need OR
    ...
}

-- ASN1STOP
```

***CSI-RS-ConfigNZP* field descriptions**
antennaPortsCount Parameter represents the number of antenna ports used for transmission of CSI reference signals where an1 corresponds to 1, an2 to 2 antenna ports etc. see TS 36.211 [21, 6.10.5].
qcl-CRS-Info Indicates CRS antenna ports that is quasi co-located with the CSI-RS antenna ports, see TS 36.213 [23, 7.2.5]. EUTRAN configures this field if and only if the UE is configured with *qcl-Operation* set to *typeB*.
resourceConfig Parameter: CSI reference signal configuration, see TS 36.211 [21, table 6.10.5.2-1 and 6.10.5.2-2].
subframeConfig Parameter: $I_{\mathrm{CSI-RS}}$, see TS 36.211 [21, table 6.10.5.3-1].
scramblingIdentity Parameter: Pseudo-random sequence generator parameter, n_{ID}, see TS 36.213 [23, 7.2.5].

– *CSI-RS-ConfigNZPId*

The IE *CSI-RS-ConfigNZPId* is used to identify a CSI-RS resource configuration using non-zero transmission power, as configured by the IE *CSI-RS-ConfigNZP*. The identity is unique within the scope of a carrier frequency.

CSI-RS-ConfigNZPId information elements

```
-- ASN1START

CSI-RS-ConfigNZPId-r11 ::=                  INTEGER (1..maxCSI-RS-NZP-r11)

-- ASN1STOP
```

– *CSI-RS-ConfigZP*

The IE *CSI-RS-ConfigZP* is the CSI-RS resource configuration, for which UE assumes zero transmission power, that E-UTRAN may configure on a serving frequency.

CSI-RS-ConfigZP information elements

```
-- ASN1START

CSI-RS-ConfigZP-r11 ::=     SEQUENCE {
    csi-RS-ConfigZPId-r11       CSI-RS-ConfigZPId-r11,
    resourceConfigList-r11      BIT STRING (SIZE (16)),
    subframeConfig-r11          INTEGER (0..154),
    ...
}

-- ASN1STOP
```

CSI-RS-ConfigZP field descriptions
resourceConfigList Parameter: *ZeroPowerCSI-RS*, see TS 36.213 [23, 7.2.7].
subframeConfig Parameter: $I_{\text{CSI-RS}}$, see TS 36.211 [21, table 6.10.5.3-1].

– *CSI-RS-ConfigZPId*

The IE *CSI-RS-ConfigZPId* is used to identify a CSI-RS resource configuration for which UE assumes zero transmission power, as configured by the IE *CSI-RS-ConfigZP*. The identity is unique within the scope of a carrier frequency.

CSI-RS-ConfigZPId information elements

```
-- ASN1START

CSI-RS-ConfigZPId-r11 ::=                   INTEGER (1..maxCSI-RS-ZP-r11)

-- ASN1STOP
```

– *DMRS-Config*

The IE *DMRS-Config* is the DMRS configuration that E-UTRAN may configure on a serving frequency.

DMRS-Config information elements

```
-- ASN1START

DMRS-Config-r11 ::=     CHOICE {
    release                     NULL,
    setup                       SEQUENCE {
        scramblingIdentity-r11      INTEGER (0..503),
        scramblingIdentity2-r11     INTEGER (0..503)
    }
}

-- ASN1STOP
```

DMRS-Config field descriptions
scramblingIdentity, scramblingIdentity2 Parameter: $n_{\text{ID}}^{\text{DMRS},i}$, see TS 36.211 [21, 6.10.3.1].

– *DRB-Identity*

The IE *DRB-Identity* is used to identify a DRB used by a UE.

DRB-Identity information elements

```
-- ASN1START

DRB-Identity ::=                    INTEGER (1..32)

-- ASN1STOP
```

– *EPDCCH-Config*

The IE EPDCCH-Config specifies the subframes and resource blocks for EPDCCH monitoring that E-UTRAN may configure for a serving cell.

EPDCCH-Config information element

```
-- ASN1START

EPDCCH-Config-r11 ::=       SEQUENCE{
    config-r11      CHOICE {
        release                     NULL,
            setup                       SEQUENCE {
            subframePatternConfig-r11   CHOICE {
                release                     NULL,
                setup                       SEQUENCE {
                    subframePattern-r11         MeasSubframePattern-r10
                }
            }                                                                   OPTIONAL, -- Need ON
            startSymbol-r11             INTEGER (1..4)                          OPTIONAL, -- Need OP
            setConfigToReleaseList-r11  EPDCCH-SetConfigToReleaseList-r11       OPTIONAL, -- Need ON
            setConfigToAddModList-r11   EPDCCH-SetConfigToAddModList-r11        OPTIONAL -- Need ON
        }
    }
}

EPDCCH-SetConfigToAddModList-r11 ::=    SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF EPDCCH-SetConfig-
r11

EPDCCH-SetConfigToReleaseList-r11 ::=   SEQUENCE (SIZE(1..maxEPDCCH-Set-r11)) OF EPDCCH-SetConfigId-
r11

EPDCCH-SetConfig-r11 ::=        SEQUENCE {
    setConfigId-r11                 EPDCCH-SetConfigId-r11,
    transmissionType-r11            ENUMERATED {localised, distributed},
    resourceBlockAssignment-r11     SEQUENCE{
        numberPRB-Pairs-r11             ENUMERATED {n2, n4, n8},
        resourceBlockAssignment-r11     BIT STRING (SIZE(4..38))
    },
    dmrs-ScramblingSequenceInt-r11  INTEGER (0..503),
    pucch-ResourceStartOffset-r11   INTEGER (0..2047),
    re-MappingQCL-ConfigId-r11      PDSCH-RE-MappingQCL-ConfigId-r11    OPTIONAL, -- Need OR
    ...,
    [[  csi-RS-ConfigZPId2-r12              CHOICE {
            release                     NULL,
            setup                       CSI-RS-ConfigZPId-r11
        }                                                           OPTIONAL-- Need ON
    ]]
}

EPDCCH-SetConfigId-r11 ::=  INTEGER (0..1)

-- ASN1STOP
```

EPDCCH-Config field descriptions
csi-RS-ConfigZPId2 Indicates the rate matching parameters in addition to those indicated by *re-MappingQCL-ConfigId*. E-UTRAN configures this field only when tm10 is configured.
dmrs-ScramblingSequenceInt The DMRS scrambling sequence initialization parameter $n_{\mathrm{ID},i}^{\mathrm{EPDCCH}}$ defined in TS 36.211[21, 6.10.3A.1].
EPDCCH-SetConfig Provides EPDCCH configuration set. See TS 36.213 [23, 9.1.4]. E-UTRAN configures at least one *EPDCCH-SetConfig when EPDCCH-Config* is configured.
numberPRB-Pairs Indicates the number of physical resource-block pairs used for the EPDCCH set. Value n2 corresponds to 2 physical resource-block pairs; n4 corresponds to 4 physical resource-block pairs and so on. Value n8 is not supported if *dl-Bandwidth* is set to 6 resource blocks.
pucch-ResourceStartOffset PUCCH format 1a, 1b and 3 resource starting offset for the EPDCCH set. See TS 36.213 [23, 10.1].
re-MappingQCL-ConfigId Indicates the starting OFDM symbol, the related rate matching parameters and quasi co-location assumption for EPDCCH when the UE is configured with tm10. This field provides the identity of a configured *PDSCH-RE-MappingQCL-Config*. E-UTRAN configures this field only when tm10 is configured.
resourceBlockAssignment Indicates the index to a specific combination of physical resource-block pair for EPDCCH set. See TS 36.213 [23, 9.1.4.4]. The size of *resourceBlockAssignment* is specified in TS 36.213 [23, 9.1.4.4] and based on *numberPRB-Pairs* and the signalled value of *dl-Bandwidth.*
setConfigId Indicates the identity of the EPDCCH configuration set.
startSymbol Indicates the OFDM starting symbol for any EPDCCH and PDSCH scheduled by EPDCCH on the same cell, see TS 36.213 [23, 9.1.4.1]. If not present, the UE shall release the configuration and shall derive the starting OFDM symbol of EPDCCH and PDSCH scheduled by EPDCCH from PCFICH. Values 1, 2, and 3 are applicable for *dl-Bandwidth* greater than 10 resource blocks. Values 2, 3, and 4 are applicable otherwise. E-UTRAN does not configure the field for UEs configured with tm10.
subframePatternConfig Configures the subframes which the UE shall monitor the UE-specific search space on EPDCCH, except for pre-defined rules in TS 36.213 [23, 9.1.4]. If the field is not configured when EPDCCH is configured, the UE shall monitor the UE-specific search space on EPDCCH in all subframes except for pre-defined rules in TS 36.213 [23, 9.1.4].
transmissionType Indicates whether distributed or localized EPDCCH transmission mode is used as defined in TS 36.211 [21, 6.8A.1].

– *EIMTA-MainConfig*

The IE *EIMTA-MainConfig* is used to specify the eIMTA-RNTI used for eIMTA and the subframes used for monitoring PDCCH with eIMTA-RNTI. The IE *EIMTA-MainConfigServCell* is used to specify the eIMTA related parameters applicable for the concerned serving cell.

***EIMTA-MainConfig* information element**

```
-- ASN1START
EIMTA-MainConfig-r12 ::=    CHOICE {
    release                         NULL,
    setup                           SEQUENCE {
        eimta-RNTI-r12              C-RNTI,
        eimta-CommandPeriodicity-r12    ENUMERATED {sf10, sf20, sf40, sf80},
        eimta-CommandSubframeSet-r12    BIT STRING (SIZE(10))
    }
}

EIMTA-MainConfigServCell-r12 ::=    CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        eimta-UL-DL-ConfigIndex-r12             INTEGER (1..5),
        eimta-HARQ-ReferenceConfig-r12      ENUMERATED {sa2,sa4,sa5},
        mbsfn-SubframeConfigList-v1250      CHOICE {
                release                             NULL,
                setup                               SEQUENCE {
                subframeConfigList-r12              MBSFN-SubframeConfigList
                }
        }
    }
```

```
}

-- ASN1STOP
```

***EIMTA-MainConfig* field descriptions**
eimta-CommandPeriodicity Configures the periodicity to monitor PDCCH with eIMTA-RNTI, see TS 36.213 [23, 13.1]. Value sf10 corresponds to 10 subframes, sf20 corresponds to 20 subframes and so on.
eimta-CommandSubframeSet Configures the subframe(s) to monitor PDCCH with eIMTA-RNTI within the periodicity configured by *eimta-CommandPeriodicity*. The 10 bits correspond to all subframes in the last radio frame within each periodicity. The left most bit is for subframe 0 and so on. Each bit can be of value 0 or 1. The value of 1 means that the corresponding subframe is configured for monitoring PDCCH with eIMTA-RNTI, and the value of 0 means otherwise. In case of TDD as PCell, only the downlink subframes indicated by the UL/ DL configuration in SIB1 can be configured for monitoring PDCCH with eIMTA-RNTI. In case of FDD as PCell, any of the ten subframes can be configured for monitoring PDCCH with eIMTA-RNTI.
eimta-HARQ-ReferenceConfig Indicates UL/ DL configuration used as the DL HARQ reference configuration for this serving cell. Value sa2 corresponds to Configuration2, sa4 to Configuration4 etc, as specified in TS 36.211 [21, table 4.2-2]. E-UTRAN configures the same value for all serving cells residing on same frequency band.
eimta-UL-DL-ConfigIndex Index of *I*, see TS 36.212 [22, 5.3.3.1.4]. E-UTRAN configures the same value for all serving cells residing on same frequency band.
mbsfn-SubframeConfigList Configure the MBSFN subframes for the UE on this serving cell. An uplink subframe indicated by the DL/UL subframe configuration in SIB1 can be configured as MBSFN subframe.

– *LogicalChannelConfig*

The IE *LogicalChannelConfig* is used to configure the logical channel parameters.

***LogicalChannelConfig* information element**

```
-- ASN1START

LogicalChannelConfig ::=            SEQUENCE {
    ul-SpecificParameters               SEQUENCE {
        priority                            INTEGER (1..16),
        prioritisedBitRate                  ENUMERATED {
                                                kBps0, kBps8, kBps16, kBps32, kBps64, kBps128,
                                                kBps256, infinity, kBps512-v1020, kBps1024-v1020,
                                                kBps2048-v1020, spare5, spare4, spare3, spare2,
                                                spare1},
        bucketSizeDuration                  ENUMERATED {
                                                ms50, ms100, ms150, ms300, ms500, ms1000, spare2,
                                                spare1},
        logicalChannelGroup                 INTEGER (0..3)          OPTIONAL            -- Need OR
    }       OPTIONAL,                                                                   -- Cond UL
    ...,
    [[  logicalChannelSR-Mask-r9            ENUMERATED {setup}      OPTIONAL        -- Cond SRmask
    ]],
    [[  logicalChannelSR-Prohibit-r12       BOOLEAN                 OPTIONAL        -- Need ON
    ]]
}

-- ASN1STOP
```

LogicalChannelConfig field descriptions
bucketSizeDuration Bucket Size Duration for logical channel prioritization in TS 36.321 [6]. Value in milliseconds. Value ms50 corresponds to 50 ms, ms100 corresponds to 100 ms and so on.
logicalChannelGroup Mapping of logical channel to logical channel group for BSR reporting in TS 36.321 [6].
logicalChannelSR-Mask Controlling SR triggering on a logical channel basis when an uplink grant is configured. See TS 36.321 [6].
logicalChannelSR-Prohibit Value *TRUE* indicates that the *logicalChannelSR-ProhibitTimer* is enabled for the logical channel. E-UTRAN only (optionally) configures the field (i.e. indicates value *TRUE*) if *logicalChannelSR-ProhibitTimer* is configured. See TS 36.321 [6].
prioritisedBitRate Prioritized Bit Rate for logical channel prioritization in TS 36.321 [6]. Value in kilobytes/second. Value kBps0 corresponds to 0 kB/second, kBps8 corresponds to 8 kB/second, kBps16 corresponds to 16 kB/second and so on. Infinity is the only applicable value for SRB1 and SRB2
priority Logical channel priority in TS 36.321 [6]. Value is an integer.

Conditional presence	Explanation
SRmask	The field is optionally present if *ul-SpecificParameters* is present, need OR; otherwise it is not present.
UL	The field is mandatory present for UL logical channels; otherwise it is not present.

– *MAC-MainConfig*

The IE *MAC-MainConfig* is used to specify the MAC main configuration for signalling and data radio bearers. All MAC main configuration parameters can be configured independently per Cell Group (i.e. MCG or SCG), unless explicitly specified otherwise.

MAC-MainConfig information element

```
-- ASN1START

MAC-MainConfig ::=                  SEQUENCE {
    ul-SCH-Config                       SEQUENCE {
        maxHARQ-Tx                          ENUMERATED {
                                                n1, n2, n3, n4, n5, n6, n7, n8,
                                                n10, n12, n16, n20, n24, n28,
                                                spare2, spare1}     OPTIONAL,   -- Need ON
        periodicBSR-Timer                   PeriodicBSR-Timer-r12   OPTIONAL,   -- Need ON
        retxBSR-Timer                       RetxBSR-Timer-r12,
        ttiBundling                         BOOLEAN
    }                                                               OPTIONAL,   -- Need ON
    drx-Config                          DRX-Config                  OPTIONAL,   -- Need ON
    timeAlignmentTimerDedicated         TimeAlignmentTimer,
    phr-Config                          CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            periodicPHR-Timer                   ENUMERATED {sf10, sf20, sf50, sf100, sf200,
                                                            sf500, sf1000, infinity},
            prohibitPHR-Timer                   ENUMERATED {sf0, sf10, sf20, sf50, sf100,
                                                            sf200, sf500, sf1000},
            dl-PathlossChange                   ENUMERATED {dB1, dB3, dB6, infinity}
        }
    }                                                               OPTIONAL,   -- Need ON
    ...,
    [[  sr-ProhibitTimer-r9             INTEGER (0..7)              OPTIONAL    -- Need ON
    ]],
    [[  mac-MainConfig-v1020            SEQUENCE {
            sCellDeactivationTimer-r10          ENUMERATED {
                                                    rf2, rf4, rf8, rf16, rf32, rf64, rf128,
                                                    spare}          OPTIONAL,   -- Need OP
            extendedBSR-Sizes-r10               ENUMERATED {setup}      OPTIONAL,   -- Need OR
            extendedPHR-r10                     ENUMERATED {setup}      OPTIONAL    -- Need OR
        }                                                           OPTIONAL    -- Need ON
    ]],
    [[  stag-ToReleaseList-r11          STAG-ToReleaseList-r11  OPTIONAL,   -- Need ON
        stag-ToAddModList-r11           STAG-ToAddModList-r11   OPTIONAL,   -- Need ON
```

```
        drx-Config-v1130                    DRX-Config-v1130        OPTIONAL    -- Need ON
    ]],
    [[  e-HARQ-Pattern-r12                  BOOLEAN                 OPTIONAL,   -- Need ON
        dualConnectivityPHR                 CHOICE {
            release                             NULL,
            setup                               SEQUENCE {
                phr-ModeOtherCG-r12                 ENUMERATED {real, virtual}
            }
        }                                                           OPTIONAL,   -- Need ON
        logicalChannelSR-Config-r12     CHOICE {
            release                             NULL,
            setup                               SEQUENCE {
                logicalChannelSR-ProhibitTimer-r12      ENUMERATED {sf20, sf40, sf64, sf128, sf512,
sf1024, sf2560, spare1}
            }
        }                                                           OPTIONAL    -- Need ON
    ]]
}

MAC-MainConfigSCell-r11 ::=         SEQUENCE {
    stag-Id-r11                         STAG-Id-r11     OPTIONAL,   -- Need OP
    ...
}

DRX-Config ::=                      CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        onDurationTimer                     ENUMERATED {
                                                psf1, psf2, psf3, psf4, psf5, psf6,
                                                psf8, psf10, psf20, psf30, psf40,
                                                psf50, psf60, psf80, psf100,
                                                psf200},
        drx-InactivityTimer                 ENUMERATED {
                                                psf1, psf2, psf3, psf4, psf5, psf6,
                                                psf8, psf10, psf20, psf30, psf40,
                                                psf50, psf60, psf80, psf100,
                                                psf200, psf300, psf500, psf750,
                                                psf1280, psf1920, psf2560, psf0-v1020,
                                                spare9, spare8, spare7, spare6,
                                                spare5, spare4, spare3, spare2,
                                                spare1},
        drx-RetransmissionTimer             ENUMERATED {
                                                psf1, psf2, psf4, psf6, psf8, psf16,
                                                psf24, psf33},
        longDRX-CycleStartOffset        CHOICE {
            sf10                            INTEGER(0..9),
            sf20                            INTEGER(0..19),
            sf32                            INTEGER(0..31),
            sf40                            INTEGER(0..39),
            sf64                            INTEGER(0..63),
            sf80                            INTEGER(0..79),
            sf128                           INTEGER(0..127),
            sf160                           INTEGER(0..159),
            sf256                           INTEGER(0..255),
            sf320                           INTEGER(0..319),
            sf512                           INTEGER(0..511),
            sf640                           INTEGER(0..639),
            sf1024                          INTEGER(0..1023),
            sf1280                          INTEGER(0..1279),
            sf2048                          INTEGER(0..2047),
            sf2560                          INTEGER(0..2559)
        },
        shortDRX                            SEQUENCE {
            shortDRX-Cycle                      ENUMERATED  {
                                                    sf2, sf5, sf8, sf10, sf16, sf20,
                                                    sf32, sf40, sf64, sf80, sf128, sf160,
                                                    sf256, sf320, sf512, sf640},
            drxShortCycleTimer                  INTEGER (1..16)
        }       OPTIONAL                                            -- Need OR
    }
}

DRX-Config-v1130 ::=                    SEQUENCE {
    drx-RetransmissionTimer-v1130           ENUMERATED {psf0-v1130} OPTIONAL,   --Need OR
    longDRX-CycleStartOffset-v1130          CHOICE {
        sf60-v1130                              INTEGER(0..59),
        sf70-v1130                              INTEGER(0..69)
    }                                                               OPTIONAL,   --Need OR
```

```
    shortDRX-Cycle-v1130                    ENUMERATED  {sf4-v1130} OPTIONAL    --Need OR
}

PeriodicBSR-Timer-r12 ::=                   ENUMERATED {
                                                sf5, sf10, sf16, sf20, sf32, sf40, sf64, sf80,
                                                sf128, sf160, sf320, sf640, sf1280, sf2560,
                                                infinity, spare1}

RetxBSR-Timer-r12 ::=                           ENUMERATED {
                                                sf320, sf640, sf1280, sf2560, sf5120,
                                                sf10240, spare2, spare1}

STAG-ToReleaseList-r11 ::=  SEQUENCE (SIZE (1..maxSTAG-r11)) OF STAG-Id-r11

STAG-ToAddModList-r11 ::=   SEQUENCE (SIZE (1..maxSTAG-r11)) OF STAG-ToAddMod-r11

STAG-ToAddMod-r11 ::=       SEQUENCE {
    stag-Id-r11                 STAG-Id-r11,
    timeAlignmentTimerSTAG-r11  TimeAlignmentTimer,
    ...
}

STAG-Id-r11::=              INTEGER (1..maxSTAG-r11)

-- ASN1STOP
```

MAC-MainConfig field descriptions
dl-PathlossChange DL Pathloss Change and the change of the required power backoff due to power management (as allowed by P-MPRc [42]) for PHR reporting in TS 36.321 [6]. Value in dB. Value dB1 corresponds to 1 dB, dB3 corresponds to 3 dB and so on. The same value applies for each serving cell (although the associated functionality is performed independently for each cell).
drx-Config Used to configure DRX as specified in TS 36.321 [6]. E-UTRAN configures the values in *DRX-Config-v1130* only if the UE indicates support for IDC indication. E-UTRAN configures *drx-Config-v1130* only if *drx-Config* (without suffix) is configured.
drx-InactivityTimer Timer for DRX in TS 36.321 [6]. Value in number of PDCCH sub-frames. Value psf1 corresponds to 1 PDCCH sub-frame, psf2 corresponds to 2 PDCCH sub-frames and so on.
drx-RetransmissionTimer Timer for DRX in TS 36.321 [6]. Value in number of PDCCH sub-frames. Value psf1 corresponds to 1 PDCCH sub-frame, psf2 corresponds to 2 PDCCH sub-frames and so on. In case *drx-RetransmissionTimer-v1130* is signalled, the UE shall ignore *drx-RetransmissionTimer* (i.e. without suffix).
drxShortCycleTimer Timer for DRX in TS 36.321 [6]. Value in multiples of shortDRX-Cycle. A value of 1 corresponds to shortDRX-Cycle, a value of 2 corresponds to 2 * shortDRX-Cycle and so on.
dualConnectivityPHR Indicates if power headroom shall be reported using Dual Connectivity Power Headroom Report MAC Control Element defined in TS 36.321 [6] (value *setup*). If PHR functionality and dual connectivity are configured, E-UTRAN always configures the value *setup* for this field and configures *phr-Config* and *dualConnectivityPHR* for both CGs.
e-HARQ-Pattern TRUE indicates that enhanced HARQ pattern for TTI bundling is enabled for FDD. E-UTRAN enables this field only when *ttiBundling* is set to *TRUE*.
extendedBSR-Sizes If value *setup* is configured, the BSR index indicates extended BSR size levels as defined in TS 36.321 [6, Table 6.1.3.1-2].
extendedPHR Indicates if power headroom shall be reported using the Extended Power Headroom Report MAC control element defined in TS 36.321 [6] (value *setup*). E-UTRAN always configures the value *setup* if more than one Serving Cell with uplink is configured and if dual connectivity is not configured. E-UTRAN configures *extendedPHR* only if *phr-Config* is configured. The UE shall release *extendedPHR* if *phr-Config* is released.
logicalChannelSR-ProhibitTimer Timer used to delay the transmission of an SR for logical channels enabled by *logicalChannelSR-Prohibit.* Value sf20 corresponds to 20 subframes, sf40 corresponds to 40 subframes, and so on. See TS 36.321 [6].
longDRX-CycleStartOffset *longDRX-Cycle* and *drxStartOffset* in TS 36.321 [6]. The value of l*ongDRX-Cycle* is in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on. If *shortDRX-Cycle* is configured, the value of *longDRX-Cycle* shall be a multiple of the *shortDRX-Cycle* value. The value of *drxStartOffset* value is in number of sub-frames. In case *longDRX-CycleStartOffset-v1130* is signalled, the UE shall ignore *longDRX-CycleStartOffset* (i.e. without suffix).
maxHARQ-Tx Maximum number of transmissions for UL HARQ in TS 36.321 [6].
onDurationTimer Timer for DRX in TS 36.321 [6]. Value in number of PDCCH sub-frames. Value psf1 corresponds to 1 PDCCH sub-frame, psf2 corresponds to 2 PDCCH sub-frames and so on.
periodicBSR-Timer Timer for BSR reporting in TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on.
periodicPHR-Timer Timer for PHR reporting in TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 subframes, sf20 corresponds to 20 subframes and so on.
phr-ModeOtherCG Indicates the mode (i.e. *real* or *virtual)* used for the PHR of the activated cells that are part of the other Cell Group (i.e. MCG or SCG), when DC is configured.
prohibitPHR-Timer Timer for PHR reporting in TS 36.321 [6]. Value in number of sub-frames. Value sf0 corresponds to 0 subframes, sf100 corresponds to 100 subframes and so on.
retxBSR-Timer Timer for BSR reporting in TS 36.321 [6]. Value in number of sub-frames. Value sf640 corresponds to 640 sub-frames, sf1280 corresponds to 1280 sub-frames and so on.

***MAC-MainConfig* field descriptions**
sCellDeactivationTimer SCell deactivation timer in TS 36.321 [6]. Value in number of radio frames. Value rf4 corresponds to 4 radio frames, value rf8 corresponds to 8 radio frames and so on. E-UTRAN only configures the field if the UE is configured with one or more SCells other than the PSCell. If the field is absent, the UE shall delete any existing value for this field and assume the value to be set to *infinity*. The same value applies for each SCell of a Cell Group (i.e. MCG or SCG) (although the associated functionality is performed independently for each SCell).
shortDRX-Cycle Short DRX cycle in TS 36.321 [6]. Value in number of sub-frames. Value sf2 corresponds to 2 sub-frames, sf5 corresponds to 5 subframes and so on. In case *shortDRX-Cycle-v1130* is signalled, the UE shall ignore *shortDRX-Cycle* (i.e. without suffix).
sr-ProhibitTimer Timer for SR transmission on PUCCH in TS 36.321 [6]. Value in number of SR period(s). Value 0 means no timer for SR transmission on PUCCH is configured. Value 1 corresponds to one SR period, Value 2 corresponds to 2*SR periods and so on. SR period is defined in TS 36.213 [23, table 10.1.5-1].
stag-Id Indicates the TAG of an SCell, see TS 36.321 [6]. Uniquely identifies the TAG within the scope of a Cell Group (i.e. MCG or SCG). If the field is not configured for an SCell (e.g. absent in *MAC-MainConfigSCell*), the SCell is part of the PTAG.
stag-ToAddModList, stag-ToReleaseList Used to configure one or more STAGs. E-UTRAN ensures that a STAG contains at least one SCell with configured uplink. If, due to SCell release a reconfiguration would result in an 'empty' TAG, E-UTRAN includes release of the concerned TAG.
timeAlignmentTimerSTAG Indicates the value of the time alignment timer for an STAG, see TS 36.321 [6].
ttiBundling TRUE indicates that TTI bundling TS 36.321 [6] is enabled while FALSE indicates that TTI bundling is disabled. TTI bundling can be enabled for FDD and for TDD only for configurations 0, 1 and 6. The functionality is performed independently per Cell Group (i.e. MCG or SCG), but E-UTRAN does not configure TTI bundling for the SCG. For a TDD PCell, E-UTRAN does not simultaneously enable TTI bundling and semi-persistent scheduling in this release of specification. Furthermore, for a Cell Group, E-UTRAN does not simultaneously configure TTI bundling and SCells with configured uplink, and E-UTRAN does not simultaneously configure TTI bundling and eIMTA.

– *PDCP-Config*

The IE *PDCP-Config* is used to set the configurable PDCP parameters for data radio bearers.

***PDCP-Config* information element**

```
-- ASN1START

PDCP-Config ::=                     SEQUENCE {
    discardTimer                        ENUMERATED {
                                            ms50, ms100, ms150, ms300, ms500,
                                            ms750, ms1500, infinity
                                                                    OPTIONAL,           -- Cond Setup
    }
    rlc-AM                              SEQUENCE {
        statusReportRequired                BOOLEAN
    }                                                               OPTIONAL,           -- Cond Rlc-AM
    rlc-UM                              SEQUENCE {
        pdcp-SN-Size                        ENUMERATED {len7bits, len12bits}
    }                                                               OPTIONAL,           -- Cond Rlc-UM
    headerCompression                   CHOICE {
        notUsed                             NULL,
        rohc                                SEQUENCE {
            maxCID                              INTEGER (1..16383)              DEFAULT 15,
            profiles                            SEQUENCE {
                profile0x0001                       BOOLEAN,
                profile0x0002                       BOOLEAN,
                profile0x0003                       BOOLEAN,
                profile0x0004                       BOOLEAN,
                profile0x0006                       BOOLEAN,
                profile0x0101                       BOOLEAN,
                profile0x0102                       BOOLEAN,
                profile0x0103                       BOOLEAN,
                profile0x0104                       BOOLEAN
            },
            ...
        }
    },
```

```
    ...,
    [[  rn-IntegrityProtection-r10      ENUMERATED {enabled}    OPTIONAL    -- Cond RN
    ]],
    [[  pdcp-SN-Size-v1130              ENUMERATED {len15bits}  OPTIONAL    -- Cond Rlc-AM2
    ]],
    [[  ul-DataSplitDRB-ViaSCG-r12      BOOLEAN     OPTIONAL,   -- Need ON
        t-Reordering-r12                ENUMERATED {
                                        ms0, ms20, ms40, ms60, ms80, ms100, ms120, ms140,
                                        ms160, ms180, ms200, ms220, ms240, ms260, ms280, ms300,
                                        ms500, ms750, spare14, spare13, spare12, spare11, spare10,
                                        spare9, spare8, spare7, spare6, spare5, spare4, spare3,
                                        spare2, spare1}                 OPTIONAL    -- Cond SetupS
    ]]
}

-- ASN1STOP
```

***PDCP-Config* field descriptions**
discardTimer Indicates the discard timer value specified in TS 36.323 [8]. Value in milliseconds. Value ms50 means 50 ms, ms100 means 100 ms and so on.
headerCompression E-UTRAN does not reconfigure header compression for an MCG DRB except for upon handover and upon the first reconfiguration after RRC connection re-establishment. E-UTRAN does not reconfigure header compression for a SCG DRB except for upon SCG change involving PDCP re-establishment. For split DRBs E-UTRAN configures only *notUsed*.
maxCID Indicates the value of the MAX_CID parameter as specified in TS 36.323 [8]. The total value of MAX_CIDs across all bearers for the UE should be less than or equal to the value of *maxNumberROHC-ContextSessions* parameter as indicated by the UE.
pdcp-SN-Size Indicates the PDCP Sequence Number length in bits. For RLC UM: value *len7bits* means that the 7-bit PDCP SN format is used and *len12bits* means that the 12-bit PDCP SN format is used. For RLC AM: value *len15bits* means that the 15-bit PDCP SN format is used, otherwise if the field is not included upon setup of the PCDP entity 12-bit PDCP SN format is used, as specified in TS 36.323 [8].
profiles The profiles used by both compressor and decompressor in both UE and E-UTRAN. The field indicates which of the ROHC profiles specified in TS 36.323 [8] are supported, i.e. value *true* indicates that the profile is supported. Profile 0x0000 shall always be supported when the use of ROHC is configured. If support of two ROHC profile identifiers with the same 8 LSB's is signalled, only the profile corresponding to the highest value shall be applied. E-UTRAN does not configure ROHC while *t-Reordering* is configured (i.e. for split DRBs or upon reconfiguration from split to MCG DRB).
t-Reordering Indicates the value of the reordering timer, as specified in TS 36.323 [8]. Value in milliseconds. Value ms0 means 0 ms, ms20 means 20 ms and so on.
rn-IntegrityProtection Indicates that integrity protection or verification shall be applied for all subsequent packets received and sent by the RN on the DRB.
statusReportRequired Indicates whether or not the UE shall send a PDCP Status Report upon re-establishment of the PDCP entity and upon PDCP data recovery as specified in TS 36.323 [8].
ul-DataSplitDRB-ViaSCG Indicates whether the UE shall send PDCP PDUs via SCG. E-UTRAN only configures the field (i.e. indicates value *TRUE*) for split DRBs.

Conditional presence	Explanation
Rlc-AM	The field is mandatory present upon setup of a PDCP entity for a radio bearer configured with RLC AM. The field is optional, need ON, in case of reconfiguration of a PDCP entity at handover, at the first reconfiguration after RRC re-establishment or at SCG change involving PDCP re-establishment or PDCP data recovery for a radio bearer configured with RLC AM. Otherwise the field is not present.
Rlc-AM2	The field is optionally present, need OP, upon setup of a PDCP entity for a radio bearer configured with RLC AM. Otherwise the field is not present.
Rlc-UM	The field is mandatory present upon setup of a PDCP entity for a radio bearer configured with RLC UM. It is optionally present, Need ON, upon handover within E-UTRA, upon the first reconfiguration after re-establishment and upon SCG change involving PDCP re-establishment. Otherwise the field is not present.
RN	The field is optionally present when signalled to the RN, need OR. Otherwise the field is not present.
Setup	The field is mandatory present in case of radio bearer setup. Otherwise the field is optionally present, need ON.
SetupS	The field is mandatory present in case of setup of or reconfiguration to a split DRB. The field is optionally present upon reconfiguration of a split DRB or upon DRB type change from split to MCG DRB, need ON. Otherwise the field is not present.

– *PDSCH-Config*

The IE *PDSCH-ConfigCommon* and the IE *PDSCH-ConfigDedicated* are used to specify the common and the UE specific PDSCH configuration respectively.

PDSCH-Config information element

```
-- ASN1START

PDSCH-ConfigCommon ::=      SEQUENCE {
    referenceSignalPower                INTEGER (-60..50),
    p-b                                 INTEGER (0..3)
}

PDSCH-ConfigDedicated::=        SEQUENCE {
    p-a                                 ENUMERATED {
                                            dB-6, dB-4dot77, dB-3, dB-1dot77,
                                            dB0, dB1, dB2, dB3}
}

PDSCH-ConfigDedicated-v1130 ::=     SEQUENCE {
    dmrs-ConfigPDSCH-r11                DMRS-Config-r11                 OPTIONAL,   -- Need ON
    qcl-Operation                       ENUMERATED {typeA, typeB}           OPTIONAL,   -- Need OR
    re-MappingQCLConfigToReleaseList-r11    RE-MappingQCLConfigToReleaseList-r11    OPTIONAL,   --
Need ON
    re-MappingQCLConfigToAddModList-r11     RE-MappingQCLConfigToAddModList-r11     OPTIONAL    --
Need ON
}

RE-MappingQCLConfigToAddModList-r11 ::=     SEQUENCE (SIZE (1..maxRE-MapQCL-r11)) OF PDSCH-RE-
MappingQCL-Config-r11

RE-MappingQCLConfigToReleaseList-r11 ::=    SEQUENCE (SIZE (1..maxRE-MapQCL-r11)) OF PDSCH-RE-
MappingQCL-ConfigId-r11

PDSCH-RE-MappingQCL-Config-r11 ::=      SEQUENCE {
    pdsch-RE-MappingQCL-ConfigId-r11    PDSCH-RE-MappingQCL-ConfigId-r11,
    optionalSetOfFields-r11             SEQUENCE {
        crs-PortsCount-r11                  ENUMERATED {n1, n2, n4, spare1},
        crs-FreqShift-r11                   INTEGER (0..5),
        mbsfn-SubframeConfigList-r11        CHOICE {
            release                             NULL,
            setup                               SEQUENCE {
                subframeConfigList                  MBSFN-SubframeConfigList
            }
        }                                                               OPTIONAL,   -- Need ON
        pdsch-Start-r11                     ENUMERATED {reserved, n1, n2, n3, n4, assigned}
    }                                                                   OPTIONAL,   -- Need OP
    csi-RS-ConfigZPId-r11               CSI-RS-ConfigZPId-r11,
    qcl-CSI-RS-ConfigNZPId-r11          CSI-RS-ConfigNZPId-r11              OPTIONAL,   -- Need OR
    ...
```

```
}

PDSCH-ConfigDedicated-v1280 ::=     SEQUENCE {
    tbsIndexAlt-r12                     ENUMERATED {a26, a33}               OPTIONAL    -- Need OR
}

-- ASN1STOP
```

***PDSCH-Config* field descriptions**
optionalSetOfFields If absent, the UE releases the configuration provided previously, if any, and applies the values from the serving cell configured on the same frequency.
p-a Parameter: P_A , see TS 36.213 [23, 5.2]. Value dB-6 corresponds to -6 dB, dB-4dot77 corresponds to -4.77 dB etc.
p-b Parameter: P_B , see TS 36.213 [23, Table 5.2-1].
pdsch-Start The starting OFDM symbol of PDSCH for the concerned serving cell, see TS 36.213 [23. 7.1.6.4]. Values 1, 2, 3 are applicable when *dl-Bandwidth* for the concerned serving cell is greater than 10 resource blocks, values 2, 3, 4 are applicable when *dl-Bandwidth* for the concerned serving cell is less than or equal to 10 resource blocks, see TS 36.211 [21, Table 6.7-1]. Value *n1* corresponds to 1, value *n2* corresponds to 2 and so on.
qcl-CSI-RS-ConfigNZPId Indicates the CSI-RS resource that is quasi co-located with the PDSCH antenna ports, see TS 36.213 [23, 7.1.9]. E-UTRAN configures this field if and only if the UE is configured with *qcl-Operation* set to *typeB*.
qcl-Operation Indicates the quasi co-location behaviour to be used by the UE, type A and type B, as described in TS 36.213 [23, 7.1.10].
referenceSignalPower Parameter: *Reference-signal power*, which provides the downlink reference-signal EPRE, see TS 36.213 [23, 5.2]. The actual value in dBm.
re-MappingQCLConfigToAddModList, re-MappingQCLConfigToReleaseList For a serving frequency E-UTRAN configures at least one *PDSCH-RE-MappingQCL-Config* when transmission mode 10 is configured for the serving cell on this carrier frequency. Otherwise it does not configure this IE.
tbsIndexAlt Indicates the applicability of the alternative TBS index for the I_{TBS} 26 and 33 (see TS 36.213 [23, Table 7.1.7.2.1-1]) to all subframes scheduled by DCI format 2C or 2D. Value *a26* refers to the alternative TBS index I_{TBS} 26A, and value *a33* refers to the alternative TBS index I_{TBS} 33A. If this field is not configured, the UE shall use I_{TBS} 26 and 33 specified in Table 7.1.7.2.1-1 in TS 36.213 [23] for all subframes instead.

– *PDSCH-RE-MappingQCL-ConfigId*

The IE *PDSCH-RE-MappingQCL-ConfigId* is used to identify a set of PDSCH parameters related to resource element mapping and quasi co-location, as configured by the IE *PDSCH-RE-MappingQCL-Config*. The identity is unique within the scope of a carrier frequency.

***PDSCH-RE-MappingQCL-ConfigId* information elements**

```
-- ASN1START

PDSCH-RE-MappingQCL-ConfigId-r11 ::=        INTEGER (1..maxRE-MapQCL-r11)

-- ASN1STOP
```

– *PHICH-Config*

The IE *PHICH-Config* is used to specify the PHICH configuration.

***PHICH-Config* information element**

```
-- ASN1START

PHICH-Config ::=                    SEQUENCE {
    phich-Duration                      ENUMERATED {normal, extended},
    phich-Resource                      ENUMERATED {oneSixth, half, one, two}
```

```
}

-- ASN1STOP
```

***PHICH-Config* field descriptions**
phich-Duration Parameter: *PHICH-Duration*, see TS 36.211 [21, Table 6.9.3-1].
phich-Resource Parameter: *Ng*, see TS 36.211 [21, 6.9]. Value oneSixth corresponds to 1/6, half corresponds to 1/2 and so on.

– *PhysicalConfigDedicated*

The IE *PhysicalConfigDedicated* is used to specify the UE specific physical channel configuration.

PhysicalConfigDedicated information element

```
-- ASN1START

PhysicalConfigDedicated ::=     SEQUENCE {
    pdsch-ConfigDedicated               PDSCH-ConfigDedicated           OPTIONAL,       -- Need ON
    pucch-ConfigDedicated               PUCCH-ConfigDedicated           OPTIONAL,       -- Need ON
    pusch-ConfigDedicated               PUSCH-ConfigDedicated           OPTIONAL,       -- Need ON
    uplinkPowerControlDedicated         UplinkPowerControlDedicated     OPTIONAL,       -- Need ON
    tpc-PDCCH-ConfigPUCCH               TPC-PDCCH-Config                OPTIONAL,       -- Need ON
    tpc-PDCCH-ConfigPUSCH               TPC-PDCCH-Config                OPTIONAL,       -- Need ON
    cqi-ReportConfig                    CQI-ReportConfig                OPTIONAL,       -- Cond CQI-
r8
    soundingRS-UL-ConfigDedicated       SoundingRS-UL-ConfigDedicated   OPTIONAL,       -- Need ON
    antennaInfo                         CHOICE {
        explicitValue                       AntennaInfoDedicated,
        defaultValue                        NULL
    }       OPTIONAL,                                                                   -- Cond AI-r8
    schedulingRequestConfig             SchedulingRequestConfig     OPTIONAL,           -- Need ON
    ...,
    [[  cqi-ReportConfig-v920               CQI-ReportConfig-v920       OPTIONAL,       -- Cond CQI-
r8
        antennaInfo-v920                    AntennaInfoDedicated-v920   OPTIONAL        -- Cond AI-
r8
    ]],
    [[  antennaInfo-r10                 CHOICE {
            explicitValue-r10               AntennaInfoDedicated-r10,
            defaultValue                    NULL
        }       OPTIONAL,                                                               -- Cond AI-r10
        antennaInfoUL-r10               AntennaInfoUL-r10               OPTIONAL,       -- Need ON
        cif-Presence-r10                BOOLEAN                         OPTIONAL,   -- Need ON
        cqi-ReportConfig-r10            CQI-ReportConfig-r10            OPTIONAL,       -- Cond CQI-
r10
        csi-RS-Config-r10               CSI-RS-Config-r10               OPTIONAL,       -- Need ON
        pucch-ConfigDedicated-v1020     PUCCH-ConfigDedicated-v1020     OPTIONAL,       -- Need ON
        pusch-ConfigDedicated-v1020     PUSCH-ConfigDedicated-v1020     OPTIONAL,       -- Need ON
        schedulingRequestConfig-v1020   SchedulingRequestConfig-v1020   OPTIONAL,       -- Need ON
        soundingRS-UL-ConfigDedicated-v1020
                                    SoundingRS-UL-ConfigDedicated-v1020     OPTIONAL,       -- Need ON
        soundingRS-UL-ConfigDedicatedAperiodic-r10
                                    SoundingRS-UL-ConfigDedicatedAperiodic-r10  OPTIONAL,   -- Need ON
        uplinkPowerControlDedicated-v1020   UplinkPowerControlDedicated-v1020   OPTIONAL    -- Need
ON
    ]],
    [[  additionalSpectrumEmissionCA-r10            CHOICE {
            release                                 NULL,
            setup                                   SEQUENCE {
                additionalSpectrumEmissionPCell-r10     AdditionalSpectrumEmission
            }
        }           OPTIONAL    -- Need ON
    ]],
    [[  -- DL configuration as well as configuration applicable for DL and UL
        csi-RS-ConfigNZPToReleaseList-r11   CSI-RS-ConfigNZPToReleaseList-r11   OPTIONAL,   -- Need
ON
        csi-RS-ConfigNZPToAddModList-r11    CSI-RS-ConfigNZPToAddModList-r11    OPTIONAL,   -- Need
ON
        csi-RS-ConfigZPToReleaseList-r11    CSI-RS-ConfigZPToReleaseList-r11    OPTIONAL,   -- Need
ON
        csi-RS-ConfigZPToAddModList-r11     CSI-RS-ConfigZPToAddModList-r11 OPTIONAL,   -- Need ON
```

```
        epdcch-Config-r11                   EPDCCH-Config-r11               OPTIONAL,   -- Need ON
        pdsch-ConfigDedicated-v1130         PDSCH-ConfigDedicated-v1130     OPTIONAL,   -- Need ON
    -- UL configuration
        cqi-ReportConfig-v1130              CQI-ReportConfig-v1130          OPTIONAL,   -- Need ON
        pucch-ConfigDedicated-v1130         PUCCH-ConfigDedicated-v1130     OPTIONAL,   -- Need ON
        pusch-ConfigDedicated-v1130         PUSCH-ConfigDedicated-v1130     OPTIONAL,   -- Need ON
        uplinkPowerControlDedicated-v1130   UplinkPowerControlDedicated-v1130   OPTIONAL    -- Need
ON
    ]],
    [[  antennaInfo-v1250                   AntennaInfoDedicated-v1250      OPTIONAL,   -- Cond AI-
r10
        eimta-MainConfig-r12                EIMTA-MainConfig-r12            OPTIONAL,   -- Need ON
        eimta-MainConfigPCell-r12           EIMTA-MainConfigServCell-r12        OPTIONAL,   -- Need
ON
        pucch-ConfigDedicated-v1250         PUCCH-ConfigDedicated-v1250     OPTIONAL,   -- Need ON
        cqi-ReportConfigPCell-v1250         CQI-ReportConfig-v1250          OPTIONAL,   -- Need ON
        uplinkPowerControlDedicated-v1250   UplinkPowerControlDedicated-v1250   OPTIONAL,   -- Need
ON
        pusch-ConfigDedicated-v1250     PUSCH-ConfigDedicated-v1250     OPTIONAL,   -- Need ON
        csi-RS-Config-v1250                 CSI-RS-Config-v1250             OPTIONAL    -- Need ON
    ]],
    [[  pdsch-ConfigDedicated-v1280         PDSCH-ConfigDedicated-v1280     OPTIONAL    -- Need ON
    ]]
}

PhysicalConfigDedicatedSCell-r10 ::=        SEQUENCE {
    -- DL configuration as well as configuration applicable for DL and UL
    nonUL-Configuration-r10                 SEQUENCE {
        antennaInfo-r10                         AntennaInfoDedicated-r10    OPTIONAL,   -- Need ON
        crossCarrierSchedulingConfig-r10        CrossCarrierSchedulingConfig-r10    OPTIONAL,   --
Need ON
        csi-RS-Config-r10                       CSI-RS-Config-r10           OPTIONAL,   -- Need ON
        pdsch-ConfigDedicated-r10               PDSCH-ConfigDedicated       OPTIONAL    -- Need ON
    }                                                                   OPTIONAL,   -- Cond SCellAdd
    -- UL configuration
    ul-Configuration-r10                    SEQUENCE {
        antennaInfoUL-r10                       AntennaInfoUL-r10           OPTIONAL,   -- Need ON
        pusch-ConfigDedicatedSCell-r10          PUSCH-ConfigDedicatedSCell-r10      OPTIONAL,   --
Need ON
        uplinkPowerControlDedicatedSCell-r10    UplinkPowerControlDedicatedSCell-r10    OPTIONAL, --
Need ON
        cqi-ReportConfigSCell-r10               CQI-ReportConfigSCell-r10   OPTIONAL,   -- Need ON
        soundingRS-UL-ConfigDedicated-r10       SoundingRS-UL-ConfigDedicated   OPTIONAL,   -- Need
ON
        soundingRS-UL-ConfigDedicated-v1020
                                SoundingRS-UL-ConfigDedicated-v1020 OPTIONAL,       -- Need ON
        soundingRS-UL-ConfigDedicatedAperiodic-r10
                                SoundingRS-UL-ConfigDedicatedAperiodic-r10  OPTIONAL    -- Need ON
    }                                                               OPTIONAL,   -- Cond CommonUL
    ...,
    [[  -- DL configuration as well as configuration applicable for DL and UL
        csi-RS-ConfigNZPToReleaseList-r11   CSI-RS-ConfigNZPToReleaseList-r11   OPTIONAL,   -- Need
ON
        csi-RS-ConfigNZPToAddModList-r11    CSI-RS-ConfigNZPToAddModList-r11    OPTIONAL,   -- Need
ON
        csi-RS-ConfigZPToReleaseList-r11    CSI-RS-ConfigZPToReleaseList-r11    OPTIONAL,   -- Need
ON
        csi-RS-ConfigZPToAddModList-r11     CSI-RS-ConfigZPToAddModList-r11 OPTIONAL,   -- Need ON
        epdcch-Config-r11                   EPDCCH-Config-r11               OPTIONAL,   -- Need ON
        pdsch-ConfigDedicated-v1130         PDSCH-ConfigDedicated-v1130     OPTIONAL,   -- Need ON
    -- UL configuration
        cqi-ReportConfig-v1130              CQI-ReportConfig-v1130          OPTIONAL,   -- Need ON
        pusch-ConfigDedicated-v1130             PUSCH-ConfigDedicated-v1130 OPTIONAL,   -- Need ON
        uplinkPowerControlDedicatedSCell-v1130  UplinkPowerControlDedicated-v1130   OPTIONAL    --
Need ON
    ]],
    [[  antennaInfo-v1250                   AntennaInfoDedicated-v1250      OPTIONAL,   -- Need ON
        eimta-MainConfigSCell-r12           EIMTA-MainConfigServCell-r12    OPTIONAL,   -- Need ON
        cqi-ReportConfigSCell-v1250         CQI-ReportConfig-v1250          OPTIONAL,   -- Need ON
        uplinkPowerControlDedicatedSCell-v1250  UplinkPowerControlDedicated-v1250   OPTIONAL,   --
Need ON
        csi-RS-Config-v1250                 CSI-RS-Config-v1250             OPTIONAL    -- Need ON
    ]],
    [[  pdsch-ConfigDedicated-v1280         PDSCH-ConfigDedicated-v1280     OPTIONAL    -- Need ON
    ]]
}
```

```
CSI-RS-ConfigNZPToAddModList-r11 ::=    SEQUENCE (SIZE (1..maxCSI-RS-NZP-r11)) OF CSI-RS-ConfigNZP-
r11

CSI-RS-ConfigNZPToReleaseList-r11 ::=   SEQUENCE (SIZE (1..maxCSI-RS-NZP-r11)) OF CSI-RS-
ConfigNZPId-r11

CSI-RS-ConfigZPToAddModList-r11 ::= SEQUENCE (SIZE (1..maxCSI-RS-ZP-r11)) OF CSI-RS-ConfigZP-r11

CSI-RS-ConfigZPToReleaseList-r11 ::=    SEQUENCE (SIZE (1..maxCSI-RS-ZP-r11)) OF CSI-RS-ConfigZPId-
r11

-- ASN1STOP
```

***PhysicalConfigDedicated* field descriptions**
additionalSpectrumEmissionPCell E-UTRAN does not configure this field in this release of the specification.
antennaInfo A choice is used to indicate whether the *antennaInfo* is signalled explicitly or set to the default antenna configuration as specified in section 9.2.4.
csi-RS-Config For a serving frequency E-UTRAN does not configure *csi-RS-Config* (includes *zeroTxPowerCSI-RS*) when transmission mode 10 is configured for the serving cell on this carrier frequency.
csi-RS-ConfigNZPToAddModList For a serving frequency E-UTRAN configures one or more *CSI-RS-ConfigNZP* only when transmission mode 10 is configured for the serving cell on this carrier frequency. EUTRAN configures a maximum of one *CSI-RS-ConfigNZP* for a serving frequency on which the UE supports only one CSI process (i.e. *supportedCSI-Proc* is indicated as ***n1***).
csi-RS-ConfigZPToAddModList For a serving frequency E-UTRAN configures one or more *CSI-RS-ConfigZP* only when transmission mode 10 is configured for the serving cell on this carrier frequency.
eimta-MainConfigPCell, eimta-MainConfigSCell If E-UTRAN configures *eimta-MainConfigPCell* or *eimta-MainConfigSCell* for one serving cell in a frequency band, E-UTRAN configures *eimta-MainConfigPCell* or *eimta-MainConfigSCell* for all serving cells residing on the frequency band. E-UTRAN configures *eimta-MainConfigPCell* or *eimta-MainConfigSCell* only if *eimta-MainConfig* is configured.
epdcch-Config indicates the *EPDCCH-Config* for the cell. E-UTRAN does not configure *EPDCCH-Config* for an SCell that is configured with value *other* for *schedulingCellInfo* in *CrossCarrierSchedulingConfig*.
pdsch-ConfigDedicated-v1130 For a serving frequency E-UTRAN configures *pdsch-ConfigDedicated-v1130* only when transmission mode 10 is configured for the serving cell on this carrier frequency.
pdsch-ConfigDedicated-v1280 For a serving frequency E-UTRAN configures *pdsch-ConfigDedicated-v1280* only when transmission mode 9 or 10 is configured for the serving cell on this carrier frequency.
pusch-ConfigDedicated-v1250 E-UTRAN configures *pusch-ConfigDedicated-v1250* only if *tpc-SubframeSet* is configured.
tpc-PDCCH-ConfigPUCCH PDCCH configuration for power control of PUCCH using format 3/3A, see TS 36.212 [22].
tpc-PDCCH-ConfigPUSCH PDCCH configuration for power control of PUSCH using format 3/3A, see TS 36.212 [22].
uplinkPowerControlDedicated E-UTRAN configures *uplinkPowerControlDedicated-v1130* only if *uplinkPowerControlDedicated* (without suffix) is configured.
uplinkPowerControlDedicatedSCell E-UTRAN configures *uplinkPowerControlDedicatedSCell-v1130* only if *uplinkPowerControlDedicatedSCell-r10* is configured for this serving cell.

Conditional presence	Explanation
AI-r8	The field is optionally present, need ON, if *antennaInfoDedicated-r10* is absent. Otherwise the field is not present
AI-r10	The field is optionally present, need ON, if *antennaInfoDedicated* is absent. Otherwise the field is not present
CommonUL	The field is mandatory present if *ul-Configuration* of *RadioResourceConfigCommonSCell-r10* is present; otherwise it is optional, need ON.
CQI-r8	The field is optionally present, need ON, if *cqi-ReportConfig-r10* is absent. Otherwise the field is not present
CQI-r10	The field is optionally present, need ON, if *cqi-ReportConfig* is absent. Otherwise the field is not present
SCellAdd	The field is mandatory present if *cellIdentification* is present; otherwise it is optional, need ON.

NOTE 1: During handover, the UE performs a MAC reset, which involves reverting to the default CQI/ SRS/ SR configuration in accordance with subclause 5.3.13 and TS 36.321 [6, 5.9 & 5.2]. Hence, for these parts of the dedicated radio resource configuration, the default configuration (rather than the configuration used in the source PCell) is used as the basis for the delta signalling that is included in the message used to perform handover.

NOTE 2: Since delta signalling is not supported for the common SCell configuration, E-UTRAN can only add or release the uplink of an SCell by releasing and adding the concerned SCell.

– *P-Max*

The IE *P-Max* is used to limit the UE's uplink transmission power on a carrier frequency and is used to calculate the parameter *Pcompensation* defined in TS 36.304 [4]. Corresponds to parameter P_{EMAX} or $P_{EMAX,c}$ in TS 36.101 [42]. The UE transmit power on one serving cell shall not exceed the configured maximum UE output power of the serving cell determined by this value as specified in TS 36.101 [42, 6.2.5 or 6.2.5A] or, when transmitting sidelink discovery announcements within the coverage of the concerned cell, as specified in TS 36.101 [42, 6.2.5D].

P-Max information element

```
-- ASN1START

P-Max ::=               INTEGER (-30..33)

-- ASN1STOP
```

– *PRACH-Config*

The IE *PRACH-ConfigSIB* and IE *PRACH-Config* are used to specify the PRACH configuration in the system information and in the mobility control information, respectively.

PRACH-Config information elements

```
-- ASN1START

PRACH-ConfigSIB ::=             SEQUENCE {
    rootSequenceIndex                   INTEGER (0..837),
    prach-ConfigInfo                    PRACH-ConfigInfo
}

PRACH-Config ::=                    SEQUENCE {
    rootSequenceIndex                   INTEGER (0..837),
    prach-ConfigInfo                    PRACH-ConfigInfo                    OPTIONAL    -- Need ON
}

PRACH-ConfigSCell-r10 ::=               SEQUENCE {
    prach-ConfigIndex-r10                   INTEGER (0..63)
}

PRACH-ConfigInfo ::=                SEQUENCE {
    prach-ConfigIndex                   INTEGER (0..63),
    highSpeedFlag                       BOOLEAN,
    zeroCorrelationZoneConfig           INTEGER (0..15),
    prach-FreqOffset                    INTEGER (0..94)
```

```
}

-- ASN1STOP
```

***PRACH-Config* field descriptions**
highSpeedFlag Parameter: High-speed-flag, see TS 36.211, [21, 5.7.2].TRUE corresponds to Restricted set and FALSE to Unrestricted set.
prach-ConfigIndex Parameter: *prach-ConfigurationIndex*, see TS 36.211 [21, 5.7.1].
prach-FreqOffset Parameter: *prach-FrequencyOffset,* see TS 36.211, [21, 5.7.1]. For TDD the value range is dependent on the value of *prach-ConfigIndex*.
rootSequenceIndex Parameter: *RACH_ROOT_SEQUENCE*, see TS 36.211 [21, 5.7.1].
zeroCorrelationZoneConfig Parameter: N_{CS} configuration, see TS 36.211, [21, 5.7.2: table 5.7.2-2] for preamble format 0..3 and TS 36.211, [21, 5.7.2: table 5.7.2-3] for preamble format 4.

– *PresenceAntennaPort1*

The IE *PresenceAntennaPort1* is used to indicate whether all the neighbouring cells use Antenna Port 1. When set to *TRUE*, the UE may assume that at least two cell-specific antenna ports are used in all neighbouring cells.

PresenceAntennaPort1 information element

```
-- ASN1START

PresenceAntennaPort1 ::=                BOOLEAN

-- ASN1STOP
```

– *PUCCH-Config*

The IE *PUCCH-ConfigCommon* and IE *PUCCH-ConfigDedicated* are used to specify the common and the UE specific PUCCH configuration respectively.

PUCCH-Config information elements

```
-- ASN1START

PUCCH-ConfigCommon ::=              SEQUENCE {
    deltaPUCCH-Shift                    ENUMERATED {ds1, ds2, ds3},
    nRB-CQI                             INTEGER (0..98),
    nCS-AN                              INTEGER (0..7),
    n1PUCCH-AN                          INTEGER (0..2047)
}

PUCCH-ConfigDedicated ::=           SEQUENCE {
    ackNackRepetition                   CHOICE{
        release                             NULL,
        setup                               SEQUENCE {
            repetitionFactor                    ENUMERATED {n2, n4, n6, spare1},
            n1PUCCH-AN-Rep                      INTEGER (0..2047)
        }
    },
    tdd-AckNackFeedbackMode             ENUMERATED {bundling, multiplexing} OPTIONAL    -- Cond TDD
}

PUCCH-ConfigDedicated-v1020 ::=     SEQUENCE {
    pucch-Format-r10                    CHOICE {
        format3-r10                             SEQUENCE {
            n3PUCCH-AN-List-r10 SEQUENCE (SIZE (1..4)) OF INTEGER (0..549)  OPTIONAL,   -- Need ON
            twoAntennaPortActivatedPUCCH-Format3-r10        CHOICE {
                release                                         NULL,
                setup                                           SEQUENCE {
                    n3PUCCH-AN-ListP1-r10   SEQUENCE (SIZE (1..4)) OF INTEGER (0..549)
                }
```

```
            }                                                                   OPTIONAL    -- Need ON
        },
        channelSelection-r10                SEQUENCE {
            n1PUCCH-AN-CS-r10                   CHOICE {
                release                             NULL,
                setup                               SEQUENCE {
                    n1PUCCH-AN-CS-List-r10              SEQUENCE (SIZE (1..2)) OF N1PUCCH-AN-CS-r10
                }
            }                                                                   OPTIONAL    -- Need ON
        }
    }                                                                           OPTIONAL,   -- Need OR
    twoAntennaPortActivatedPUCCH-Format1a1b-r10     ENUMERATED {true}       OPTIONAL,   -- Need OR
    simultaneousPUCCH-PUSCH-r10                     ENUMERATED {true}       OPTIONAL,   -- Need OR
    n1PUCCH-AN-RepP1-r10                            INTEGER (0..2047)       OPTIONAL    -- Need OR
}

PUCCH-ConfigDedicated-v1130 ::=     SEQUENCE {
    n1PUCCH-AN-CS-v1130                 CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            n1PUCCH-AN-CS-ListP1-r11            SEQUENCE (SIZE (2..4)) OF INTEGER (0..2047)
        }
    }                                                                           OPTIONAL,   -- Need ON
    nPUCCH-Param-r11                    CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            nPUCCH-Identity-r11                 INTEGER (0..503),
            n1PUCCH-AN-r11                      INTEGER (0..2047)
        }
    }                                                                           OPTIONAL    -- Need ON
}

PUCCH-ConfigDedicated-v1250 ::=     SEQUENCE {
    nkaPUCCH-Param-r12                  CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            nkaPUCCH-AN-r12                     INTEGER (0..2047)
        }
    }
}

N1PUCCH-AN-CS-r10   ::= SEQUENCE (SIZE (1..4)) OF INTEGER (0..2047)

-- ASN1STOP
```

PUCCH-Config field descriptions
ackNackRepetition Parameter indicates whether ACK/NACK repetition is configured, see TS 36.213 [23, 10.1].
deltaPUCCH-Shift Parameter: $\Delta_{\text{shift}}^{\text{PUCCH}}$, see 36.211 [21, 5.4.1], where ds1 corresponds to value 1 ds2 to 2 etc.
n1PUCCH-AN Parameter: $N_{PUCCH}^{(1)}$, see TS 36.213 [23, 10.1]. *n1PUCCH-AN-r11* indicates UE-specific PUCCH AN resource offset, see TS 36.213 [23, 10.1].
n1PUCCH-AN-CS-List Parameter: $n_{\text{PUCCH},j}^{(1)}$ for antenna port p_0 for PUCCH format 1b with channel selection, see TS 36.213 [23, 10.1.2.2.1, 10.1.3.2.1].
n1PUCCH-AN-CS-ListP1 Parameter: $n_{\text{PUCCH},j}^{(1,\tilde{p}_1)}$ for antenna port p_1 for PUCCH format 1b with channel selection, see TS 36.213 [23, 10.1]. E-UTRAN configures this field only when *pucch-Format* is set to *channelSelection*.
n1PUCCH-AN-Rep, n1PUCCH-AN-RepP1 Parameter: $n_{\text{PUCCH, ANRep}}^{(1,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 10.1].
n3PUCCH-AN-List, n3PUCCH-AN-ListP1 Parameter: $n_{\text{PUCCH}}^{(3,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 10.1].
nCS-An Parameter: $N_{cs}^{(1)}$ see TS 36.211 [21, 5.4].
nkaPUCCH-AN Parameter: $N_{\text{PUCCH}}^{\text{K}_\text{A}}$, see TS 36.213 [23, 10.1.3]. *nkaPUCCH-AN-r12* indicates PUCCH format 1a/1b starting offset for the subframe set K^A, see TS 36.213 [23, 10.1.3]. E-UTRAN configures *nkaPUCCH-AN* only if *eimta-MainConfig* is configured.
nPUCCH-Identity Parameter: $n_{\text{ID}}^{\text{PUCCH}}$, see TS 36.211 [21, 5.5.1.5].
nRB-CQI Parameter: $N_{\text{RB}}^{(2)}$, see TS 36.211 [21, 5.4].
pucch-Format Parameter indicates one of the PUCCH formats for transmission of HARQ-ACK, see TS 36.213 [23, 10.1]. For TDD, if the UE is configured with PCell only, the *channelSelection* indicates the transmission of HARQ-ACK multiplexing as defined in Tables 10.1.3-5, 10.1.3-6, and 10.1.3-7 in TS 36.213 [23] for PUCCH, and in 7.3 in TS 36.213 [23] for PUSCH.
repetitionFactor Parameter N_{ANRep} see TS 36.213 [23, 10.1] where n2 corresponds to repetition factor 2, n4 to 4.
simultaneousPUCCH-PUSCH Parameter indicates whether simultaneous PUCCH and PUSCH transmissions is configured, see TS 36.213 [23, 10.1 and 5.1.1]. E-UTRAN configures this field for the PCell, only when the *nonContiguousUL-RA-WithinCC-Info* is set to *supported* in the band on which PCell is configured. Likewise, E-UTRAN configures this field for the PSCell, only when the *nonContiguousUL-RA-WithinCC-Info* is set to *supported* in the band on which PSCell is configured.
tdd-AckNackFeedbackMode Parameter indicates one of the TDD ACK/NACK feedback modes used, see TS 36.213 [23, 7.3 and 10.1.3]. The value bundling corresponds to use of ACK/NACK bundling whereas, the value multiplexing corresponds to ACK/NACK multiplexing as defined in Tables 10.1.3-2, 10.1.3-3, and 10.1.3-4 in TS 36.213 [23]. The same value applies to both ACK/NACK feedback modes on PUCCH as well as on PUSCH.
twoAntennaPortActivatedPUCCH-Format1a1b Indicates whether two antenna ports are configured for PUCCH format 1a/1b for HARQ-ACK, see TS 36.213 [23, 10.1]. The field also applies for PUCCH format 1a/1b transmission when *format3* is configured, see TS 36.213 [23, 10.1.2.2.2, 10.1.3.2.2].
twoAntennaPortActivatedPUCCH-Format3 Indicates whether two antenna ports are configured for PUCCH format 3 for HARQ-ACK, see TS 36.213 [23, 10.1].

Conditional presence	Explanation
TDD	The field is mandatory present for TDD if the *pucch-Format* is not present. If the *pucch-Format* is present, the field is not present and the UE shall delete any existing value for this field. It is not present for FDD and the UE shall delete any existing value for this field.

– *PUSCH-Config*

The IE *PUSCH-ConfigCommon* is used to specify the common PUSCH configuration and the reference signal configuration for PUSCH and PUCCH. The IE *PUSCH-ConfigDedicated* is used to specify the UE specific PUSCH configuration.

PUSCH-Config information element

```
-- ASN1START

PUSCH-ConfigCommon ::=              SEQUENCE {
    pusch-ConfigBasic                   SEQUENCE {
        n-SB                                INTEGER (1..4),
        hoppingMode                         ENUMERATED {interSubFrame, intraAndInterSubFrame},
        pusch-HoppingOffset                 INTEGER (0..98),
        enable64QAM                         BOOLEAN
    },
    ul-ReferenceSignalsPUSCH            UL-ReferenceSignalsPUSCH
}

PUSCH-ConfigCommon-v1270 ::=        SEQUENCE {
    enable64QAM-v1270                   ENUMERATED {true}
}

PUSCH-ConfigDedicated ::=           SEQUENCE {
    betaOffset-ACK-Index                INTEGER (0..15),
    betaOffset-RI-Index                 INTEGER (0..15),
    betaOffset-CQI-Index                INTEGER (0..15)
}

PUSCH-ConfigDedicated-v1020 ::=     SEQUENCE {
    betaOffsetMC-r10                    SEQUENCE {
        betaOffset-ACK-Index-MC-r10         INTEGER (0..15),
        betaOffset-RI-Index-MC-r10          INTEGER (0..15),
        betaOffset-CQI-Index-MC-r10         INTEGER (0..15)
    }                                                                   OPTIONAL,   -- Need OR
    groupHoppingDisabled-r10            ENUMERATED {true}               OPTIONAL,   -- Need OR
    dmrs-WithOCC-Activated-r10          ENUMERATED {true}               OPTIONAL    -- Need OR
}

PUSCH-ConfigDedicated-v1130 ::=     SEQUENCE {
    pusch-DMRS-r11                      CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            nPUSCH-Identity-r11                 INTEGER (0..509),
            nDMRS-CSH-Identity-r11              INTEGER (0..509)
        }
    }
}

PUSCH-ConfigDedicated-v1250::=          SEQUENCE {
    uciOnPUSCH              CHOICE {
        release                 NULL,
        setup                   SEQUENCE {
            betaOffset-ACK-Index-SubframeSet2-r12               INTEGER (0..15),
            betaOffset-RI-Index-SubframeSet2-r12                INTEGER (0..15),
            betaOffset-CQI-Index-SubframeSet2-r12               INTEGER (0..15),
            betaOffsetMC-r12                        SEQUENCE {
                betaOffset-ACK-Index-MC-SubframeSet2-r12            INTEGER (0..15),
                betaOffset-RI-Index-MC-SubframeSet2-r12         INTEGER (0..15),
                betaOffset-CQI-Index-MC-SubframeSet2-r12            INTEGER (0..15)
            }                                                           OPTIONAL    -- Need OR
        }
    }
}

PUSCH-ConfigDedicatedSCell-r10 ::=      SEQUENCE {
    groupHoppingDisabled-r10                ENUMERATED {true}               OPTIONAL,   -- Need OR
    dmrs-WithOCC-Activated-r10              ENUMERATED {true}               OPTIONAL    -- Need OR
}

UL-ReferenceSignalsPUSCH ::=        SEQUENCE {
    groupHoppingEnabled                 BOOLEAN,
    groupAssignmentPUSCH                INTEGER (0..29),
    sequenceHoppingEnabled              BOOLEAN,
    cyclicShift                         INTEGER (0..7)
```

```
}

-- ASN1STOP
```

PUSCH-Config field descriptions
betaOffset-ACK-Index, betaOffset-ACK-Index-MC
Parameter: $I_{offset}^{HARQ-ACK}$, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-1]. One value applies for all serving cells with an uplink and not configured with uplink power control subframe sets. The same value also applies for subframe set 1 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell).
betaOffset-ACK-Index-SubframeSet2, betaOffset-ACK-Index-MC-SubframeSet2
Parameter: $I_{offset}^{HARQ-ACK}$, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-1]. One value applies for subframe set 2 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell configured with uplink power control subframe sets).
betaOffset-CQI-Index, betaOffset-CQI-Index-MC
Parameter: I_{offset}^{CQI}, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-3]. One value applies for all serving cells with an uplink and not configured with uplink power control subframe sets. The same value also applies for subframe set 1 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell).
betaOffset-CQI-Index-SubframeSet2, betaOffset-CQI-Index-MC-SubframeSet2
Parameter: I_{offset}^{CQI}, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-3]. One value applies for subframe set 2 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell configured with uplink power control subframe sets).
betaOffset-RI-Index, betaOffset-RI-Index-MC
Parameter: I_{offset}^{RI}, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-2]. One value applies for all serving cells with an uplink and not configured with uplink power control subframe sets. The same value also applies for subframe set 1 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell).
betaOffset-RI-Index-SubframeSet2, betaOffset-RI-Index-MC-SubframeSet2
Parameter: I_{offset}^{RI}, for single- and multiple-codeword respectively, see TS 36.213 [23, Table 8.6.3-2]. One value applies for subframe set 2 of all serving cells with an uplink and configured with uplink power control subframe sets (the associated functionality is common i.e. not performed independently for each cell configured with uplink power control subframe sets).
cyclicShift
Parameters: *cyclicShift*, see TS 36.211 [21, Table 5.5.2.1.1-2].
dmrs-WithOCC-Activated
Parameter: *Activate-DMRS-with OCC*, see TS 36.211 [21, 5.5.2.1].
enable64QAM
See TS 36.213 [23, 8.6.1]. If *enable64QAM* (without suffix) is set to TRUE, it indicates that 64QAM is allowed for UE categories 5 and 8 indicated in *ue-Category* while FALSE indicates that 64QAM is not allowed. If *enable64QAM-v1270* is set to TRUE, it indicates that 64QAM is allowed for UL categories 5 and 13 indicated in *ue-CategoryUL*. E-UTRAN configures *enable64QAM-v1270* only when *enable64QAM* (without suffix) is set to TRUE.
groupAssignmentPUSCH
Parameter: ΔSS See TS 36.211 [21, 5.5.1.3].
groupHoppingDisabled
Parameter: *Disable-sequence-group-hopping*, see TS 36.211 [21, 5.5.1.3].
groupHoppingEnabled
Parameter: *Group-hopping-enabled*, see TS 36.211 [21, 5.5.1.3].
hoppingMode
Parameter: *Hopping-mode*, see TS 36.211 [21, 5.3.4].
nDMRS-CSH-Identity
Parameter: $N_{\mathrm{ID}}^{\mathrm{csh\_DMRS}}$, see TS 36.211 [21, 5.5.2.1.1].
nPUSCH-Identity
Parameter: $n_{\mathrm{ID}}^{\mathrm{PUSCH}}$, see TS 36.211 [21, 5.5.1.5].
n-SB
Parameter: N_{sb} see TS 36.211 [21, 5.3.4].
pusch-hoppingOffset
Parameter: $N_{\mathrm{RB}}^{\mathrm{HO}}$, see TS 36.211 [21, 5.3.4].
sequenceHoppingEnabled
Parameter: *Sequence-hopping-enabled*, see TS 36.211 [21, 5.5.1.4].
ul- ReferenceSignalsPUSCH
Used to specify parameters needed for the transmission on PUSCH (or PUCCH).

– *RACH-ConfigCommon*

The IE *RACH-ConfigCommon* is used to specify the generic random access parameters.

RACH-ConfigCommon information element

```
-- ASN1START

RACH-ConfigCommon ::=       SEQUENCE {
    preambleInfo                        SEQUENCE {
        numberOfRA-Preambles                ENUMERATED {
                                                n4, n8, n12, n16 ,n20, n24, n28,
                                                n32, n36, n40, n44, n48, n52, n56,
                                                n60, n64},
        preamblesGroupAConfig               SEQUENCE {
            sizeOfRA-PreamblesGroupA            ENUMERATED {
                                                    n4, n8, n12, n16 ,n20, n24, n28,
                                                    n32, n36, n40, n44, n48, n52, n56,
                                                    n60},
            messageSizeGroupA                   ENUMERATED {b56, b144, b208, b256},
            messagePowerOffsetGroupB            ENUMERATED {
                                                    minusinfinity, dB0, dB5, dB8, dB10, dB12,
                                                    dB15, dB18},
            ...
        }           OPTIONAL                                                    -- Need OP
    },
    powerRampingParameters              PowerRampingParameters,
    ra-SupervisionInfo                  SEQUENCE {
        preambleTransMax                    PreambleTransMax,
        ra-ResponseWindowSize               ENUMERATED {
                                                sf2, sf3, sf4, sf5, sf6, sf7,
                                                sf8, sf10},
        mac-ContentionResolutionTimer       ENUMERATED {
                                                sf8, sf16, sf24, sf32, sf40, sf48,
                                                sf56, sf64}
    },
    maxHARQ-Msg3Tx                      INTEGER (1..8),
    ...
}

RACH-ConfigCommon-v1250 ::=     SEQUENCE {
    txFailParams-r12                SEQUENCE {
        connEstFailCount-r12                ENUMERATED {n1, n2, n3, n4},
        connEstFailOffsetValidity-r12       ENUMERATED {s30, s60, s120, s240,
                                                        s300, s420, s600, s900},
        connEstFailOffset-r12               INTEGER (0..15)     OPTIONAL    -- Need OP
    }
}

RACH-ConfigCommonSCell-r11 ::=      SEQUENCE {
    powerRampingParameters-r11              PowerRampingParameters,
    ra-SupervisionInfo-r11                  SEQUENCE {
        preambleTransMax-r11                    PreambleTransMax
    },
    ...
}

PowerRampingParameters ::=          SEQUENCE {
    powerRampingStep                    ENUMERATED {dB0, dB2,dB4, dB6},
    preambleInitialReceivedTargetPower  ENUMERATED {
                                            dBm-120, dBm-118, dBm-116, dBm-114, dBm-112,
                                            dBm-110, dBm-108, dBm-106, dBm-104, dBm-102,
                                            dBm-100, dBm-98, dBm-96, dBm-94,
                                            dBm-92, dBm-90}
}

PreambleTransMax ::=                ENUMERATED {
                                            n3, n4, n5, n6, n7, n8, n10, n20, n50,
                                            n100, n200}

-- ASN1STOP
```

RACH-ConfigCommon field descriptions
connEstFailCount Number of times that the UE detects T300 expiry on the same cell before applying *connEstFailOffset*.
connEstFailOffset Parameter "$Qoffset_{temp}$" in TS 36.304 [4]. If the field is not present the value of infinity shall be used for "$Qoffset_{temp}$".
connEstFailOffsetValidity Amount of time that the UE applies *connEstFailOffset* before removing the offset from evaluation of the cell. Value s30 corresponds to 30 seconds, s60 corresponds to 60 seconds, and so on.
mac-ContentionResolutionTimer Timer for contention resolution in TS 36.321 [6]. Value in subframes. Value sf8 corresponds to 8 subframes, sf16 corresponds to 16 subframes and so on.
maxHARQ-Msg3Tx Maximum number of Msg3 HARQ transmissions in TS 36.321 [6], used for contention based random access. Value is an integer.
messagePowerOffsetGroupB Threshold for preamble selection in TS 36.321 [6]. Value in dB. Value minusinfinity corresponds to –infinity. Value dB0 corresponds to 0 dB, dB5 corresponds to 5 dB and so on.
messageSizeGroupA Threshold for preamble selection in TS 36.321 [6]. Value in bits. Value b56 corresponds to 56 bits, b144 corresponds to 144 bits and so on.
numberOfRA-Preambles Number of non-dedicated random access preambles in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on.
powerRampingStep Power ramping factor in TS 36.321 [6]. Value in dB. Value dB0 corresponds to 0 dB, dB2 corresponds to 2 dB and so on.
preambleInitialReceivedTargetPower Initial preamble power in TS 36.321 [6]. Value in dBm. Value dBm-120 corresponds to -120 dBm, dBm-118 corresponds to -118 dBm and so on.
preamblesGroupAConfig Provides the configuration for preamble grouping in TS 36.321 [6]. If the field is not signalled, the size of the random access preambles group A [6] is equal to *numberOfRA-Preambles*.
preambleTransMax Maximum number of preamble transmission in TS 36.321 [6]. Value is an integer. Value n3 corresponds to 3, n4 corresponds to 4 and so on.
ra-ResponseWindowSize Duration of the RA response window in TS 36.321 [6]. Value in subframes. Value sf2 corresponds to 2 subframes, sf3 corresponds to 3 subframes and so on. The same value applies for each serving cell (although the associated functionality is performed independently for each cell).
sizeOfRA-PreamblesGroupA Size of the random access preambles group A in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on.

– *RACH-ConfigDedicated*

The IE *RACH-ConfigDedicated* is used to specify the dedicated random access parameters.

RACH-ConfigDedicated information element

```
-- ASN1START

RACH-ConfigDedicated ::=        SEQUENCE {
    ra-PreambleIndex                    INTEGER (0..63),
    ra-PRACH-MaskIndex                  INTEGER (0..15)
}

-- ASN1STOP
```

RACH-ConfigDedicated field descriptions
ra-PRACH-MaskIndex Explicitly signalled PRACH Mask Index for RA Resource selection in TS 36.321 [6].
ra-PreambleIndex Explicitly signalled Random Access Preamble for RA Resource selection in TS 36.321 [6].

– *RadioResourceConfigCommon*

The IE *RadioResourceConfigCommonSIB* and IE *RadioResourceConfigCommon* are used to specify common radio resource configurations in the system information and in the mobility control information, respectively, e.g., the random access parameters and the static physical layer parameters.

RadioResourceConfigCommon information element

```
-- ASN1START

RadioResourceConfigCommonSIB ::=    SEQUENCE {
    rach-ConfigCommon                   RACH-ConfigCommon,
    bcch-Config                         BCCH-Config,
    pcch-Config                         PCCH-Config,
    prach-Config                        PRACH-ConfigSIB,
    pdsch-ConfigCommon                  PDSCH-ConfigCommon,
    pusch-ConfigCommon                  PUSCH-ConfigCommon,
    pucch-ConfigCommon                  PUCCH-ConfigCommon,
    soundingRS-UL-ConfigCommon          SoundingRS-UL-ConfigCommon,
    uplinkPowerControlCommon            UplinkPowerControlCommon,
    ul-CyclicPrefixLength               UL-CyclicPrefixLength,
    ...,
    [[  uplinkPowerControlCommon-v1020  UplinkPowerControlCommon-v1020      OPTIONAL    -- Need OR
    ]],
    [[  rach-ConfigCommon-v1250         RACH-ConfigCommon-v1250     OPTIONAL    -- Need OR
    ]],
    [[  pusch-ConfigCommon-v1270        PUSCH-ConfigCommon-v1270        OPTIONAL        -- Need OR
    ]]
}

RadioResourceConfigCommon ::=       SEQUENCE {
    rach-ConfigCommon                   RACH-ConfigCommon                   OPTIONAL,   -- Need ON
    prach-Config                        PRACH-Config,
    pdsch-ConfigCommon                  PDSCH-ConfigCommon                  OPTIONAL,   -- Need ON
    pusch-ConfigCommon                  PUSCH-ConfigCommon,
    phich-Config                        PHICH-Config                        OPTIONAL,   -- Need ON
    pucch-ConfigCommon                  PUCCH-ConfigCommon                  OPTIONAL,   -- Need ON
    soundingRS-UL-ConfigCommon          SoundingRS-UL-ConfigCommon          OPTIONAL,   -- Need ON
    uplinkPowerControlCommon            UplinkPowerControlCommon            OPTIONAL,   -- Need ON
    antennaInfoCommon                   AntennaInfoCommon           OPTIONAL,   -- Need ON
    p-Max                               P-Max                               OPTIONAL,   -- Need OP
    tdd-Config                          TDD-Config                          OPTIONAL,   -- Cond TDD
    ul-CyclicPrefixLength               UL-CyclicPrefixLength,
    ...,
    [[  uplinkPowerControlCommon-v1020  UplinkPowerControlCommon-v1020      OPTIONAL    -- Need ON
    ]],
    [[  tdd-Config-v1130                TDD-Config-v1130                OPTIONAL    -- Cond TDD3
    ]],
    [[  pusch-ConfigCommon-v1270        PUSCH-ConfigCommon-v1270        OPTIONAL        -- Need OR
    ]]
}

RadioResourceConfigCommonPSCell-r12 ::= SEQUENCE {
    basicFields-r12                     RadioResourceConfigCommonSCell-r10,
    pucch-ConfigCommon-r12              PUCCH-ConfigCommon,
    rach-ConfigCommon-r12               RACH-ConfigCommon,
    uplinkPowerControlCommonPSCell-r12  UplinkPowerControlCommonPSCell-r12,
    ...
}

RadioResourceConfigCommonSCell-r10 ::=  SEQUENCE {
    -- DL configuration as well as configuration applicable for DL and UL
    nonUL-Configuration-r10                 SEQUENCE {
        -- 1: Cell characteristics
        dl-Bandwidth-r10                        ENUMERATED {n6, n15, n25, n50, n75, n100},
        -- 2: Physical configuration, general
        antennaInfoCommon-r10                   AntennaInfoCommon,
        mbsfn-SubframeConfigList-r10            MBSFN-SubframeConfigList    OPTIONAL,   -- Need OR
        -- 3: Physical configuration, control
        phich-Config-r10                        PHICH-Config,
        -- 4: Physical configuration, physical channels
        pdsch-ConfigCommon-r10                  PDSCH-ConfigCommon,
        tdd-Config-r10                          TDD-Config                  OPTIONAL    -- Cond
TDDSCell
    },
    -- UL configuration
```

```
    ul-Configuration-r10                        SEQUENCE {
        ul-FreqInfo-r10                     SEQUENCE {
            ul-CarrierFreq-r10                  ARFCN-ValueEUTRA            OPTIONAL,   -- Need OP
            ul-Bandwidth-r10                    ENUMERATED {n6, n15,
                                                    n25, n50, n75, n100}    OPTIONAL,   -- Need OP
            additionalSpectrumEmissionSCell-r10     AdditionalSpectrumEmission
        },
        p-Max-r10                           P-Max                       OPTIONAL,   -- Need OP
        uplinkPowerControlCommonSCell-r10       UplinkPowerControlCommonSCell-r10,
        -- A special version of IE UplinkPowerControlCommon may be introduced
        -- 3: Physical configuration, control
        soundingRS-UL-ConfigCommon-r10      SoundingRS-UL-ConfigCommon,
        ul-CyclicPrefixLength-r10           UL-CyclicPrefixLength,
        -- 4: Physical configuration, physical channels
        prach-ConfigSCell-r10                   PRACH-ConfigSCell-r10       OPTIONAL,   -- Cond TDD-
OR-NoR11
        pusch-ConfigCommon-r10              PUSCH-ConfigCommon
    }                                                                       OPTIONAL,   -- Need OR
    ...,
    [[  ul-CarrierFreq-v1090                ARFCN-ValueEUTRA-v9e0           OPTIONAL    -- Need OP
    ]],
    [[  rach-ConfigCommonSCell-r11          RACH-ConfigCommonSCell-r11      OPTIONAL,   -- Cond
ULSCell
        prach-ConfigSCell-r11               PRACH-Config                    OPTIONAL,   -- Cond UL
        tdd-Config-v1130                    TDD-Config-v1130            OPTIONAL,   -- Cond TDD2
        uplinkPowerControlCommonSCell-v1130
                                UplinkPowerControlCommonSCell-v1130 OPTIONAL    -- Cond UL
    ]],
    [[  pusch-ConfigCommon-v1270        PUSCH-ConfigCommon-v1270        OPTIONAL        -- Need OR
    ]]
}

BCCH-Config ::=                     SEQUENCE {
    modificationPeriodCoeff             ENUMERATED {n2, n4, n8, n16}
}

PCCH-Config ::=                     SEQUENCE {
    defaultPagingCycle                  ENUMERATED {
                                            rf32, rf64, rf128, rf256},
    nB                                  ENUMERATED {
                                            fourT, twoT, oneT, halfT, quarterT, oneEighthT,
                                            oneSixteenthT, oneThirtySecondT}
}

UL-CyclicPrefixLength ::=           ENUMERATED {len1, len2}

-- ASN1STOP
```

***RadioResourceConfigCommon* field descriptions**
additionalSpectrumEmissionSCell The UE requirements related to *additionalSpectrumEmissionSCell* are defined in TS 36.101 [42]. E-UTRAN configures the same value in *additionalSpectrumEmissionSCell* for all SCell(s) of the same band with UL configured. The *additionalSpectrumEmissionSCell* is applicable for all serving cells (including PCell) of the same band with UL configured.
defaultPagingCycle Default paging cycle, used to derive 'T' in TS 36.304 [4]. Value rf32 corresponds to 32 radio frames, rf64 corresponds to 64 radio frames and so on.
modificationPeriodCoeff Actual modification period, expressed in number of radio frames= *modificationPeriodCoeff* * *defaultPagingCycle*. n2 corresponds to value 2, n4 corresponds to value 4, n8 corresponds to value 8 and n16 corresponds to value 16.
nB Parameter: nB is used as one of parameters to derive the Paging Frame and Paging Occasion according to TS 36.304 [4]. Value in multiples of 'T' as defined in TS 36.304 [4]. A value of fourT corresponds to 4 * T, a value of twoT corresponds to 2 * T and so on.
p-Max Pmax to be used in the target cell. If absent the UE applies the maximum power according to the UE capability.
ul-Bandwidth Parameter: transmission bandwidth configuration, N_{RB}, in uplink, see TS 36.101 [42, table 5.6-1]. Value n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on. If for FDD this parameter is absent, the uplink bandwidth is equal to the downlink bandwidth. For TDD this parameter is absent and it is equal to the downlink bandwidth.
ul-CarrierFreq For FDD: If absent, the (default) value determined from the default TX-RX frequency separation defined in TS 36.101 [42, table 5.7.3-1] applies. For TDD: This parameter is absent and it is equal to the downlink frequency.
UL-CyclicPrefixLength Parameter: Uplink cyclic prefix length see 36.211 [21, 5.2.1] where len1 corresponds to normal cyclic prefix and len2 corresponds to extended cyclic prefix.

Conditional presence	Explanation
TDD	The field is optional for TDD, Need ON; it is not present for FDD and the UE shall delete any existing value for this field.
TDD2	If *tdd-Config-r10* is present, the field is optional, Need OR. Otherwise the field is not present and the UE shall delete any existing value for this field.
TDD3	If *tdd-Config* is present, the field is optional, Need OR. Otherwise the field is not present and the UE shall delete any existing value for this field.
TDD-OR-NoR11	If *prach-ConfigSCell-r11* is absent, the field is optional for TDD, Need OR. Otherwise the field is not present and the UE shall delete any existing value for this field.
TDDSCell	This field is mandatory present for TDD; it is not present for FDD and the UE shall delete any existing value for this field.
UL	If the SCell is part of the STAG or concerns the PSCell and if *ul-Configuration* is included, the field is optional, Need OR. Otherwise the field is not present and the UE shall delete any existing value for this field.
ULSCell	For the PSCell (IE is included in *RadioResourceConfigCommonPSCell*) the field is absent. Otherwise, if the SCell is part of the STAG and if *ul-Configuration* is included, the field is optional, Need OR. Otherwise the field is not present and the UE shall delete any existing value for this field.

– *RadioResourceConfigDedicated*

The IE *RadioResourceConfigDedicated* is used to setup/modify/release RBs, to modify the MAC main configuration, to modify the SPS configuration and to modify dedicated physical configuration.

***RadioResourceConfigDedicated* information element**

```
-- ASN1START

RadioResourceConfigDedicated ::=        SEQUENCE {
    srb-ToAddModList                    SRB-ToAddModList            OPTIONAL,       -- Cond HO-Conn
    drb-ToAddModList                    DRB-ToAddModList            OPTIONAL,       -- Cond HO-
toEUTRA
    drb-ToReleaseList                   DRB-ToReleaseList           OPTIONAL,       -- Need ON
    mac-MainConfig                      CHOICE {
            explicitValue                   MAC-MainConfig,
```

```
            defaultValue                    NULL
    }       OPTIONAL,                                                       -- Cond HO-
toEUTRA2
    sps-Config                          SPS-Config                  OPTIONAL,       -- Need ON
    physicalConfigDedicated             PhysicalConfigDedicated     OPTIONAL,       -- Need ON
    ...,
    [[  rlf-TimersAndConstants-r9       RLF-TimersAndConstants-r9           OPTIONAL    -- Need ON
    ]],
    [[  measSubframePatternPCell-r10    MeasSubframePatternPCell-r10        OPTIONAL    -- Need ON
    ]],
    [[  neighCellsCRS-Info-r11          NeighCellsCRS-Info-r11              OPTIONAL    -- Need ON
    ]],
    [[  naics-Info-r12              NAICS-AssistanceInfo-r12            OPTIONAL    -- Need ON
    ]]}

RadioResourceConfigDedicatedPSCell-r12 ::=      SEQUENCE {
    -- UE specific configuration extensions applicable for an PSCell
    physicalConfigDedicatedPSCell-r12       PhysicalConfigDedicated     OPTIONAL,   -- Need ON
    sps-Config-r12                          SPS-Config                  OPTIONAL,   -- Need ON
    naics-Info-r12                          NAICS-AssistanceInfo-r12    OPTIONAL,   -- Need ON
    ...
}

RadioResourceConfigDedicatedSCG-r12 ::=     SEQUENCE {
    drb-ToAddModListSCG-r12             DRB-ToAddModListSCG-r12         OPTIONAL,   -- Need ON
    mac-MainConfigSCG-r12               MAC-MainConfig                  OPTIONAL,   -- Need ON
    rlf-TimersAndConstantsSCG-r12       RLF-TimersAndConstantsSCG-r12   OPTIONAL,   -- Need ON
    ...
}

RadioResourceConfigDedicatedSCell-r10 ::=   SEQUENCE {
    -- UE specific configuration extensions applicable for an SCell
    physicalConfigDedicatedSCell-r10        PhysicalConfigDedicatedSCell-r10    OPTIONAL,   -- Need
ON
    ...,
    [[  mac-MainConfigSCell-r11         MAC-MainConfigSCell-r11         OPTIONAL    -- Cond SCellAdd
    ]],
    [[  naics-Info-r12              NAICS-AssistanceInfo-r12        OPTIONAL    -- Need ON
    ]]
}

SRB-ToAddModList ::=                SEQUENCE (SIZE (1..2)) OF SRB-ToAddMod

SRB-ToAddMod ::=    SEQUENCE {
    srb-Identity                        INTEGER (1..2),
    rlc-Config                          CHOICE {
        explicitValue                       RLC-Config,
        defaultValue                        NULL
    }       OPTIONAL,                                                       -- Cond Setup
    logicalChannelConfig                CHOICE {
        explicitValue                       LogicalChannelConfig,
        defaultValue                        NULL
    }       OPTIONAL,                                                       -- Cond Setup
    ...
}

DRB-ToAddModList ::=                SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod

DRB-ToAddModListSCG-r12 ::=     SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddModSCG-r12

DRB-ToAddMod ::=    SEQUENCE {
    eps-BearerIdentity                  INTEGER (0..15)         OPTIONAL,       -- Cond DRB-Setup
    drb-Identity                        DRB-Identity,
    pdcp-Config                         PDCP-Config             OPTIONAL,       -- Cond PDCP
    rlc-Config                          RLC-Config              OPTIONAL,       -- Cond SetupM
    logicalChannelIdentity              INTEGER (3..10)         OPTIONAL,       -- Cond DRB-SetupM
    logicalChannelConfig                LogicalChannelConfig    OPTIONAL,       -- Cond SetupM
    ...,
    [[  drb-TypeChange-r12                      ENUMERATED {toMCG}  OPTIONAL,       -- Need OP
        rlc-Config-v1250                    RLC-Config-v1250        OPTIONAL        -- Need ON
    ]]
}

DRB-ToAddModSCG-r12 ::= SEQUENCE {
    drb-Identity-r12                    DRB-Identity,
    drb-Type-r12                        CHOICE {
        split-r12                           NULL,
        scg-r12                             SEQUENCE {
```

```
            eps-BearerIdentity-r12              INTEGER (0..15) OPTIONAL,   -- Cond DRB-Setup
            pdcp-Config-r12                     PDCP-Config     OPTIONAL    -- Cond PDCP-S
        }
    }                                                           OPTIONAL,   -- Cond SetupS2
    rlc-ConfigSCG-r12                   RLC-Config              OPTIONAL,   -- Cond SetupS
    rlc-Config-v1250                        RLC-Config-v1250            OPTIONAL,   -- Need ON
    logicalChannelIdentitySCG-r12       INTEGER (3..10)         OPTIONAL,   -- Cond DRB-SetupS
    logicalChannelConfigSCG-r12         LogicalChannelConfig    OPTIONAL,   -- Cond SetupS
    ...
}

DRB-ToReleaseList ::=               SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity

MeasSubframePatternPCell-r10 ::=        CHOICE {
    release                             NULL,
    setup                           MeasSubframePattern-r10
}

NeighCellsCRS-Info-r11 ::=      CHOICE {
    release                         NULL,
    setup                           CRS-AssistanceInfoList-r11
}

CRS-AssistanceInfoList-r11 ::=  SEQUENCE (SIZE (1..maxCellReport)) OF CRS-AssistanceInfo-r11

CRS-AssistanceInfo-r11 ::= SEQUENCE {
    physCellId-r11                      PhysCellId,
    antennaPortsCount-r11               ENUMERATED {an1, an2, an4, spare1},
    mbsfn-SubframeConfigList-r11        MBSFN-SubframeConfigList,
    ...
}

NAICS-AssistanceInfo-r12 ::=        CHOICE {
    release                         NULL,
    setup                           SEQUENCE {
        neighCellsToReleaseList-r12     NeighCellsToReleaseList-r12         OPTIONAL,   -- Need ON
        neighCellsToAddModList-r12      NeighCellsToAddModList-r12          OPTIONAL,   -- Need ON
        servCellp-a-r12                 P-a                                 OPTIONAL    -- Need ON
    }
}

NeighCellsToReleaseList-r12 ::=     SEQUENCE (SIZE (1..maxNeighCell-r12)) OF PhysCellId

NeighCellsToAddModList-r12 ::=  SEQUENCE (SIZE (1..maxNeighCell-r12)) OF NeighCellsInfo-r12

NeighCellsInfo-r12  ::=           SEQUENCE {
    physCellId-r12              PhysCellId,
    p-b-r12                     INTEGER (0..3),
    crs-PortsCount-r12          ENUMERATED {n1, n2, n4, spare},
    mbsfn-SubframeConfig-r12    MBSFN-SubframeConfigList                OPTIONAL,   -- Need ON
    p-aList-r12                 SEQUENCE (SIZE (1..maxP-a-PerNeighCell-r12)) OF P-a,
    transmissionModeList-r12    BIT STRING (SIZE(8)),
    resAllocGranularity-r12     INTEGER (1..4),
    ...
}
P-a ::= ENUMERATED {    dB-6, dB-4dot77, dB-3, dB-1dot77,
                        dB0, dB1, dB2, dB3}

-- ASN1STOP
```

RadioResourceConfigDedicated field descriptions
crs-PortsCount Parameter represents the number of antenna ports for cell-specific reference signal used by the signaled neighboring cell where n1 corresponds to 1 antenna port, n2 to 2 antenna ports etc. see TS 36.211 [21, 6.10.1].
drb-Identity In case of DC, the DRB identity is unique within the scope of the UE i.e. an SCG DRB can not use the same value as used for an MCG or split DRB. For a split DRB the same identity is used for the MCG- and SCG parts of the configuration.
drb-ToAddModListSCG When an SCG is configured, E-UTRAN configures at least one SCG or split DRB.
drb-Type This field indicates whether the DRB is split or SCG DRB. E-UTRAN does not configure split and SCG DRBs simultaneously for the UE.
drb-TypeChange Indicates that a split/SCG DRB is reconfigured to an MCG DRB (i.e. E-UTRAN only signals the field in case the DRB type changes).
logicalChannelConfig For SRBs a choice is used to indicate whether the logical channel configuration is signalled explicitly or set to the default logical channel configuration for SRB1 as specified in 9.2.1.1 or for SRB2 as specified in 9.2.1.2.
logicalChannelIdentity The logical channel identity for both UL and DL.
mac-MainConfig Although the ASN.1 includes a choice that is used to indicate whether the mac-MainConfig is signalled explicitly or set to the default MAC main configuration as specified in 9.2.2, EUTRAN does not apply "*defaultValue*".
mbsfn-SubframeConfig Defines the MBSFN subframe configuration used by the signaled neighboring cell. If absent, UE assumes no MBSFN configuration for the neighboring cell.
measSubframePatternPCell Time domain measurement resource restriction pattern for the PCell measurements (RSRP, RSRQ and the radio link monitoring).
neighCellsCRS-Info This field contains assistance information, concerning the primary frequency, used by the UE to mitigate interference from CRS while performing RRM/RLM/CSI measurement or data demodulation. When the received CRS assistance information is for a cell with CRS colliding with that of the CRS of the cell to measure, the UE may use the CRS assistance information to mitigate CRS interference (as specified in TS 36.101 [42]) on the subframes indicated by *measSubframePatternPCell*, *measSubframePatternConfigNeigh*, *csi-MeasSubframeSet1* if configured, and the CSI subframe set 1 if *csi-MeasSubframeSets-r12* is configured. Furthermore, the UE may use CRS assistance information to mitigate CRS interference from the cells in the IE for the demodulation purpose as specified in TS 36.101 [42]. EUTRAN does not configure *neighCellsCRS-Info-r11* if *eimta-MainConfigPCell-r12* is configured.
neighCellsToAddModList This field contains assistance information used by the UE to cancel and suppress interference of a neighbouring cell. If this field is present for a neighbouring cell, the UE assumes that the transmission parameters listed in the sub-fields are used by the neighbouring cell. If this field is present for a neighbouring cell, the UE assumes the neighbour cell is subframe and SFN synchronized to the serving cell, has the same system bandwidth, UL/DL and special subframe configuration, and cyclic prefix length as the serving cell.
p-aList Indicates the restricted subset of power offset for QPSK, 16QAM, and 64QAM PDSCH transmissions for the neighbouring cell by using the parameter P_A , see TS 36.213 [23, 5.2]. Value dB-6 corresponds to -6 dB, dB-4dot77 corresponds to -4.77 dB etc.
p-b Parameter: P_B , indicates the cell-specific ratio used by the signaled neighboring cell, see TS 36.213 [23, Table 5.2-1].
physicalConfigDedicated The default dedicated physical configuration is specified in 9.2.4.
resAllocGranularity Indicates the resource allocation and precoding granularity in PRB pair level of the signaled neighboring cell, see TS 36.213 [23, 7.1.6].
rlc-Config For SRBs a choice is used to indicate whether the RLC configuration is signalled explicitly or set to the values defined in the default RLC configuration for SRB1 in 9.2.1.1 or for SRB2 in 9.2.1.2. RLC AM is the only applicable RLC mode for SRB1 and SRB2. E-UTRAN does not reconfigure the RLC mode of DRBs except when a full configuration option is used, and may reconfigure the UM RLC SN field size and the AM RLC LI field size only upon handover within E-UTRA or upon the first reconfiguration after RRC connection re-establishment or upon SCG Change for SCG and split DRBs.
servCellp-a Indicates the power offset for QPSK C-RNTI based PDSCH transmissions used by the serving cell, see 36.213 [23, 5.2]. Value dB-6 corresponds to -6 dB, dB-4dot77 corresponds to -4.77 dB etc.

***RadioResourceConfigDedicated* field descriptions**
sps-Config The default SPS configuration is specified in 9.2.3. Except for handover or releasing SPS for MCG, E-UTRAN does not reconfigure *sps-Config* for MCG when there is a configured downlink assignment or a configured uplink grant for MCG (see TS 36.321 [6]). Except for SCG change or releasing SPS for SCG, E-UTRAN does not reconfigure *sps-Config* for SCG when there is a configured downlink assignment or a configured uplink grant for SCG (see TS 36.321 [6]).
srb-Identity Value 1 is applicable for SRB1 only. Value 2 is applicable for SRB2 only.
transmissionModeList Indicates a subset of transmission mode 1, 2, 3, 4, 6, 8, 9, 10, for the signaled neighboring cell for which *NeighCellsInfo* applies. When TM10 is signaled, other signaled transmission parameters in *NeighCellsInfo* are not applicable to up to 8 layer transmission scheme of TM10. E-UTRAN may indicate TM9 when TM10 with QCL type A and DMRS scrambling with $n_{\mathrm{ID}}^{(i)} = N_{\mathrm{ID}}^{\mathrm{cell}}$ in TS 36.211 [21, 6.10.3.1] is used in the signalled neighbour cell and TM9 or TM10 with QCL type A and DMRS scrambling with $n_{\mathrm{ID}}^{(i)} = N_{\mathrm{ID}}^{\mathrm{cell}}$ in TS 36.211 [21, 6.10.3.1] is used in the serving cell. UE behaviour with NAICS when TM10 is used is only defined when QCL type A and DMRS scrambling with $n_{\mathrm{ID}}^{(i)} = N_{\mathrm{ID}}^{\mathrm{cell}}$ in TS 36.211 [21, 6.10.3.1] is used for the serving cell and all signalled neighbour cells. The first/ leftmost bit is for transmission mode 1, the second bit is for transmission mode 2, and so on.

Conditional presence	Explanation
DRB-Setup	The field is mandatory present if the corresponding DRB is being set up; otherwise it is not present.
DRB-SetupM	The field is mandatory present upon setup of MCG or split DRB; The field is optionally present, Need ON, upon change from SCG to MCG DRB; otherwise it is not present.
DRB-SetupS	The field is mandatory present upon setup of SCG or split DRB, or upon change from MCG to split DRB; The field is optionally present, Need ON, upon change from MCG to SCG DRB; otherwise it is not present.
HO-Conn	The field is mandatory present in case of handover to E-UTRA or when the *fullConfig* is included in the *RRCConnectionReconfiguration* message or in case of RRC connection establishment; otherwise the field is optionally present, need ON. Upon connection establishment/ re-establishment only SRB1 is applicable.
HO-toEUTRA	The field is mandatory present in case of handover to E-UTRA or when the *fullConfig* is included in the *RRCConnectionReconfiguration* message; In case of RRC connection establishment and RRC connection re-establishment the field is not present; otherwise the field is optionally present, need ON.
HO-toEUTRA2	The field is mandatory present in case of handover to E-UTRA or when the *fullConfig* is included in the *RRCConnectionReconfiguration* message; otherwise the field is optionally present, need ON.
PDCP	The field is mandatory present if the corresponding DRB is being setup; the field is optionally present, need ON, upon reconfiguration of the corresponding split DRB, upon the corresponding DRB type change from split to MCG bearer, upon the corresponding DRB type change from MCG to split bearer, upon handover within E-UTRA and upon the first reconfiguration after re-establishment but in all these cases only when fullConfig is not included in the RRCConnectionReconfiguration message; otherwise it is not present.
PDCP-S	The field is mandatory present if the corresponding DRB is being setup; the field is optionally present, need ON, upon SCG change; otherwise it is not present.
RLC-Setup	This field is optionally present if the corresponding DRB is being setup, need ON; otherwise it is not present.
SCellAdd	The field is optionally present, need ON, upon SCell addition; otherwise it is not present.
Setup	The field is mandatory present if the corresponding SRB/DRB is being setup; otherwise the field is optionally present, need ON.
SetupM	The field is mandatory present upon setup of an MCG or split DRB; otherwise the field is optionally present, need ON.
SetupS	The field is mandatory present upon setup of an SCG or split DRB, as well as upon change from MCG to split DRB; otherwise the field is optionally present, need ON.
SetupS2	The field is mandatory present upon setup of an SCG or split DRB, as well as upon change from MCG to split or SCG DRB. For an SCG DRB the field is optionally present, need ON. Otherwise the field is not present.

– *RLC-Config*

The IE *RLC-Config* is used to specify the RLC configuration of SRBs and DRBs.

RLC-Config information element

```
-- ASN1START

RLC-Config ::=              CHOICE {
    am                                  SEQUENCE {
        ul-AM-RLC                           UL-AM-RLC,
        dl-AM-RLC                           DL-AM-RLC
    },
    um-Bi-Directional                   SEQUENCE {
        ul-UM-RLC                           UL-UM-RLC,
        dl-UM-RLC                           DL-UM-RLC
    },
    um-Uni-Directional-UL               SEQUENCE {
        ul-UM-RLC                           UL-UM-RLC
    },
    um-Uni-Directional-DL               SEQUENCE {
        dl-UM-RLC                           DL-UM-RLC
    },
    ...
}

RLC-Config-v1250 ::=                SEQUENCE {
    ul-extended-RLC-LI-Field-r12            BOOLEAN,
    dl-extended-RLC-LI-Field-r12            BOOLEAN
}

UL-AM-RLC ::=                       SEQUENCE {
    t-PollRetransmit                    T-PollRetransmit,
    pollPDU                             PollPDU,
    pollByte                            PollByte,
    maxRetxThreshold                    ENUMERATED {
                                            t1, t2, t3, t4, t6, t8, t16, t32}
}

DL-AM-RLC ::=                       SEQUENCE {
    t-Reordering                        T-Reordering,
    t-StatusProhibit                    T-StatusProhibit
}

UL-UM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength
}

DL-UM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength,
    t-Reordering                        T-Reordering
}

SN-FieldLength ::=                  ENUMERATED {size5, size10}

T-PollRetransmit ::=                ENUMERATED {
                                        ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
                                        ms110, ms115, ms120, ms125, ms130, ms135,
                                        ms140, ms145, ms150, ms155, ms160, ms165,
                                        ms170, ms175, ms180, ms185, ms190, ms195,
                                        ms200, ms205, ms210, ms215, ms220, ms225,
                                        ms230, ms235, ms240, ms245, ms250, ms300,
                                        ms350, ms400, ms450, ms500, spare9, spare8,
                                        spare7, spare6, spare5, spare4, spare3,
                                        spare2, spare1}

PollPDU ::=                         ENUMERATED {
                                        p4, p8, p16, p32, p64, p128, p256, pInfinity}

PollByte ::=                        ENUMERATED {
                                        kB25, kB50, kB75, kB100, kB125, kB250, kB375,
                                        kB500, kB750, kB1000, kB1250, kB1500, kB2000,
                                        kB3000, kBinfinity, spare1}

T-Reordering ::=                    ENUMERATED {
```

```
                                        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms110,
                                        ms120, ms130, ms140, ms150, ms160, ms170,
                                        ms180, ms190, ms200, spare1}

T-StatusProhibit ::=                ENUMERATED {
                                        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
                                        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
                                        ms110, ms115, ms120, ms125, ms130, ms135,
                                        ms140, ms145, ms150, ms155, ms160, ms165,
                                        ms170, ms175, ms180, ms185, ms190, ms195,
                                        ms200, ms205, ms210, ms215, ms220, ms225,
                                        ms230, ms235, ms240, ms245, ms250, ms300,
                                        ms350, ms400, ms450, ms500, spare8, spare7,
                                        spare6, spare5, spare4, spare3, spare2,
                                        spare1}

-- ASN1STOP
```

***RLC-Config* field descriptions**
dl-extended-RLC-LI-Field, ul-extended-RLC-LI-Field Indicates the RLC LI field size. Value *TRUE* means that 15 bit LI length shall be used, otherwise 11 bit LI length shall be used; see TS 36.322 [7]. E-UTRAN enables this field only when *RLC-Config* (without suffix) is set to *am.*
maxRetxThreshold Parameter for RLC AM in TS 36.322 [7]. Value t1 corresponds to 1 retransmission, t2 to 2 retransmissions and so on.
pollByte Parameter for RLC AM in TS 36.322 [7]. Value kB25 corresponds to 25 kBytes, kB50 to 50 kBytes and so on. kBInfinity corresponds to an infinite amount of kBytes.
pollPDU Parameter for RLC AM in TS 36.322 [7]. Value p4 corresponds to 4 PDUs, p8 to 8 PDUs and so on. pInfinity corresponds to an infinite number of PDUs.
sn-FieldLength Indicates the UM RLC SN field size, see TS 36.322 [7], in bits. Value size5 means 5 bits, size10 means 10 bits.
t-PollRetransmit Timer for RLC AM in TS 36.322 [7], in milliseconds. Value ms5 means 5ms, ms10 means 10ms and so on.
t-Reordering Timer for reordering in TS 36.322 [7], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on.
t-StatusProhibit Timer for status reporting in TS 36.322 [7], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on.

– *RLF-TimersAndConstants*

The IE *RLF-TimersAndConstants* contains UE specific timers and constants applicable for UEs in RRC_CONNECTED.

***RLF-TimersAndConstants* information element**

```
-- ASN1START

RLF-TimersAndConstants-r9 ::=           CHOICE {
    release                                 NULL,
    setup                                   SEQUENCE {
        t301-r9                             ENUMERATED {
                                                ms100, ms200, ms300, ms400, ms600, ms1000, ms1500,
                                                ms2000},
        t310-r9                             ENUMERATED {
                                                ms0, ms50, ms100, ms200, ms500, ms1000, ms2000},
        n310-r9                             ENUMERATED {
                                                n1, n2, n3, n4, n6, n8, n10, n20},
        t311-r9                             ENUMERATED {
                                                ms1000, ms3000, ms5000, ms10000, ms15000,
                                                ms20000, ms30000},
        n311-r9                             ENUMERATED {
                                                n1, n2, n3, n4, n5, n6, n8, n10},
        ...
    }
}
```

```
RLF-TimersAndConstantsSCG-r12 ::=           CHOICE {
    release                                 NULL,
    setup                                   SEQUENCE {
        t313-r12                                ENUMERATED {
                                                    ms0, ms50, ms100, ms200, ms500, ms1000, ms2000},
        n313-r12                                ENUMERATED {
                                                    n1, n2, n3, n4, n6, n8, n10, n20},
        n314-r12                                ENUMERATED {
                                                    n1, n2, n3, n4, n5, n6, n8, n10},
        ...
    }
}

-- ASN1STOP
```

***RLF-TimersAndConstants* field descriptions**
n3xy Constants are described in section 7.4. n1 corresponds with 1, n2 corresponds with 2 and so on.
t3xy Timers are described in section 7.3. Value ms0 corresponds with 0 ms, ms50 corresponds with 50 ms and so on.

– *RN-SubframeConfig*

The IE *RN-SubframeConfig* is used to specify the subframe configuration for an RN.

RN-SubframeConfig information element

```
-- ASN1START

RN-SubframeConfig-r10 ::=       SEQUENCE {
    subframeConfigPattern-r10           CHOICE {
        subframeConfigPatternFDD-r10    BIT STRING (SIZE(8)),
        subframeConfigPatternTDD-r10    INTEGER (0..31)
    }                                                                   OPTIONAL,   -- Need ON
    rpdcch-Config-r10               SEQUENCE {
        resourceAllocationType-r10      ENUMERATED {type0, type1, type2Localized, type2Distributed,
                                                    spare4, spare3, spare2, spare1},
        resourceBlockAssignment-r10         CHOICE {
            type01-r10                          CHOICE {
                nrb6-r10                            BIT STRING (SIZE(6)),
                nrb15-r10                           BIT STRING (SIZE(8)),
                nrb25-r10                           BIT STRING (SIZE(13)),
                nrb50-r10                           BIT STRING (SIZE(17)),
                nrb75-r10                           BIT STRING (SIZE(19)),
                nrb100-r10                          BIT STRING (SIZE(25))
            },
            type2-r10                           CHOICE {
                nrb6-r10                            BIT STRING (SIZE(5)),
                nrb15-r10                           BIT STRING (SIZE(7)),
                nrb25-r10                           BIT STRING (SIZE(9)),
                nrb50-r10                           BIT STRING (SIZE(11)),
                nrb75-r10                           BIT STRING (SIZE(12)),
                nrb100-r10                          BIT STRING (SIZE(13))
            },
            ...
        },
        demodulationRS-r10              CHOICE {
            interleaving-r10                ENUMERATED {crs},
            noInterleaving-r10              ENUMERATED {crs, dmrs}
        },
        pdsch-Start-r10                 INTEGER (1..3),
        pucch-Config-r10                CHOICE {
            tdd                             CHOICE {
                channelSelectionMultiplexingBundling    SEQUENCE {
                    n1PUCCH-AN-List-r10         SEQUENCE (SIZE (1..4)) OF INTEGER (0..2047)
                },
                fallbackForFormat3              SEQUENCE {
                    n1PUCCH-AN-P0-r10               INTEGER (0..2047),
                    n1PUCCH-AN-P1-r10               INTEGER (0..2047)       OPTIONAL    -- Need OR
                }
            },
            fdd                             SEQUENCE {
                n1PUCCH-AN-P0-r10               INTEGER (0..2047),
```

```
                n1PUCCH-AN-P1-r10               INTEGER (0..2047)           OPTIONAL    -- Need OR
            }
        },
        ...
    }                                                                       OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

***RN-SubframeConfig* field descriptions**
demodulationRS Indicates which reference signals are used for R-PDCCH demodulation according to TS 36.216 [55, 7.4.1]. Value interleaving corresponds to cross-interleaving and value noInterleaving corresponds to no cross-interleaving according to TS 36.216 [55, 7.4.2 and 7.4.3].
n1PUCCH-AN-List Parameter: $n^{(1)}_{\mathrm{PUCCH},i}$, see TS 36.216, [55, 7.5.1]. This parameter is only applicable for TDD. Configures PUCCH HARQ-ACK resources if the RN is configured to use HARQ-ACK channel selection, HARQ-ACK multiplexing or HARQ-ACK bundling.
n1PUCCH-AN-P0, n1PUCCH-AN-P1 Parameter: $n^{(1,p)}_{\mathrm{PUCCH}}$, for antenna port P0 and for antenna port P1 respectively, see TS 36.216, [55, 7.5.1] for FDD and [55, 7.5.2] for TDD.
pdsch-Start Parameter: *DL-StartSymbol*, see TS 36.216 [55, Table 5.4-1].
resourceAllocationType Represents the resource allocation used: type 0, type 1 or type 2 according to TS 36.213 [23, 7.1.6]. Value type0 corresponds to type 0, value type1 corresponds to type 1, value type2Localized corresponds to type 2 with localized virtual resource blocks and type2Distributed corresponds to type 2 with distributed virtual resource blocks.
resourceBlockAssignment Indicates the resource block assignment bits according to TS 36.213 [23, 7.1.6]. Value type01 corresponds to type 0 and type 1, and the value type2 corresponds to type 2. Value nrb6 corresponds to a downlink system bandwidth of 6 resource blocks, value nrb15 corresponds to a downlink system bandwidth of 15 resource blocks, and so on.
subframeConfigPatternFDD Parameter: *SubframeConfigurationFDD*, see TS 36.216 [55, Table 5.2-1]. Defines the DL subframe configuration for eNB-to-RN transmission, i.e. those subframes in which the eNB may indicate downlink assignments for the RN. The radio frame in which the pattern starts (i.e. the radio frame in which the first bit of the *subframeConfigPatternFDD* corresponds to subframe #0) occurs when SFN mod 4 = 0.
subframeConfigPatternTDD Parameter: *SubframeConfigurationTDD*, see TS 36.216 [55, Table 5.2-2]. Defines the DL and UL subframe configuration for eNB-RN transmission.

– *SchedulingRequestConfig*

The IE *SchedulingRequestConfig* is used to specify the Scheduling Request related parameters

SchedulingRequestConfig information element

```
-- ASN1START

SchedulingRequestConfig ::=     CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        sr-PUCCH-ResourceIndex              INTEGER (0..2047),
        sr-ConfigIndex                      INTEGER (0..157),
        dsr-TransMax                        ENUMERATED {
                                                n4, n8, n16, n32, n64, spare3, spare2, spare1}
    }
}

SchedulingRequestConfig-v1020 ::=   SEQUENCE {
    sr-PUCCH-ResourceIndexP1-r10        INTEGER (0..2047)           OPTIONAL        -- Need OR
}

-- ASN1STOP
```

***SchedulingRequestConfig* field descriptions**
dsr-TransMax Parameter for SR transmission in TS 36.321 [6, 5.4.4]. The value n4 corresponds to 4 transmissions, n8 corresponds to 8 transmissions and so on.
sr-ConfigIndex Parameter I_{SR}. See TS 36.213 [23,10.1]. The values 156 and 157 are not applicable for Release 8.
sr-PUCCH-ResourceIndex, sr-PUCCH-ResourceIndexP1 Parameter: $n_{\mathrm{PUCCH,SRI}}^{(1,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 10.1]. E-UTRAN configures *sr-PUCCH-ResourceIndexP1* only if *sr-PUCCHResourceIndex* is configured.

– *SoundingRS-UL-Config*

The IE *SoundingRS-UL-Config* is used to specify the uplink Sounding RS configuration for periodic and aperiodic sounding.

***SoundingRS-UL-Config* information element**

```
-- ASN1START

SoundingRS-UL-ConfigCommon ::=      CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        srs-BandwidthConfig                 ENUMERATED {bw0, bw1, bw2, bw3, bw4, bw5, bw6, bw7},
        srs-SubframeConfig                  ENUMERATED {
                                                sc0, sc1, sc2, sc3, sc4, sc5, sc6, sc7,
                                                sc8, sc9, sc10, sc11, sc12, sc13, sc14, sc15},
        ackNackSRS-SimultaneousTransmission BOOLEAN,
        srs-MaxUpPts                        ENUMERATED {true}           OPTIONAL    -- Cond TDD
    }
}

SoundingRS-UL-ConfigDedicated ::=   CHOICE{
    release                             NULL,
    setup                               SEQUENCE {
        srs-Bandwidth                       ENUMERATED {bw0, bw1, bw2, bw3},
        srs-HoppingBandwidth                ENUMERATED {hbw0, hbw1, hbw2, hbw3},
        freqDomainPosition                  INTEGER (0..23),
        duration                            BOOLEAN,
        srs-ConfigIndex                     INTEGER (0..1023),
        transmissionComb                    INTEGER (0..1),
        cyclicShift                         ENUMERATED {cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7}
    }
}

SoundingRS-UL-ConfigDedicated-v1020 ::= SEQUENCE {
    srs-AntennaPort-r10                 SRS-AntennaPort
}

SoundingRS-UL-ConfigDedicatedAperiodic-r10 ::=  CHOICE{
    release                             NULL,
    setup                               SEQUENCE {
        srs-ConfigIndexAp-r10               INTEGER (0..31),
        srs-ConfigApDCI-Format4-r10         SEQUENCE (SIZE (1..3)) OF SRS-ConfigAp-r10  OPTIONAL,--
Need ON
        srs-ActivateAp-r10                  CHOICE {
                release                         NULL,
                setup                           SEQUENCE {
                    srs-ConfigApDCI-Format0-r10         SRS-ConfigAp-r10,
                    srs-ConfigApDCI-Format1a2b2c-r10        SRS-ConfigAp-r10,
                    ...
                }
        }                                                                   OPTIONAL    -- Need ON
    }
}

SRS-ConfigAp-r10 ::= SEQUENCE {
    srs-AntennaPortAp-r10               SRS-AntennaPort,
    srs-BandwidthAp-r10                 ENUMERATED {bw0, bw1, bw2, bw3},
    freqDomainPositionAp-r10            INTEGER (0..23),
    transmissionCombAp-r10              INTEGER (0..1),
    cyclicShiftAp-r10                   ENUMERATED {cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7}
}
```

```
SRS-AntennaPort ::=                ENUMERATED {an1, an2, an4, spare1}

-- ASN1STOP
```

***SoundingRS-UL-Config* field descriptions**
ackNackSRS-SimultaneousTransmission Parameter: *Simultaneous-AN-and-SRS*, see TS 36.213 [23, 8.2]. For SCells this field is not applicable and the UE shall ignore the value.
cyclicShift, cyclicShiftAp Parameter: n_SRS for periodic and aperiodic sounding reference signal transmission respectively. See TS 36.211 [21, 5.5.3.1], where cs0 corresponds to 0 etc.
duration Parameter: Duration for periodic sounding reference signal transmission. See TS 36.213 [21, 8.2]. FALSE corresponds to "single" and value TRUE to "indefinite".
freqDomainPosition, freqDomainPositionAp Parameter: n_{RRC} for periodic and aperiodic sounding reference signal transmission respectively, see TS 36.211 [21, 5.5.3.2].
srs-AntennaPort, srs-AntennaPortAp Indicates the number of antenna ports used for periodic and aperiodic sounding reference signal transmission respectively, see TS 36.211 [21, 5.5.3]. UE shall release *srs-AntennaPort* if *SoundingRS-UL-ConfigDedicated* is released.
srs-Bandwidth, srs-BandwidthAp Parameter: B_{SRS} for periodic and aperiodic sounding reference signal transmission respectively, see TS 36.211 [21, tables 5.5.3.2-1, 5.5.3.2-2, 5.5.3.2-3 and 5.5.3.2-4].
srs-BandwidthConfig Parameter: SRS Bandwidth Configuration. See TS 36.211, [21, table 5.5.3.2-1, 5.5.3.2-2, 5.5.3.2-3 and 5.5.3.2-4]. Actual configuration depends on UL bandwidth. bw0 corresponds to value 0, bw1 to value 1 and so on.
srs-ConfigApDCI-Format0 / srs-ConfigApDCI-Format1a2b2c / srs-ConfigApDCI-Format4 Parameters indicate the resource configurations for aperiodic sounding reference signal transmissions triggered by DCI formats 0, 1A, 2B, 2C, 4. See TS 36.213 [23, 8.2].
srs-ConfigIndex, srs-ConfigIndexAp Parameter: I_{SRS} for periodic and aperiodic sounding reference signal transmission respectively. See TS 36.213 [23, table 8.2-1 and table 8.2-2] for periodic and TS 36.213 [23, table 8.2-4 and table 8.2-5] for aperiodic SRS transmission.
srs-HoppingBandwidth Parameter: SRS hopping bandwidth $b_{hop} \in \{0,1,2,3\}$ for periodic sounding reference signal transmission, see TS 36.211 [21, 5.5.3.2] where hbw0 corresponds to value 0, hbw1 to value 1 and so on.
srs-MaxUpPts Parameter: srsMaxUpPts, see TS 36.211 [21, 5.5.3.2]. If this field is present, reconfiguration of $m_{\mathrm{SRS},0}^{\max}$ applies for UpPts, otherwise reconfiguration does not apply.
srs-SubframeConfig Parameter: SRS SubframeConfiguration. See TS 36.211, [21, table 5.5.3.3-1] applies for FDD whereas TS 36.211, [21, table 5.5.3.3-2] applies for TDD. sc0 corresponds to value 0, sc1 to value 1 and so on.
transmissionComb, transmissionCombAp Parameter: $\bar{k}_{\mathrm{TC}} \in \{0,1\}$ for periodic and aperiodic sounding reference signal transmission respectively, see TS 36.211 [21, 5.5.3.2].

Conditional presence	Explanation
TDD	This field is optional present for TDD, need OR; it is not present for FDD and the UE shall delete any existing value for this field.

– *SPS-Config*

The IE *SPS-Config* is used to specify the semi-persistent scheduling configuration.

***SPS-Config* information element**

```
-- ASN1START

SPS-Config ::=  SEQUENCE {
```

```
    semiPersistSchedC-RNTI          C-RNTI                  OPTIONAL,           -- Need OR
    sps-ConfigDL                    SPS-ConfigDL            OPTIONAL,           -- Need ON
    sps-ConfigUL                    SPS-ConfigUL            OPTIONAL            -- Need ON
}

SPS-ConfigDL ::=    CHOICE{
    release                         NULL,
    setup                           SEQUENCE {
        semiPersistSchedIntervalDL          ENUMERATED {
                                                sf10, sf20, sf32, sf40, sf64, sf80,
                                                sf128, sf160, sf320, sf640, spare6,
                                                spare5, spare4, spare3, spare2,
                                                spare1},
        numberOfConfSPS-Processes           INTEGER (1..8),
        n1PUCCH-AN-PersistentList           N1PUCCH-AN-PersistentList,
        ...,
        [[  twoAntennaPortActivated-r10     CHOICE {
                release                         NULL,
                setup                           SEQUENCE {
                    n1PUCCH-AN-PersistentListP1-r10 N1PUCCH-AN-PersistentList
                }
            }                                                               OPTIONAL    -- Need ON
        ]]
    }
}

SPS-ConfigUL ::=    CHOICE {
    release                         NULL,
    setup                           SEQUENCE {
        semiPersistSchedIntervalUL          ENUMERATED {
                                                sf10, sf20, sf32, sf40, sf64, sf80,
                                                sf128, sf160, sf320, sf640, spare6,
                                                spare5, spare4, spare3, spare2,
                                                spare1},
        implicitReleaseAfter                ENUMERATED {e2, e3, e4, e8},
        p0-Persistent                       SEQUENCE {
            p0-NominalPUSCH-Persistent          INTEGER (-126..24),
            p0-UE-PUSCH-Persistent              INTEGER (-8..7)
        }       OPTIONAL,                                           -- Need OP
        twoIntervalsConfig                  ENUMERATED {true}       OPTIONAL,   -- Cond TDD
        ...,
        [[  p0-PersistentSubframeSet2-r12       CHOICE {
                release                             NULL,
                setup                               SEQUENCE {
                    p0-NominalPUSCH-PersistentSubframeSet2-r12      INTEGER (-126..24),
                    p0-UE-PUSCH-PersistentSubframeSet2-r12          INTEGER (-8..7)
                }
            }                                                       OPTIONAL    -- Need ON
        ]]
    }
}

N1PUCCH-AN-PersistentList ::=       SEQUENCE (SIZE (1..4)) OF INTEGER (0..2047)

-- ASN1STOP
```

SPS-Config field descriptions
implicitReleaseAfter Number of empty transmissions before implicit release, see TS 36.321 [6, 5.10.2]. Value e2 corresponds to 2 transmissions, e3 corresponds to 3 transmissions and so on.
n1PUCCH-AN-PersistentList , n1PUCCH-AN-PersistentListP1 List of parameter: $n_{\mathrm{PUCCH}}^{(1,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 10.1]. Field *n1-PUCCH-AN-PersistentListP1* is applicable only if the *twoAntennaPortActivatedPUCCH-Format1a1b* in *PUCCH-ConfigDedicated-v1020* is set to *true*. Otherwise the field is not configured.
numberOfConfSPS-Processes The number of configured HARQ processes for Semi-Persistent Scheduling, see TS 36.321 [6].
p0-NominalPUSCH-Persistent Parameter: $P_{\mathrm{O\_NOMINAL\_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dBm step 1. This field is applicable for persistent scheduling, only. If choice setup is used and *p0-Persistent* is absent, apply the value of *p0-NominalPUSCH* for *p0-NominalPUSCH-Persistent.* If uplink power control subframe sets are configured by *tpc-SubframeSet*, this field applies for uplink power control subframe set 1.
p0-NominalPUSCH-PersistentSubframeSet2 Parameter: $P_{\mathrm{O\_NOMINAL\_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dBm step 1. This field is applicable for persistent scheduling, only. If *p0-PersistentSubframeSet2-r12* is not configured, apply the value of *p0-NominalPUSCH-SubframeSet2-r12* for *p0-NominalPUSCH-PersistentSubframeSet2.* E-UTRAN configures this field only if uplink power control subframe sets are configured by *tpc-SubframeSet*, in which case this field applies for uplink power control subframe set 2.
p0-UE-PUSCH-Persistent Parameter: $P_{\mathrm{O\_UE\_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for persistent scheduling, only. If choice setup is used and *p0-Persistent* is absent, apply the value of p0-UE-PUSCH for *p0-UE-PUSCH-Persistent.* If uplink power control subframe sets are configured by *tpc-SubframeSet*, this field applies for uplink power control subframe set 1.
p0-UE-PUSCH-PersistentSubframeSet2 Parameter: $P_{\mathrm{O\_UE\_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for persistent scheduling, only. If *p0-PersistentSubframeSet2-r12* is not configured, apply the value of *p0-UE-PUSCH-SubframeSet2* for *p0-UE-PUSCH-PersistentSubframeSet2.* E-UTRAN configures this field only if uplink power control subframe sets are configured by *tpc-SubframeSet*, in which case this field applies for uplink power control subframe set 2.
semiPersistSchedC-RNTI Semi-persistent Scheduling C-RNTI, see TS 36.321 [6].
semiPersistSchedIntervalDL Semi-persistent scheduling interval in downlink, see TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on. For TDD, the UE shall round this parameter down to the nearest integer (of 10 sub-frames), e.g. sf10 corresponds to 10 sub-frames, sf32 corresponds to 30 sub-frames, sf128 corresponds to 120 sub-frames.
semiPersistSchedIntervalUL Semi-persistent scheduling interval in uplink, see TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on. For TDD, the UE shall round this parameter down to the nearest integer (of 10 sub-frames), e.g. sf10 corresponds to 10 sub-frames, sf32 corresponds to 30 sub-frames, sf128 corresponds to 120 sub-frames.
twoIntervalsConfig Trigger of two-intervals-Semi-Persistent Scheduling in uplink. See TS 36.321 [6, 5.10]. If this field is present, two-intervals-SPS is enabled for uplink. Otherwise, two-intervals-SPS is disabled.

Conditional presence	Explanation
TDD	This field is optional present for TDD, need OR; it is not present for FDD and the UE shall delete any existing value for this field.

– *TDD-Config*

The IE *TDD-Config* is used to specify the TDD specific physical channel configuration.

***TDD-Config* information element**

```
-- ASN1START

TDD-Config ::=                      SEQUENCE {
    subframeAssignment                  ENUMERATED {
                                            sa0, sa1, sa2, sa3, sa4, sa5, sa6},
    specialSubframePatterns             ENUMERATED {
```

```
                                            ssp0, ssp1, ssp2, ssp3, ssp4,ssp5, ssp6, ssp7,
                                            ssp8}
}

TDD-Config-v1130 ::=                SEQUENCE {
    specialSubframePatterns-v1130       ENUMERATED {ssp7,ssp9}
}

TDD-ConfigSL-r12 ::=        SEQUENCE {
    subframeAssignmentSL-r12                ENUMERATED {
                                            none, sa0, sa1, sa2, sa3, sa4, sa5, sa6}
}

-- ASN1STOP
```

***TDD-Config* field descriptions**
specialSubframePatterns Indicates Configuration as in TS 36.211 [21, table 4.2-1] where *ssp0* points to Configuration 0, *ssp1* to Configuration 1 etc. Value *ssp7* points to Configuration 7 for extended cyclic prefix and value *ssp9* points to Configuration 9 for normal cyclic prefix. E-UTRAN signals *ssp7* only when setting *specialSubframePatterns* (without suffix i.e. the version defined in REL-8) to *ssp4*. E-UTRAN signals value *ssp9* only when setting *specialSubframePatterns* (without suffix) to *ssp5*. If *specialSubframePatterns-v1130* is present, the UE shall ignore *specialSubframePatterns* (without suffix).
subframeAssignment Indicates DL/UL subframe configuration where sa0 points to Configuration 0, sa1 to Configuration 1 etc. as specified in TS 36.211 [21, table 4.2-2]. E-UTRAN configures the same value for serving cells residing on same frequency band.
subframeAssignmentSL Indicates UL/ DL subframe configuration where sa0 points to Configuration 0, sa1 to Configuration 1 etc. as specified in TS 36.211 [21, table 4.2-2]. The value *none* means that no TDD specific physical channel configuration is applicable (i.e. the carrier on which *MasterInformationBlock-SL* is transmitted is an FDD UL carrier).

– *TimeAlignmentTimer*

The IE *TimeAlignmentTimer* is used to control how long the UE considers the serving cells belonging to the associated TAG to be uplink time aligned. Corresponds to the Timer for time alignment in TS 36.321 [6]. Value in number of sub-frames. Value sf500 corresponds to 500 sub-frames, sf750 corresponds to 750 sub-frames and so on.

TimeAlignmentTimer information element

```
-- ASN1START

TimeAlignmentTimer ::=                  ENUMERATED {
                                                sf500, sf750, sf1280, sf1920, sf2560, sf5120,
                                                sf10240, infinity}
-- ASN1STOP
```

– *TPC-PDCCH-Config*

The IE *TPC-PDCCH-Config* is used to specify the RNTIs and indexes for PUCCH and PUSCH power control according to TS 36.212 [22]. The power control function can either be setup or released with the IE.

TPC-PDCCH-Config information element

```
-- ASN1START

TPC-PDCCH-Config ::=                    CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        tpc-RNTI                            BIT STRING (SIZE (16)),
        tpc-Index                           TPC-Index
    }
}

TPC-Index ::=                           CHOICE {
    indexOfFormat3                      INTEGER (1..15),
    indexOfFormat3A                     INTEGER (1..31)
}
```

```
-- ASN1STOP
```

TPC-PDCCH-Config field descriptions
indexOfFormat3 Index of N when DCI format 3 is used. See TS 36.212 [22, 5.3.3.1.6].
IndexOfFormat3A Index of M when DCI format 3A is used. See TS 36.212 [22, 5.3.3.1.7].
tpc-Index Index of N or M, see TS 36.212 [22, 5.3.3.1.6 and 5.3.3.1.7], where N or M is dependent on the used DCI format (i.e. format 3 or 3a).
tpc-RNTI RNTI for power control using DCI format 3/3A, see TS 36.212 [22].

– *UplinkPowerControl*

The IE *UplinkPowerControlCommon* and IE *UplinkPowerControlDedicated* are used to specify parameters for uplink power control in the system information and in the dedicated signalling, respectively.

UplinkPowerControl information elements

```
-- ASN1START

UplinkPowerControlCommon ::=        SEQUENCE {
    p0-NominalPUSCH                     INTEGER (-126..24),
    alpha                               Alpha-r12,
    p0-NominalPUCCH                     INTEGER (-127..-96),
    deltaFList-PUCCH                    DeltaFList-PUCCH,
    deltaPreambleMsg3                   INTEGER (-1..6)
}

UplinkPowerControlCommon-v1020 ::=  SEQUENCE {
    deltaF-PUCCH-Format3-r10                ENUMERATED {deltaF-1, deltaF0, deltaF1, deltaF2,
                                                        deltaF3, deltaF4, deltaF5, deltaF6},
    deltaF-PUCCH-Format1bCS-r10             ENUMERATED {deltaF1, deltaF2, spare2, spare1}
}

UplinkPowerControlCommonPSCell-r12 ::=      SEQUENCE {
-- For uplink power control the additional/ missing fields are signalled (compared to SCell)
    deltaF-PUCCH-Format3-r12                ENUMERATED {deltaF-1, deltaF0, deltaF1, deltaF2,
                                                        deltaF3, deltaF4, deltaF5, deltaF6},
    deltaF-PUCCH-Format1bCS-r12             ENUMERATED {deltaF1, deltaF2, spare2, spare1},
    p0-NominalPUCCH-r12                     INTEGER (-127..-96),
    deltaFList-PUCCH-r12                    DeltaFList-PUCCH
}

UplinkPowerControlCommonSCell-r10 ::=   SEQUENCE {
    p0-NominalPUSCH-r10                 INTEGER (-126..24),
    alpha-r10                           Alpha-r12
}

UplinkPowerControlCommonSCell-v1130 ::= SEQUENCE {
    deltaPreambleMsg3-r11               INTEGER (-1..6)
}

UplinkPowerControlDedicated ::=     SEQUENCE {
    p0-UE-PUSCH                         INTEGER (-8..7),
    deltaMCS-Enabled                    ENUMERATED {en0, en1},
    accumulationEnabled                 BOOLEAN,
    p0-UE-PUCCH                         INTEGER (-8..7),
    pSRS-Offset                         INTEGER (0..15),
    filterCoefficient                   FilterCoefficient                   DEFAULT fc4
}

UplinkPowerControlDedicated-v1020 ::= SEQUENCE {
    deltaTxD-OffsetListPUCCH-r10        DeltaTxD-OffsetListPUCCH-r10    OPTIONAL,       -- Need OR
    pSRS-OffsetAp-r10                   INTEGER (0..15)                 OPTIONAL        -- Need OR
}

UplinkPowerControlDedicated-v1130 ::=       SEQUENCE {
    pSRS-Offset-v1130                   INTEGER (16..31)            OPTIONAL,       -- Need OR
    pSRS-OffsetAp-v1130                 INTEGER (16..31)            OPTIONAL,       -- Need OR
```

```
    deltaTxD-OffsetListPUCCH-v1130          DeltaTxD-OffsetListPUCCH-v1130  OPTIONAL    -- Need OR
}

UplinkPowerControlDedicated-v1250 ::=   SEQUENCE {
    set2PowerControlParameter       CHOICE {
        release                         NULL,
        setup                           SEQUENCE {
            tpc-SubframeSet-r12                 BIT STRING (SIZE(10)),
            p0-NominalPUSCH-SubframeSet2-r12        INTEGER (-126..24),
            alpha-SubframeSet2-r12              Alpha-r12,
            p0-UE-PUSCH-SubframeSet2-r12            INTEGER (-8..7)
        }
    }
}

UplinkPowerControlDedicatedSCell-r10 ::=        SEQUENCE {
    p0-UE-PUSCH-r10                     INTEGER (-8..7),
    deltaMCS-Enabled-r10                    ENUMERATED {en0, en1},
    accumulationEnabled-r10             BOOLEAN,
    pSRS-Offset-r10                     INTEGER (0..15),
    pSRS-OffsetAp-r10                   INTEGER (0..15)                     OPTIONAL,   -- Need OR
    filterCoefficient-r10               FilterCoefficient                   DEFAULT fc4,
    pathlossReferenceLinking-r10        ENUMERATED {pCell, sCell}
}

Alpha-r12 ::=                       ENUMERATED {al0, al04, al05, al06, al07, al08, al09, al1}

DeltaFList-PUCCH ::=                SEQUENCE {
    deltaF-PUCCH-Format1                ENUMERATED {deltaF-2, deltaF0, deltaF2},
    deltaF-PUCCH-Format1b               ENUMERATED {deltaF1, deltaF3, deltaF5},
    deltaF-PUCCH-Format2                ENUMERATED {deltaF-2, deltaF0, deltaF1, deltaF2},
    deltaF-PUCCH-Format2a               ENUMERATED {deltaF-2, deltaF0, deltaF2},
    deltaF-PUCCH-Format2b               ENUMERATED {deltaF-2, deltaF0, deltaF2}
}

DeltaTxD-OffsetListPUCCH-r10 ::=    SEQUENCE {
    deltaTxD-OffsetPUCCH-Format1-r10        ENUMERATED {dB0, dB-2},
    deltaTxD-OffsetPUCCH-Format1a1b-r10     ENUMERATED {dB0, dB-2},
    deltaTxD-OffsetPUCCH-Format22a2b-r10    ENUMERATED {dB0, dB-2},
    deltaTxD-OffsetPUCCH-Format3-r10        ENUMERATED {dB0, dB-2},
    ...

}

DeltaTxD-OffsetListPUCCH-v1130 ::=  SEQUENCE {
    deltaTxD-OffsetPUCCH-Format1bCS-r11     ENUMERATED {dB0, dB-1}
}
-- ASN1STOP
```

UplinkPowerControl field descriptions
accumulationEnabled Parameter: Accumulation-enabled, see TS 36.213 [23, 5.1.1.1]. TRUE corresponds to "enabled" whereas FALSE corresponds to "disabled".
alpha Parameter: *α* See TS 36.213 [23, 5.1.1.1] where al0 corresponds to 0, al04 corresponds to value 0.4, al05 to 0.5, al06 to 0.6, al07 to 0.7, al08 to 0.8, al09 to 0.9 and al1 corresponds to 1. This field applies for uplink power control subframe set 1 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
alpha-SubframeSet2 Parameter: *α*. See TS 36.213 [23, 5.1.1.1] where al0 corresponds to 0, al04 corresponds to value 0.4, al05 to 0.5, al06 to 0.6, al07 to 0.7, al08 to 0.8, al09 to 0.9 and al1 corresponds to 1. This field applies for uplink power control subframe set 2 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
deltaF-PUCCH-FormatX Parameter: $\Delta_{\text{F\_PUCCH}}(F)$ for the PUCCH formats 1, 1b, 2, 2a, 2b, 3 and 1b with channel selection. See TS 36.213 [23, 5.1.2] where deltaF-2 corresponds to -2 dB, deltaF0 corresponds to 0 dB and so on.
deltaMCS-Enabled Parameter: *Ks* See TS 36.213 [23, 5.1.1.1]. en0 corresponds to value 0 corresponding to state "disabled". en1 corresponds to value 1.25 corresponding to "enabled".
deltaPreambleMsg3 Parameter: $\Delta_{PREAMBLE\_Msg3}$ *see* TS 36.213 [23, 5.1.1.1]. Actual value = IE value * 2 [dB].
deltaTxD-OffsetPUCCH-FormatX Parameter: $\Delta_{TxD}(F')$ for the PUCCH formats 1, 1a/1b, 1b with channel selection, 2/2a/2b and 3 when two antenna ports are configured for PUCCH transmission. See TS 36.213 [23, 5.1.2.1] where dB0 corresponds to 0 dB, dB-1 corresponds to -1 dB, dB-2 corresponds to -2 dB. EUTRAN configures the field *deltaTxD-OffsetPUCCH-Format1bCS-r11* for the PCell and/or the PSCell only.
filterCoefficient Specifies the filtering coefficient for RSRP measurements used to calculate path loss, as specified in TS 36.213 [23, 5.1.1.1]. The same filtering mechanism applies as for *quantityConfig* described in 5.5.3.2.
p0-NominalPUCCH Parameter: $P_{\text{O\_NOMINAL\_PUCCH}}$ See TS 36.213 [23, 5.1.2.1], unit dBm.
p0-NominalPUSCH Parameter: $P_{\text{O\_NOMINAL\_PUSCH}}(1)$ See TS 36.213 [23, 5.1.1.1], unit dBm. This field is applicable for non-persistent scheduling only. This field applies for uplink power control subframe set 1 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
p0-NominalPUSCH-SubframeSet2 Parameter: $P_{\text{O\_NOMINAL\_PUSCH}}(1)$. See TS 36.213 [23, 5.1.1.1], unit dBm. This field is applicable for non-persistent scheduling only. This field applies for uplink power control subframe set 2 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
p0-UE-PUCCH Parameter: $P_{\text{O\_UE\_PUCCH}}$ See TS 36.213 [23, 5.1.2.1]. Unit dB
p0-UE-PUSCH Parameter: $P_{\text{O\_UE\_PUSCH}}(1)$ See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for non-persistent scheduling, only. This field applies for uplink power control subframe set 1 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
p0-UE-PUSCH-SubframeSet2 Parameter: $P_{\text{O\_UE\_PUSCH}}(1)$ See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for non-persistent scheduling, only. This field applies for uplink power control subframe set 2 if uplink power control subframe sets are configured by *tpc-SubframeSet*.
pathlossReferenceLinking Indicates whether the UE shall apply as pathloss reference either the downlink of the PCell or of the SCell that corresponds with this uplink (i.e. according to the *cellIdentification* within the field *sCellToAddMod*). For SCells part of an STAG E-UTRAN sets the value to sCell.
pSRS-Offset, pSRS-OffsetAp Parameter: P_{SRS_OFFSET} for periodic and aperiodic sounding reference signal transmission repectively. See TS 36.213 [23, 5.1.3.1]. For Ks=1.25, the actual parameter value is pSRS-Offset value – 3. For Ks=0, the actual parameter value is -10.5 + 1.5*pSRS-Offset value. If *pSRS-Offset-v1130* is included, the UE ignores *pSRS-Offset* (i.e., without suffix). Likewise, if *pSRS-OffsetAp-v1130* is included, the UE ignores *pSRS-OffsetAp-r10*. For Ks=0, E-UTRAN does not set values larger than 26.

UplinkPowerControl field descriptions
tpc-SubframeSet Indicates the uplink subframes (including UpPTS in special subframes) of the uplink power control subframe sets. Value 0 means the subframe belongs to uplink power control subframe set 1, and value 1 means the subframe belongs to uplink power control subframe set 2.

6.3.3 Security control information elements

– *NextHopChainingCount*

The IE *NextHopChainingCount* is used to update the K_{eNB} key and corresponds to parameter NCC: See TS 33.401 [32, 7.2.8.4].

***NextHopChainingCount* information element**

```
-- ASN1START

NextHopChainingCount ::=                    INTEGER (0..7)

-- ASN1STOP
```

– *SecurityAlgorithmConfig*

The IE *SecurityAlgorithmConfig* is used to configure AS integrity protection algorithm (SRBs) and AS ciphering algorithm (SRBs and DRBs). For RNs, the IE *SecurityAlgorithmConfig* is also used to configure AS integrity protection algorithm for DRBs between the RN and the E-UTRAN.

***SecurityAlgorithmConfig* information element**

```
-- ASN1START

SecurityAlgorithmConfig ::=         SEQUENCE {
    cipheringAlgorithm                  CipheringAlgorithm-r12,
    integrityProtAlgorithm              ENUMERATED {
                                            eia0-v920, eia1, eia2, eia3-v1130, spare4, spare3,
                                            spare2, spare1, ...}
}

CipheringAlgorithm-r12 ::=              ENUMERATED {
                                            eea0, eea1, eea2, eea3-v1130, spare4, spare3,
                                            spare2, spare1, ...}

-- ASN1STOP
```

SecurityAlgorithmConfig field descriptions
cipheringAlgorithm Indicates the ciphering algorithm to be used for SRBs and DRBs, as specified in TS 33.401 [32, 5.1.3.2].
integrityProtAlgorithm Indicates the integrity protection algorithm to be used for SRBs, as specified in TS 33.401 [32, 5.1.4.2]. For RNs, also indicates the integrity protection algorithm to be used for integrity protection-enabled DRB(s).

– *ShortMAC-I*

The IE *ShortMAC-I* is used to identify and verify the UE at RRC connection re-establishment. The 16 least significant bits of the MAC-I calculated using the security configuration of the source PCell, as specified in 5.3.7.4.

***ShortMAC-I* information element**

```
-- ASN1START

ShortMAC-I ::=                      BIT STRING (SIZE (16))

-- ASN1STOP
```

6.3.4 Mobility control information elements

– *AdditionalSpectrumEmission*

***AdditionalSpectrumEmission* information element**

```
-- ASN1START

AdditionalSpectrumEmission ::=      INTEGER (1..32)

-- ASN1STOP
```

– *ARFCN-ValueCDMA2000*

The IE *ARFCN-ValueCDMA2000* used to indicate the CDMA2000 carrier frequency within a CDMA2000 band, see C.S0002 [12].

***ARFCN-ValueCDMA2000* information element**

```
-- ASN1START

ARFCN-ValueCDMA2000 ::=         INTEGER (0..2047)

-- ASN1STOP
```

– *ARFCN-ValueEUTRA*

The IE *ARFCN-ValueEUTRA* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) E-UTRA carrier frequency, as defined in TS 36.101 [42]. If an extension is signalled using the extended value range (as defined by IE *ARFCN-ValueEUTRA-v9e0*), the UE shall only consider this extension (and hence ignore the corresponding original field, using the value range as defined by IE *ARFCN-ValueEUTRA* i.e. without suffix, if signalled). In dedicated signalling, E-UTRAN only provides an EARFCN corresponding to an E-UTRA band supported by the UE.

***ARFCN-ValueEUTRA* information element**

```
-- ASN1START

ARFCN-ValueEUTRA ::=                INTEGER (0..maxEARFCN)

ARFCN-ValueEUTRA-v9e0 ::=           INTEGER (maxEARFCN-Plus1..maxEARFCN2)

ARFCN-ValueEUTRA-r9 ::=             INTEGER (0..maxEARFCN2)

-- ASN1STOP
```

NOTE: For fields using the original value range, as defined by IE *ARFCN-ValueEUTRA* i.e. without suffix, value *maxEARFCN* indicates that the E-UTRA carrier frequency is indicated by means of an extension. In such a case, UEs not supporting the extension consider the field to be set to a not supported value.

– *ARFCN-ValueGERAN*

The IE *ARFCN-ValueGERAN* is used to specify the ARFCN value applicable for a GERAN BCCH carrier frequency, see TS 45.005 [20].

***ARFCN-ValueGERAN* information element**

```
-- ASN1START
```

```
ARFCN-ValueGERAN ::=            INTEGER (0..1023)

-- ASN1STOP
```

– *ARFCN-ValueUTRA*

The IE *ARFCN-ValueUTRA* is used to indicate the ARFCN applicable for a downlink (Nd, FDD) or bi-directional (Nt, TDD) UTRA carrier frequency, as defined in TS 25.331 [19].

ARFCN-ValueUTRA information element

```
-- ASN1START

ARFCN-ValueUTRA ::=                 INTEGER (0..16383)

-- ASN1STOP
```

– *BandclassCDMA2000*

The IE *BandclassCDMA2000* is used to define the CDMA2000 band in which the CDMA2000 carrier frequency can be found, as defined in C.S0057 [24, table 1.5-1].

BandclassCDMA2000 information element

```
-- ASN1START

BandclassCDMA2000 ::=                   ENUMERATED {
                                            bc0, bc1, bc2, bc3, bc4, bc5, bc6, bc7, bc8,
                                            bc9, bc10, bc11, bc12, bc13, bc14, bc15, bc16,
                                            bc17, bc18-v9a0, bc19-v9a0, bc20-v9a0, bc21-v9a0,
                                            spare10, spare9, spare8, spare7, spare6, spare5, spare4,
                                            spare3, spare2, spare1, ...}

-- ASN1STOP
```

– *BandIndicatorGERAN*

The IE *BandIndicatorGERAN* indicates how to interpret an associated GERAN carrier ARFCN, see TS 45.005 [20]. More specifically, the IE indicates the GERAN frequency band in case the ARFCN value can concern either a DCS 1800 or a PCS 1900 carrier frequency. For ARFCN values not associated with one of these bands, the indicator has no meaning.

BandIndicatorGERAN information element

```
-- ASN1START

BandIndicatorGERAN ::=          ENUMERATED {dcs1800, pcs1900}

-- ASN1STOP
```

– *CarrierFreqCDMA2000*

The IE *CarrierFreqCDMA2000* used to provide the CDMA2000 carrier information.

CarrierFreqCDMA2000 information element

```
-- ASN1START

CarrierFreqCDMA2000 ::=         SEQUENCE {
    bandClass                           BandclassCDMA2000,
    arfcn                           ARFCN-ValueCDMA2000
}
```

```
-- ASN1STOP
```

– CarrierFreqGERAN

The IE *CarrierFreqGERAN* is used to provide an unambiguous carrier frequency description of a GERAN cell.

CarrierFreqGERAN information element

```
-- ASN1START

CarrierFreqGERAN ::=            SEQUENCE {
    arfcn                           ARFCN-ValueGERAN,
    bandIndicator                   BandIndicatorGERAN
}

-- ASN1STOP
```

CarrierFreqGERAN field descriptions
arfcn GERAN ARFCN of BCCH carrier.
bandIndicator Indicates how to interpret the ARFCN of the BCCH carrier.

– CarrierFreqsGERAN

The IE *CarrierFreqListGERAN* is used to provide one or more GERAN ARFCN values, as defined in TS 44.005 [43], which represents a list of GERAN BCCH carrier frequencies.

CarrierFreqsGERAN information element

```
-- ASN1START

CarrierFreqsGERAN ::=           SEQUENCE {
    startingARFCN                       ARFCN-ValueGERAN,
    bandIndicator                       BandIndicatorGERAN,
    followingARFCNs                     CHOICE {
        explicitListOfARFCNs                ExplicitListOfARFCNs,
        equallySpacedARFCNs                 SEQUENCE {
            arfcn-Spacing                       INTEGER (1..8),
            numberOfFollowingARFCNs             INTEGER (0..31)
        },
        variableBitMapOfARFCNs              OCTET STRING (SIZE (1..16))
    }
}

ExplicitListOfARFCNs ::=            SEQUENCE (SIZE (0..31)) OF ARFCN-ValueGERAN

-- ASN1STOP
```

***CarrierFreqsGERAN* field descriptions**
arfcn-Spacing Space, d, between a set of equally spaced ARFCN values.
bandIndicator Indicates how to interpret the ARFCN of the BCCH carrier.
explicitListOfARFCNs The remaining ARFCN values in the set are explicitly listed one by one.
followingARFCNs Field containing a representation of the remaining ARFCN values in the set.
numberOfFollowingARFCNs The number, n, of the remaining equally spaced ARFCN values in the set. The complete set of (n+1) ARFCN values is defined as: {s, ((s + d) mod 1024), ((s + 2*d) mod 1024) ... ((s + n*d) mod 1024)}.
startingARFCN The first ARFCN value, s, in the set.
variableBitMapOfARFCNs Bitmap field representing the remaining ARFCN values in the set. The leading bit of the first octet in the bitmap corresponds to the ARFCN = ((s + 1) mod 1024), the next bit to the ARFCN = ((s + 2) mod 1024), and so on. If the bitmap consist of N octets, the trailing bit of octet N corresponds to ARFCN = ((s + 8*N) mod 1024). The complete set of ARFCN values consists of ARFCN = s and the ARFCN values, where the corresponding bit in the bitmap is set to "1".

– *CarrierFreqListMBMS*

The IE *CarrierFreqListMBMS* is used to indicate the E-UTRA ARFCN values of the one or more MBMS frequencies the UE is interested to receive.

CarrierFreqListMBMS information element

```
-- ASN1START

CarrierFreqListMBMS-r11 ::=     SEQUENCE (SIZE (1..maxFreqMBMS-r11)) OF ARFCN-ValueEUTRA-r9

-- ASN1STOP
```

– *CDMA2000-Type*

The IE *CDMA2000-Type* is used to describe the type of CDMA2000 network.

CDMA2000-Type information element

```
-- ASN1START

CDMA2000-Type ::=                   ENUMERATED {type1XRTT, typeHRPD}

-- ASN1STOP
```

– *CellIdentity*

The IE *CellIdentity* is used to unambiguously identify a cell within a PLMN.

CellIdentity information element

```
-- ASN1START

CellIdentity ::=                    BIT STRING (SIZE (28))

-- ASN1STOP
```

– *CellIndexList*

The IE *CellIndexList* concerns a list of cell indices, which may be used for different purposes.

***CellIndexList* information element**

```
-- ASN1START

CellIndexList ::=                       SEQUENCE (SIZE (1..maxCellMeas)) OF CellIndex

CellIndex ::=                           INTEGER (1..maxCellMeas)

-- ASN1STOP
```

– *CellReselectionPriority*

The IE *CellReselectionPriority* concerns the absolute priority of the concerned carrier frequency/ set of frequencies (GERAN)/ bandclass (CDMA2000), as used by the cell reselection procedure. Corresponds with parameter "priority" in TS 36.304 [4]. Value 0 means: lowest priority. The UE behaviour for the case the field is absent, if applicable, is specified in TS 36.304 [4].

***CellReselectionPriority* information element**

```
-- ASN1START

CellReselectionPriority ::=             INTEGER (0..7)

-- ASN1STOP
```

– *CSFB-RegistrationParam1XRTT*

The IE *CSFB-RegistrationParam1XRTT* is used to indicate whether or not the UE shall perform a CDMA2000 1xRTT pre-registration if the UE does not have a valid / current pre-registration.

```
-- ASN1START

CSFB-RegistrationParam1XRTT ::=     SEQUENCE {
    sid                                 BIT STRING (SIZE (15)),
    nid                                 BIT STRING (SIZE (16)),
    multipleSID                         BOOLEAN,
    multipleNID                         BOOLEAN,
    homeReg                             BOOLEAN,
    foreignSIDReg                       BOOLEAN,
    foreignNIDReg                       BOOLEAN,
    parameterReg                        BOOLEAN,
    powerUpReg                          BOOLEAN,
    registrationPeriod                  BIT STRING (SIZE (7)),
    registrationZone                    BIT STRING (SIZE (12)),
    totalZone                           BIT STRING (SIZE (3)),
    zoneTimer                           BIT STRING (SIZE (3))
}

CSFB-RegistrationParam1XRTT-v920 ::=    SEQUENCE {
    powerDownReg-r9                     ENUMERATED {true}
}

-- ASN1STOP
```

CSFB-RegistrationParam1XRTT field descriptions
foreignNIDReg The CDMA2000 1xRTT NID roamer registration indicator.
foreignSIDReg The CDMA2000 1xRTT SID roamer registration indicator.
homeReg The CDMA2000 1xRTT Home registration indicator.
multipleNID The CDMA2000 1xRTT Multiple NID storage indicator.
multipleSID The CDMA2000 1xRTT Multiple SID storage indicator.
nid Used along with the *sid* as a pair to control when the UE should Register or Re-Register with the CDMA2000 1xRTT network.
parameterReg The CDMA2000 1xRTT Parameter-change registration indicator.
powerDownReg The CDMA2000 1xRTT Power-down registration indicator. If set to TRUE, the UE that has a valid / current CDMA2000 1xRTT pre-registration will perform a CDMA2000 1xRTT power down registration when it is switched off.
powerUpReg The CDMA2000 1xRTT Power-up registration indicator.
registrationPeriod The CDMA2000 1xRTT Registration period.
registrationZone The CDMA2000 1xRTT Registration zone.
sid Used along with the *nid* as a pair to control when the UE should Register or Re-Register with the CDMA2000 1xRTT network.
totalZone The CDMA2000 1xRTT Number of registration zones to be retained.
zoneTimer The CDMA2000 1xRTT Zone timer length.

– *CellGlobalIdEUTRA*

The IE *CellGlobalIdEUTRA* specifies the Evolved Cell Global Identifier (ECGI), the globally unique identity of a cell in E-UTRA.

CellGlobalIdEUTRA information element

```
-- ASN1START

CellGlobalIdEUTRA ::=                   SEQUENCE {
    plmn-Identity                           PLMN-Identity,
    cellIdentity                            CellIdentity
}

-- ASN1STOP
```

CellGlobalIdEUTRA field descriptions
cellIdentity Identity of the cell within the context of the PLMN.
plmn-Identity Identifies the PLMN of the cell as given by the first PLMN entry in the *plmn-IdentityList* in *SystemInformationBlockType1*.

– *CellGlobalIdUTRA*

The IE *CellGlobalIdUTRA* specifies the global UTRAN Cell Identifier, the globally unique identity of a cell in UTRA.

CellGlobalIdUTRA information element

```
-- ASN1START
```

```
CellGlobalIdUTRA ::=                    SEQUENCE {
    plmn-Identity                           PLMN-Identity,
    cellIdentity                            BIT STRING (SIZE (28))
}

-- ASN1STOP
```

CellGlobalIdUTRA field descriptions
cellIdentity
UTRA Cell Identifier which is unique within the context of the identified PLMN as defined in TS 25.331 [19].
plmn-Identity
Identifies the PLMN of the cell as given by the common PLMN broadcast in the MIB, as defined in TS 25.331 [19].

– *CellGlobalIdGERAN*

The IE *CellGlobalIdGERAN* specifies the Cell Global Identification (CGI), the globally unique identity of a cell in GERAN.

CellGlobalIdGERAN information element

```
-- ASN1START

CellGlobalIdGERAN ::=                   SEQUENCE {
    plmn-Identity                           PLMN-Identity,
    locationAreaCode                        BIT STRING (SIZE (16)),
    cellIdentity                        BIT STRING (SIZE (16))
}

-- ASN1STOP
```

CellGlobalIdGERAN field descriptions
cellIdentity
Cell Identifier which is unique within the context of the GERAN location area as defined in TS 23.003 [27].
locationAreaCode
A fixed length code identifying the location area within a PLMN as defined in TS 23.003 [27].
plmn-Identity
Identifies the PLMN of the cell, as defined in TS 23.003 [27]..

– *CellGlobalIdCDMA2000*

The IE *CellGlobalIdCDMA2000* specifies the Cell Global Identification (CGI), the globally unique identity of a cell in CDMA2000.

CellGlobalIdCDMA2000 information element

```
-- ASN1START

CellGlobalIdCDMA2000 ::=                CHOICE {
    cellGlobalId1XRTT                       BIT STRING (SIZE (47)),
    cellGlobalIdHRPD                        BIT STRING (SIZE (128))
}

-- ASN1STOP
```

CellGlobalIdCDMA2000 field descriptions
cellGlobalId1XRTT
Unique identifier for a CDMA2000 1xRTT cell, corresponds to BASEID, SID and NID parameters (in that order) defined in C.S0005 [25].
cellGlobalIdHRPD
Unique identifier for a CDMA2000 HRPD cell, corresponds to SECTOR ID parameter defined in C.S0024 [26, 14.9].

– *CSG-Identity*

The IE *CSG-Identity* is used to identify a Closed Subscriber Group.

CSG-Identity information element

```
-- ASN1START

CSG-Identity ::=                    BIT STRING (SIZE (27))

-- ASN1STOP
```

– *FreqBandIndicator*

The IE *FreqBandIndicator* indicates the E-UTRA operating band as defined in TS 36.101 [42, table 5.5-1]. If an extension is signalled using the extended value range (as defined by IE *FreqBandIndicator-v9e0*), the UE shall only consider this extension (and hence ignore the corresponding original field, using the value range as defined by IE *FreqBandIndicator* i.e. without suffix, if signalled).

FreqBandIndicator information element

```
-- ASN1START

FreqBandIndicator ::=                   INTEGER (1..maxFBI)

FreqBandIndicator-v9e0 ::=              INTEGER (maxFBI-Plus1..maxFBI2)

FreqBandIndicator-r11 ::=               INTEGER (1..maxFBI2)

-- ASN1STOP
```

NOTE: For fields using the original value range, as defined by IE *FreqBandIndicator* i.e. without suffix, value *maxFBI* indicates that the frequency band is indicated by means of an extension. In such a case, UEs not supporting the extension consider the field to be set to a not supported value.

– *MobilityControlInfo*

The IE *MobilityControlInfo* includes parameters relevant for network controlled mobility to/within E-UTRA.

MobilityControlInfo information element

```
-- ASN1START

MobilityControlInfo ::=     SEQUENCE {
    targetPhysCellId                    PhysCellId,
    carrierFreq                         CarrierFreqEUTRA                    OPTIONAL,   -- Cond HO-
toEUTRA2
    carrierBandwidth                    CarrierBandwidthEUTRA               OPTIONAL,   -- Cond HO-
toEUTRA
    additionalSpectrumEmission          AdditionalSpectrumEmission          OPTIONAL,   -- Cond HO-
toEUTRA
    t304                                ENUMERATED {
                                            ms50, ms100, ms150, ms200, ms500, ms1000,
                                            ms2000, spare1},
    newUE-Identity                      C-RNTI,
    radioResourceConfigCommon           RadioResourceConfigCommon,
    rach-ConfigDedicated                RACH-ConfigDedicated                OPTIONAL,   -- Need OP
    ...,
    [[  carrierFreq-v9e0                CarrierFreqEUTRA-v9e0               OPTIONAL    -- Need ON
    ]],
    [[  drb-ContinueROHC-r11            ENUMERATED {true}                   OPTIONAL    -- Cond HO
    ]]
}

MobilityControlInfoSCG-r12 ::=      SEQUENCE {
    t307-r12                            ENUMERATED {
                                            ms50, ms100, ms150, ms200, ms500, ms1000,
```

```
                                        ms2000, spare1},
    ue-IdentitySCG-r12                  C-RNTI                          OPTIONAL,   -- Cond SCGEst,
    rach-ConfigDedicated-r12            RACH-ConfigDedicated            OPTIONAL,   -- Need OP
    cipheringAlgorithmSCG-r12       CipheringAlgorithm-r12      OPTIONAL,   -- Need ON
    ...
}

CarrierBandwidthEUTRA ::=           SEQUENCE {
    dl-Bandwidth                        ENUMERATED {
                                                n6, n15, n25, n50, n75, n100, spare10,
                                                spare9, spare8, spare7, spare6, spare5,
                                                spare4, spare3, spare2, spare1},
    ul-Bandwidth                        ENUMERATED {
                                                n6, n15, n25, n50, n75, n100, spare10,
                                                spare9, spare8, spare7, spare6, spare5,
                                                spare4, spare3, spare2, spare1} OPTIONAL -- Need OP
}

CarrierFreqEUTRA ::=                SEQUENCE {
    dl-CarrierFreq                      ARFCN-ValueEUTRA,
    ul-CarrierFreq                      ARFCN-ValueEUTRA                OPTIONAL    -- Cond FDD
}

CarrierFreqEUTRA-v9e0 ::=           SEQUENCE {
    dl-CarrierFreq-v9e0                 ARFCN-ValueEUTRA-r9,
    ul-CarrierFreq-v9e0                 ARFCN-ValueEUTRA-r9         OPTIONAL    -- Cond FDD
}

-- ASN1STOP
```

***MobilityControlInfo* field descriptions**
additionalSpectrumEmission For a UE with no SCells configured for UL in the same band as the PCell, the UE shall apply the value for the PCell instead of the corresponding value from *SystemInformationBlockType2* or *SystemInformationBlockType1*. For a UE with SCell(s) configured for UL in the same band as the PCell, the UE shall, in case all SCells configured for UL in that band are released after handover completion, apply the value for the PCell instead of the corresponding value from *SystemInformationBlockType2* or *SystemInformationBlockType1*. The UE requirements related to IE *AdditionalSpectrumEmission* are defined in TS 36.101 [42, table 6.2.4.1]**.**
carrierBandwidth Provides the parameters *Downlink bandwidth*, and *Uplink bandwidth*, see TS 36.101 [42].
carrierFreq Provides the EARFCN to be used by the UE in the target cell.
cipheringAlgorithmSCG Indicates the ciphering algorithm to be used for SCG DRBs. E-UTRAN includes the field upon SCG change when one or more SCG DRBs are configured. Otherwise E-UTRAN does not include the field.
dl-Bandwidth Parameter: *Downlink bandwidth*, see TS 36.101 [42].
drb-ContinueROHC This field indicates whether to continue or reset, for this handover, the header compression protocol context for the RLC UM bearers configured with the header compression protocol. Presence of the field indicates that the header compression protocol context continues while absence indicates that the header compression protocol context is reset. E-UTRAN includes the field only in case of a handover within the same eNB.
rach-ConfigDedicated The dedicated random access parameters. If absent the UE applies contention based random access as specified in TS 36.321 [6].
t304 Timer T304 as described in section 7.3. ms50 corresponds with 50 ms, ms100 corresponds with 100 ms and so on.
t307 Timer T307 as described in section 7.3. ms50 corresponds with 50 ms, ms100 corresponds with 100 ms and so on.
ul-Bandwidth Parameter: *Uplink bandwidth*, see TS 36.101 [42, table 5.6-1]. For TDD, the parameter is absent and it is equal to downlink bandwidth. If absent for FDD, apply the same value as applies for the downlink bandwidth.

Conditional presence	Explanation
FDD	The field is mandatory with default value (the default duplex distance defined for the concerned band, as specified in TS 36.101 [42]) in case of "FDD"; otherwise the field is not present.
HO	This field is optionally present, need OP, in case of handover within E-UTRA when the *fullConfig* is not included; otherwise the field is not present.
HO-toEUTRA	The field is mandatory present in case of inter-RAT handover to E-UTRA; otherwise the field is optionally present, need ON.
HO-toEUTRA2	The field is absent if *carrierFreq-v9e0* is present. Otherwise it is mandatory present in case of inter-RAT handover to E-UTRA and optionally present, need ON, in all other cases.
SCGEst	This field is mandatory present in case of SCG establishment; otherwise the field is optionally present, need ON.

– *MobilityParametersCDMA2000 (1xRTT)*

The *MobilityParametersCDMA2000* contains the parameters provided to the UE for handover and (enhanced) CSFB to 1xRTT support, as defined in C.S0097 [53].

MobilityParametersCDMA2000 information element

```
-- ASN1START

MobilityParametersCDMA2000 ::=          OCTET STRING

-- ASN1STOP
```

– *MobilityStateParameters*

The IE *MobilityStateParameters* contains parameters to determine UE mobility state.

MobilityStateParameters information element

```
-- ASN1START

MobilityStateParameters ::=         SEQUENCE {
    t-Evaluation                        ENUMERATED {
                                            s30, s60, s120, s180, s240, spare3, spare2, spare1},
    t-HystNormal                        ENUMERATED {
                                            s30, s60, s120, s180, s240, spare3, spare2, spare1},
    n-CellChangeMedium                  INTEGER (1..16),
    n-CellChangeHigh                    INTEGER (1..16)
}

-- ASN1STOP
```

MobilityStateParameters field descriptions
n-CellChangeHigh The number of cell changes to enter high mobility state. Corresponds to N_{CR_H} in TS 36.304 [4].
n-CellChangeMedium The number of cell changes to enter medium mobility state. Corresponds to N_{CR_M} in TS 36.304 [4].
t-Evaluation The duration for evaluating criteria to enter mobility states. Corresponds to T_{CRmax} in TS 36.304 [4]. Value in seconds, s30 corresponds to 30 s and so on.
t-HystNormal The additional duration for evaluating criteria to enter normal mobility state. Corresponds to $T_{CRmaxHyst}$ in TS 36.304 [4]. Value in seconds, s30 corresponds to 30 s and so on.

– *MultiBandInfoList*

MultiBandInfoList information element

```
-- ASN1START
```

```
MultiBandInfoList ::=   SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicator

MultiBandInfoList-v9e0 ::=  SEQUENCE (SIZE (1..maxMultiBands)) OF MultiBandInfo-v9e0

MultiBandInfoList-v10j0 ::= SEQUENCE (SIZE (1..maxMultiBands)) OF NS-PmaxList-r10

MultiBandInfoList-r11 ::=   SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicator-r11

MultiBandInfo-v9e0 ::=      SEQUENCE {
    freqBandIndicator-v9e0              FreqBandIndicator-v9e0      OPTIONAL    -- Need OP
}

-- ASN1STOP
```

– NS-PmaxList

The IE *NS-PmaxList* concerns a list of *additionalPmax* and *additionalSpectrumEmission* as defined in TS 36.101 [42, table 6.2.4-1] for a given frequency band. E-UTRAN does not include the same value of *additionalSpectrumEmission* in *SystemInformationType2* within this list.

NS-PmaxList information element

```
-- ASN1START

NS-PmaxList-r10 ::=             SEQUENCE (SIZE (1..maxNS-Pmax-r10)) OF NS-PmaxValue-r10

NS-PmaxValue-r10 ::=            SEQUENCE {
    additionalPmax-r10                  P-Max                           OPTIONAL,   -- Need OP
    additionalSpectrumEmission          AdditionalSpectrumEmission
}

-- ASN1STOP
```

– PhysCellId

The IE *PhysCellId* is used to indicate the physical layer identity of the cell, as defined in TS 36.211 [21].

PhysCellId information element

```
-- ASN1START

PhysCellId ::=                      INTEGER (0..503)

-- ASN1STOP
```

– PhysCellIdRange

The IE *PhysCellIdRange* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *PhysCellIdRange*, E-UTRAN may configure overlapping ranges of physical cell identities.

PhysCellIdRange information element

```
-- ASN1START

PhysCellIdRange ::=             SEQUENCE {
    start                           PhysCellId,
    range                           ENUMERATED {
                                        n4, n8, n12, n16, n24, n32, n48, n64, n84,
                                        n96, n128, n168, n252, n504, spare2,
                                        spare1}                     OPTIONAL    -- Need OP
}

-- ASN1STOP
```

***PhysCellIdRange* field descriptions**
range Indicates the number of physical cell identities in the range (including *start*). Value n4 corresponds with 4, n8 corresponds with 8 and so on. The UE shall apply value 1 in case the field is absent, in which case only the physical cell identity value indicated by *start* applies.
start Indicates the lowest physical cell identity in the range.

– *PhysCellIdRangeUTRA-FDDList*

The IE *PhysCellIdRangeUTRA-FDDList* is used to encode one or more of *PhysCellIdRangeUTRA-FDD*. While the IE *PhysCellIdRangeUTRA-FDD* is used to encode either a single physical layer identity or a range of physical layer identities, i.e. primary scrambling codes. Each range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range.

PhysCellIdRangeUTRA-FDDList information element

```
-- ASN1START

PhysCellIdRangeUTRA-FDDList-r9::=       SEQUENCE (SIZE (1..maxPhysCellIdRange-r9)) OF
PhysCellIdRangeUTRA-FDD-r9

PhysCellIdRangeUTRA-FDD-r9 ::=          SEQUENCE {
        start-r9                            PhysCellIdUTRA-FDD,
        range-r9                            INTEGER (2..512)                OPTIONAL    -- Need OP
}

-- ASN1STOP
```

***PhysCellIdRangeUTRA-FDDList* field descriptions**
range Indicates the number of primary scrambling codes in the range (including *start*). The UE shall apply value 1 in case the field is absent, in which case only the primary scrambling code value indicated by *start* applies.
start Indicates the lowest primary scrambling code in the range.

– *PhysCellIdCDMA2000*

The IE *PhysCellIdCDMA2000* identifies the PNOffset that represents the "Physical cell identity" in CDMA2000.

PhysCellIdCDMA2000 information element

```
-- ASN1START

PhysCellIdCDMA2000 ::=          INTEGER (0..maxPNOffset)

-- ASN1STOP
```

– *PhysCellIdGERAN*

The IE *PhysCellIdGERAN* contains the Base Station Identity Code (BSIC).

PhysCellIdGERAN information element

```
-- ASN1START

PhysCellIdGERAN ::=             SEQUENCE {
    networkColourCode                   BIT STRING (SIZE (3)),
    baseStationColourCode               BIT STRING (SIZE (3))
}

-- ASN1STOP
```

PhysCellIdGERAN field descriptions
baseStationColourCode Base station Colour Code as defined in TS 23.003 [27].
networkColourCode Network Colour Code as defined in TS 23.003 [27].

– *PhysCellIdUTRA-FDD*

The IE *PhysCellIdUTRA-FDD* is used to indicate the physical layer identity of the cell, i.e. the primary scrambling code, as defined in TS 25.331 [19].

***PhysCellIdUTRA-FDD* information element**

```
-- ASN1START

PhysCellIdUTRA-FDD ::=              INTEGER (0..511)

-- ASN1STOP
```

– *PhysCellIdUTRA-TDD*

The IE *PhysCellIdUTRA-TDD* is used to indicate the physical layer identity of the cell, i.e. the cell parameters ID (TDD), as specified in TS 25.331 [19]. Also corresponds to the Initial Cell Parameter Assignment in TS 25.223 [46].

***PhysCellIdUTRA-TDD* information element**

```
-- ASN1START

PhysCellIdUTRA-TDD ::=              INTEGER (0..127)

-- ASN1STOP
```

– *PLMN-Identity*

The IE *PLMN-Identity* identifies a Public Land Mobile Network. Further information regarding how to set the IE are specified in TS 23.003 [27].

***PLMN-Identity* information element**

```
-- ASN1START

PLMN-Identity ::=                   SEQUENCE {
    mcc                                 MCC                 OPTIONAL,                   -- Cond MCC
    mnc                                 MNC
}

MCC ::=                             SEQUENCE (SIZE (3)) OF
                                            MCC-MNC-Digit

MNC ::=                             SEQUENCE (SIZE (2..3)) OF
                                            MCC-MNC-Digit

MCC-MNC-Digit ::=                   INTEGER (0..9)


-- ASN1STOP
```

***PLMN-Identity* field descriptions**
mcc The first element contains the first MCC digit, the second element the second MCC digit and so on. If the field is absent, it takes the same value as the mcc of the immediately preceding IE PLMN-Identity. See TS 23.003 [27].
mnc The first element contains the first MNC digit, the second element the second MNC digit and so on. See TS 23.003 [27].

Conditional presence	Explanation
MCC	This IE is mandatory when *PLMN-Identity* is included in *CellGlobalIdEUTRA*, in *CellGlobalIdUTRA,* in *CellGlobalIdGERAN* or in *RegisteredMME*. This IE is also mandatory in the first occurrence of the IE *PLMN-Identity* within the IE *PLMN-IdentityList*. Otherwise it is optional, need OP.

– *PLMN-IdentityList3*

Includes a list of PLMN identities.

***PLMN-IdentityList3* information element**

```
-- ASN1START

PLMN-IdentityList3-r11 ::=              SEQUENCE (SIZE (1..16)) OF PLMN-Identity

-- ASN1STOP
```

– *PreRegistrationInfoHRPD*

```
-- ASN1START

PreRegistrationInfoHRPD ::=         SEQUENCE {
    preRegistrationAllowed              BOOLEAN,
    preRegistrationZoneId               PreRegistrationZoneIdHRPD   OPTIONAL, -- cond PreRegAllowed
    secondaryPreRegistrationZoneIdList  SecondaryPreRegistrationZoneIdListHRPD  OPTIONAL -- Need OR
}

SecondaryPreRegistrationZoneIdListHRPD ::=  SEQUENCE (SIZE (1..2)) OF PreRegistrationZoneIdHRPD

PreRegistrationZoneIdHRPD ::=           INTEGER (0..255)

-- ASN1STOP
```

***PreRegistrationInfoHRPD* field descriptions**
preRegistrationAllowed TRUE indicates that a UE shall perform a CDMA2000 HRPD pre-registration if the UE does not have a valid / current pre-registration. FALSE indicates that the UE is not allowed to perform CDMA2000 HRPD pre-registration in the current cell.
preRegistrationZoneID ColorCode (see C.S0024 [26], C.S0087 [44]) of the CDMA2000 Reference Cell corresponding to the HRPD sector under the HRPD AN that is configured for this LTE cell. It is used to control when the UE should register or re-register.
secondaryPreRegistrationZoneIdList List of SecondaryColorCodes (see C.S0024 [26], C.S0087 [44]) of the CDMA2000 Reference Cell corresponding to the HRPD sector under the HRPD AN that is configured for this LTE cell. They are used to control when the UE should re-register.

Conditional presence	Explanation
PreRegAllowed	*The field is mandatory in case the preRegistrationAllowed is set to true. Otherwise the field is not present and the UE shall delete any existing value for this field.*

– *Q-QualMin*

The IE *Q-QualMin* is used to indicate for cell selection/ re-selection the required minimum received RSRQ level in the (E-UTRA) cell. Corresponds to parameter $Q_{qualmin}$ in 36.304 [4]. Actual value $Q_{qualmin}$ = IE value [dB].

Q-QualMin information element

```
-- ASN1START

Q-QualMin-r9 ::=                    INTEGER (-34..-3)

-- ASN1STOP
```

– *Q-RxLevMin*

The IE *Q-RxLevMin* is used to indicate for cell selection/ re-selection the required minimum received RSRP level in the (E-UTRA) cell. Corresponds to parameter $Q_{rxlevmin}$ in 36.304 [4]. Actual value $Q_{rxlevmin}$ = IE value * 2 [dBm].

Q-RxLevMin information element

```
-- ASN1START

Q-RxLevMin ::=                      INTEGER (-70..-22)

-- ASN1STOP
```

– *Q-OffsetRange*

The IE *Q-OffsetRange* is used to indicate a cell, CSI-RS resource or frequency specific offset to be applied when evaluating candidates for cell re-selection or when evaluating triggering conditions for measurement reporting. The value in dB. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.

Q- OffsetRange information element

```
-- ASN1START

Q-OffsetRange ::=                       ENUMERATED {
                                                dB-24, dB-22, dB-20, dB-18, dB-16, dB-14,
                                                dB-12, dB-10, dB-8, dB-6, dB-5, dB-4, dB-3,
                                                dB-2, dB-1, dB0, dB1, dB2, dB3, dB4, dB5,
                                                dB6, dB8, dB10, dB12, dB14, dB16, dB18,
                                                dB20, dB22, dB24}

-- ASN1STOP
```

– *Q-OffsetRangeInterRAT*

The IE *Q-OffsetRangeInterRAT* is used to indicate a frequency specific offset to be applied when evaluating triggering conditions for measurement reporting. The value in dB.

Q-OffsetRangeInterRAT information element

```
-- ASN1START

Q-OffsetRangeInterRAT ::=                   INTEGER (-15..15)

-- ASN1STOP
```

– *ReselectionThreshold*

The IE *ReselectionThreshold* is used to indicate an Rx level threshold for cell reselection. Actual value of threshold = IE value * 2 [dB].

***ReselectionThreshold* information element**

```
-- ASN1START

ReselectionThreshold ::=                INTEGER (0..31)

-- ASN1STOP
```

– *ReselectionThresholdQ*

The IE *ReselectionThresholdQ* is used to indicate a quality level threshold for cell reselection. Actual value of threshold = IE value [dB].

***ReselectionThresholdQ* information element**

```
-- ASN1START

ReselectionThresholdQ-r9 ::=            INTEGER (0..31)

-- ASN1STOP
```

– *SCellIndex*

The IE *SCellIndex* concerns a short identity, used to identify an SCell.

***SCellIndex* information element**

```
-- ASN1START

SCellIndex-r10 ::=                      INTEGER (1..7)

-- ASN1STOP
```

– *ServCellIndex*

The IE *ServCellIndex* concerns a short identity, used to identify a serving cell (i.e. the PCell or an SCell). Value 0 applies for the PCell, while the *SCellIndex* that has previously been assigned applies for SCells.

***ServCellIndex* information element**

```
-- ASN1START

ServCellIndex-r10 ::=                   INTEGER (0..7)

-- ASN1STOP
```

– *SpeedStateScaleFactors*

The IE *SpeedStateScaleFactors* concerns factors, to be applied when the UE is in medium or high speed state, used for scaling a mobility control related parameter.

***SpeedStateScaleFactors* information element**

```
-- ASN1START

SpeedStateScaleFactors ::=          SEQUENCE {
    sf-Medium                           ENUMERATED {oDot25, oDot5, oDot75, lDot0},
    sf-High                             ENUMERATED {oDot25, oDot5, oDot75, lDot0}
}
-- ASN1STOP
```

***SpeedStateScaleFactors* field descriptions**
sf-High
The concerned mobility control related parameter is multiplied with this factor if the UE is in High Mobility state as defined in TS 36.304 [4]. Value oDot25 corresponds to 0.25, oDot5 corresponds to 0.5 , oDot75 corresponds to 0.75 and so on.
sf-Medium
The concerned mobility control related parameter is multiplied with this factor if the UE is in Medium Mobility state as defined in TS 36.304 [4]. Value oDot25 corresponds to 0.25, oDot5 corresponds to 0.5 , oDot75 corresponds to 0.75 and so on.

– *SystemInfoListGERAN*

The IE *SystemInfoListGERAN* contains system information of a GERAN cell.

SystemInfoListGERAN information element

```
-- ASN1START

SystemInfoListGERAN ::=             SEQUENCE (SIZE (1..maxGERAN-SI)) OF
                                        OCTET STRING (SIZE (1..23))

-- ASN1STOP
```

***SystemInfoListGERAN* field descriptions**
SystemInfoListGERAN
Each OCTET STRING contains one System Information (SI) message as defined in TS 44.018 [45, table 9.1.1] excluding the L2 Pseudo Length, the RR management Protocol Discriminator and the Skip Indicator or a complete Packet System Information (PSI) message as defined in TS 44.060 [36, table 11.2.1].

– *SystemTimeInfoCDMA2000*

The IE *SystemTimeInfoCDMA2000* informs the UE about the absolute time in the current cell. The UE uses this absolute time knowledge to derive the CDMA2000 Physical cell identity, expressed as PNOffset, of neighbour CDMA2000 cells.

NOTE: The UE needs the CDMA2000 system time with a certain level of accuracy for performing measurements as well as for communicating with the CDMA2000 network (HRPD or 1xRTT).

SystemTimeInfoCDMA2000 information element

```
-- ASN1START

SystemTimeInfoCDMA2000 ::=          SEQUENCE {
    cdma-EUTRA-Synchronisation          BOOLEAN,
    cdma-SystemTime                     CHOICE {
        synchronousSystemTime               BIT STRING (SIZE (39)),
        asynchronousSystemTime              BIT STRING (SIZE (49))
    }
}

-- ASN1STOP
```

SystemTimeInfoCDMA2000 field descriptions
asynchronousSystemTime The CDMA2000 system time corresponding to the SFN boundary at or after the ending boundary of the SI-Window in which *SystemInformationBlockType8* is transmitted. E-UTRAN includes this field if the E-UTRA frame boundary is not aligned to the start of CDMA2000 system time. This field size is 49 bits and the unit is 8 CDMA chips based on 1.2288 Mcps.
cdma-EUTRA-Synchronisation TRUE indicates that there is no drift in the timing between E-UTRA and CDMA2000. FALSE indicates that the timing between E-UTRA and CDMA2000 can drift. NOTE 1
synchronousSystemTime CDMA2000 system time corresponding to the SFN boundary at or after the ending boundary of the SI-window in which *SystemInformationBlockType8* is transmitted. E-UTRAN includes this field if the E-UTRA frame boundary is aligned to the start of CDMA2000 system time. This field size is 39 bits and the unit is 10 ms based on a 1.2288 Mcps chip rate.

NOTE 1: The following table shows the recommended combinations of the *cdma-EUTRA-Synchronisation* field and the choice of cdma-SystemTime included by E-UTRAN for FDD and TDD:

FDD/TDD	*cdma-EUTRA-Synchronisation*	*synchronousSystemTime*	*asynchronousSystemTime*
FDD	FALSE	Not Recommended	Recommended
FDD	TRUE	Recommended	Recommended
TDD	FALSE	Not Recommended	Recommended
TDD	TRUE	Recommended	Recommended

– *TrackingAreaCode*

The IE *TrackingAreaCode* is used to identify a tracking area within the scope of a PLMN, see TS 24.301 [35].

TrackingAreaCode information element

```
-- ASN1START

TrackingAreaCode ::=                BIT STRING (SIZE (16))

-- ASN1STOP
```

– *T-Reselection*

The IE *T-Reselection* concerns the cell reselection timer $Treselection_{RAT}$ for E-UTRA, UTRA, GERAN or CDMA2000. Value in seconds.

T-Reselection information element

```
-- ASN1START

T-Reselection ::=                   INTEGER (0..7)

-- ASN1STOP
```

6.3.5 Measurement information elements

– *AllowedMeasBandwidth*

The IE *AllowedMeasBandwidth* is used to indicate the maximum allowed measurement bandwidth on a carrier frequency as defined by the parameter Transmission Bandwidth Configuration "N_{RB}" TS 36.104 [47]. The values mbw6, mbw15, mbw25, mbw50, mbw75, mbw100 indicate 6, 15, 25, 50, 75 and 100 resource blocks respectively.

***AllowedMeasBandwidth* information element**

```
-- ASN1START

AllowedMeasBandwidth ::=                ENUMERATED {mbw6, mbw15, mbw25, mbw50, mbw75, mbw100}

-- ASN1STOP
```

– *CSI-RSRP-Range*

The IE *CSI-RSRP-Range* specifies the value range used in CSI-RSRP measurements and thresholds. Integer value for CSI-RSRP measurements according to mapping table in TS 36.133 [16].

***CSI-RSRP-Range* information element**

```
-- ASN1START

CSI-RSRP-Range-r12 ::=                      INTEGER(0..97)

-- ASN1STOP
```

– *Hysteresis*

The IE *Hysteresis* is a parameter used within the entry and leave condition of an event triggered reporting condition. The actual value is IE value * 0.5 dB.

***Hysteresis* information element**

```
-- ASN1START

Hysteresis ::=                          INTEGER (0..30)

-- ASN1STOP
```

– *LocationInfo*

The IE *LocationInfo* is used to transfer detailed location information available at the UE to correlate measurements and UE position information.

***LocationInfo* information element**

```
-- ASN1START

LocationInfo-r10 ::=    SEQUENCE {
    locationCoordinates-r10                 CHOICE {
        ellipsoid-Point-r10                     OCTET STRING,
        ellipsoidPointWithAltitude-r10          OCTET STRING,
    ...,
        ellipsoidPointWithUncertaintyCircle-r11                 OCTET STRING,
        ellipsoidPointWithUncertaintyEllipse-r11                OCTET STRING,
        ellipsoidPointWithAltitudeAndUncertaintyEllipsoid-r11   OCTET STRING,
        ellipsoidArc-r11                                        OCTET STRING,
        polygon-r11                                             OCTET STRING
    },
    horizontalVelocity-r10                  OCTET STRING                OPTIONAL,
    gnss-TOD-msec-r10                       OCTET STRING                OPTIONAL,
    ...
}

-- ASN1STOP
```

LocationInfo field descriptions
ellipsoidArc Parameter *EllipsoidArc* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
ellipsoid-Point Parameter *Ellipsoid-Point* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
ellipsoidPointWithAltitude Parameter *EllipsoidPointWithAltitude* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
ellipsoidPointWithAltitudeAndUncertaintyEllipsoid Parameter *EllipsoidPointWithAltitudeAndUncertaintyEllipsoid* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
ellipsoidPointWithUncertaintyCircle Parameter *Ellipsoid-PointWithUncertaintyCircle* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
ellipsoidPointWithUncertaintyEllipse Parameter *EllipsoidPointWithUncertaintyEllipse* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
gnss-TOD-msec Parameter *Gnss-TOD-msec* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
horizontalVelocity Parameter *HorizontalVelocity* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.
polygon Parameter *Polygon* defined in TS36.355 [54]. The first/leftmost bit of the first octet contains the most significant bit.

– *MBSFN-RSRQ-Range*

The IE *MBSFN-RSRQ-Range* specifies the value range used in MBSFN RSRQ measurements. Integer value for MBSFN RSRQ measurements according to mapping table in TS 36.133 [16].

MBSFN-RSRQ-Range information element

```
-- ASN1START

MBSFN-RSRQ-Range-r12 ::=                INTEGER(0..31)
-- ASN1STOP
```

– *MeasConfig*

The IE *MeasConfig* specifies measurements to be performed by the UE, and covers intra-frequency, inter-frequency and inter-RAT mobility as well as configuration of measurement gaps.

MeasConfig information element

```
-- ASN1START

MeasConfig ::=                      SEQUENCE {
    -- Measurement objects
    measObjectToRemoveList              MeasObjectToRemoveList              OPTIONAL,   -- Need ON
    measObjectToAddModList              MeasObjectToAddModList              OPTIONAL,   -- Need ON
    -- Reporting configurations
    reportConfigToRemoveList            ReportConfigToRemoveList            OPTIONAL,   -- Need ON
    reportConfigToAddModList            ReportConfigToAddModList            OPTIONAL,   -- Need ON
    -- Measurement identities
    measIdToRemoveList                  MeasIdToRemoveList                  OPTIONAL,   -- Need ON
    measIdToAddModList                  MeasIdToAddModList                  OPTIONAL,   -- Need ON
    -- Other parameters
    quantityConfig                      QuantityConfig                      OPTIONAL,   -- Need ON
    measGapConfig                       MeasGapConfig                       OPTIONAL,   -- Need ON
    s-Measure                           RSRP-Range                          OPTIONAL,   -- Need ON
    preRegistrationInfoHRPD             PreRegistrationInfoHRPD             OPTIONAL,   -- Need OP
    speedStatePars          CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            mobilityStateParameters             MobilityStateParameters,
```

```
            timeToTrigger-SF                    SpeedStateScaleFactors
        }
    }                                                                       OPTIONAL,   -- Need ON
    ...,
    [[  measObjectToAddModList-v9e0         MeasObjectToAddModList-v9e0     OPTIONAL    -- Need ON
    ]],
    [[  allowInterruptions-r11              BOOLEAN                         OPTIONAL    -- Need ON
    ]],
    [[  measScaleFactor-r12         CHOICE {
            release                     NULL,
            setup                       MeasScaleFactor-r12
        }                                                           OPTIONAL,   -- Need ON
        measIdToRemoveListExt-r12           MeasIdToRemoveListExt-r12       OPTIONAL,   -- Need ON
        measIdToAddModListExt-r12           MeasIdToAddModListExt-r12       OPTIONAL,   -- Need ON
        measRSRQ-OnAllSymbols-r12       BOOLEAN                         OPTIONAL    -- Need ON
    ]]
}

MeasIdToRemoveList ::=              SEQUENCE (SIZE (1..maxMeasId)) OF MeasId

MeasIdToRemoveListExt-r12 ::=       SEQUENCE (SIZE (1..maxMeasId)) OF MeasId-v1250

MeasObjectToRemoveList ::=          SEQUENCE (SIZE (1..maxObjectId)) OF MeasObjectId

ReportConfigToRemoveList ::=        SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigId

-- ASN1STOP
```

***MeasConfig* field descriptions**
allowInterruptions Value TRUE indicates that the UE is allowed to cause interruptions to serving cells when performing measurements of deactivated SCell carriers for *measCycleSCell* of less than 640ms, as specified in TS 36.133 [16]. E-UTRAN enables this field only when an SCell is configured.
measGapConfig Used to setup and release measurement gaps.
measIdToRemoveList List of measurement identities to remove. Field *measIdToRemoveListExt* includes additional measurement identities i.e. extends the size of the measurement identity list using the general principles specified in 5.1.2.
measObjectToAddModList If E-UTRAN includes *measObjectToAddModList-v9e0* it includes the same number of entries, and listed in the same order, as in *measObjectToAddModList* (i.e. without suffix).
measObjectToRemoveList List of measurement objects to remove.
measRSRQ-OnAllSymbols Value *TRUE* indicates that the UE shall, when performing RSRQ measurements, perform RSRQ measurement on all OFDM symbols in accordance with TS 36.214 [48]. If *widebandRSRQ-Meas* is enabled for the frequency in *MeasObjectEUTRA,* the UE shall, when performing RSRQ measurements, perform RSRQ measurement on all OFDM symbols with wider bandwidth for concerned frequency in accordance with TS 36.214 [48].
measScaleFactor Even if *reducedMeasPerformance* is not included in any *measObjectEUTRA* or *measObjectUTRA*, E-UTRAN may configure this field. The UE behavior is specified in TS 36.133 [16].
PreRegistrationInfoHRPD The CDMA2000 HRPD Pre-Registration Information tells the UE if it should pre-register with the CDMA2000 HRPD network and identifies the Pre-registration zone to the UE.
reportConfigToRemoveList List of measurement reporting configurations to remove.
s-Measure PCell quality threshold controlling whether or not the UE is required to perform measurements of intra-frequency, inter-frequency and inter-RAT neighbouring cells. Value “0” indicates to disable *s-Measure*.
timeToTrigger-SF The *timeToTrigger* in *ReportConfigEUTRA* and in *ReportConfigInterRAT* are multiplied with the scaling factor applicable for the UE’s speed state.

– *MeasDS-Config*

The IE *MeasDS-Config* specifies information applicable for discovery signals measurement.

MeasDS-Config information elements

```
-- ASN1START

MeasDS-Config-r12 ::=           CHOICE {
    release                         NULL,
    setup                           SEQUENCE {
        dmtc-PeriodOffset-r12           CHOICE {
            ms40-r12                        INTEGER(0..39),
            ms80-r12                        INTEGER(0..79),
            ms160-r12                       INTEGER(0..159),
            ...
        },
        ds-OccasionDuration-r12     CHOICE {
            durationFDD-r12                 INTEGER(1..maxDS-Duration-r12),
            durationTDD-r12                 INTEGER(2..maxDS-Duration-r12)
        },
        measCSI-RS-ToRemoveList-r12 MeasCSI-RS-ToRemoveList-r12 OPTIONAL,   -- Need ON
        measCSI-RS-ToAddModList-r12 MeasCSI-RS-ToAddModList-r12 OPTIONAL,   -- Need ON
        ...
    }
}

MeasCSI-RS-ToRemoveList-r12 ::= SEQUENCE (SIZE (1..maxCSI-RS-Meas-r12)) OF MeasCSI-RS-Id-r12

MeasCSI-RS-ToAddModList-r12 ::= SEQUENCE (SIZE (1..maxCSI-RS-Meas-r12)) OF MeasCSI-RS-Config-r12

MeasCSI-RS-Id-r12 ::=           INTEGER (1..maxCSI-RS-Meas-r12)

MeasCSI-RS-Config-r12 ::=       SEQUENCE {
    measCSI-RS-Id-r12               MeasCSI-RS-Id-r12,
    physCellId-r12                  INTEGER (0..503),
    scramblingIdentity-r12          INTEGER (0..503),
    resourceConfig-r12              INTEGER (0..31),
    subframeOffset-r12              INTEGER (0..4),
    csi-RS-IndividualOffset-r12     Q-OffsetRange,
    ...
}

-- ASN1STOP
```

***MeasDS-Config* field descriptions**
csi-RS-IndividualOffset CSI-RS individual offset applicable to a specific CSI-RS resource. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.
dmtc-PeriodOffset Indicates the discovery signals measurement timing configuration (DMTC) periodicity (*dmtc-Periodicity*) and offset (*dmtc-Offset*) for this frequency. For DMTC periodicity, value ms40 corresponds to 40ms, ms80 corresponds to 80ms and so on. The value of DMTC offset is in number of subframe(s). The duration of a DMTC occasion is 6ms.
ds-OccasionDuration Indicates the duration of discovery signal occasion for this frequency. Discovery signal occasion duration is common for all cells transmitting discovery signals on one frequency.
measCSI-RS-ToAddModList List of CSI-RS resources to add/ modify in the CSI-RS resource list for discovery signals measurement.
measCSI-RS-ToRemoveList List of CSI-RS resources to remove from the CSI-RS resource list for discovery signals measurement.
physCellId Indicates the physical cell identity where UE may assume that the CSI-RS and the PSS/SSS/CRS corresponding to the indicated physical cell identity are quasi co-located with respect to average delay and doppler shift.
resourceConfig Parameter: CSI reference signal configuration, see TS 36.211 [21, table 6.10.5.2-1 and 6.10.5.2-2].
scramblingIdentity Parameter: Pseudo-random sequence generator parameter, n_{ID}, see TS 36.213 [23, 7.2.5].
subframeOffset Indicates the subframe offset between SSS of the cell indicated by physCellId and the CSI-RS resource in a discovery signal occasion.

– *MeasGapConfig*

The IE *MeasGapConfig* specifies the measurement gap configuration and controls setup/ release of measurement gaps.

MeasGapConfig information element

```
-- ASN1START

MeasGapConfig ::=                   CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        gapOffset                           CHOICE {
                gp0                                 INTEGER (0..39),
                gp1                                 INTEGER (0..79),
                ...
        }
    }
}

-- ASN1STOP
```

***MeasGapConfig* field descriptions**
gapOffset   Value *gapOffset* of *gp0* corresponds to gap offset of Gap Pattern Id "0" with MGRP = 40ms, *gapOffset* of *gp1* corresponds to gap offset of Gap Pattern Id "1" with MGRP = 80ms. Also used to specify the measurement gap pattern to be applied, as defined in TS 36.133 [16].

– *MeasId*

The IE *MeasId* is used to identify a measurement configuration, i.e., linking of a measurement object and a reporting configuration.

MeasId information element

```
-- ASN1START

MeasId ::=                          INTEGER (1..maxMeasId)

MeasId-v1250 ::=                    INTEGER (maxMeasId-Plus1..maxMeasId-r12)

-- ASN1STOP
```

– *MeasIdToAddModList*

The IE *MeasIdToAddModList* concerns a list of measurement identities to add or modify, with for each entry the *measId*, the associated *measObjectId* and the associated *reportConfigId*. Field *measIdToAddModListExt* includes additional measurement identities i.e. extends the size of the measurement identity list using the general principles specified in 5.1.2.

MeasIdToAddModList information element

```
-- ASN1START

MeasIdToAddModList ::=              SEQUENCE (SIZE (1..maxMeasId)) OF MeasIdToAddMod

MeasIdToAddModListExt-r12 ::=       SEQUENCE (SIZE (1..maxMeasId)) OF MeasIdToAddModExt-r12

MeasIdToAddMod ::=  SEQUENCE {
    measId                              MeasId,
    measObjectId                        MeasObjectId,
    reportConfigId                      ReportConfigId
}

MeasIdToAddModExt-r12 ::=   SEQUENCE {
    measId-v1250                        MeasId-v1250,
    measObjectId-r12                    MeasObjectId,
    reportConfigId-r12                  ReportConfigId
```

```
}

-- ASN1STOP
```

– MeasObjectCDMA2000

The IE *MeasObjectCDMA2000* specifies information applicable for inter-RAT CDMA2000 neighbouring cells.

MeasObjectCDMA2000 information element

```
-- ASN1START

MeasObjectCDMA2000 ::=              SEQUENCE {
    cdma2000-Type                       CDMA2000-Type,
    carrierFreq                         CarrierFreqCDMA2000,
    searchWindowSize                    INTEGER (0..15)                     OPTIONAL,   -- Need ON
    offsetFreq                          Q-OffsetRangeInterRAT               DEFAULT 0,
    cellsToRemoveList                   CellIndexList                       OPTIONAL,   -- Need ON
    cellsToAddModList                   CellsToAddModListCDMA2000           OPTIONAL,   -- Need ON
    cellForWhichToReportCGI             PhysCellIdCDMA2000                  OPTIONAL,   -- Need ON
    ...
}

CellsToAddModListCDMA2000 ::=       SEQUENCE (SIZE (1..maxCellMeas)) OF CellsToAddModCDMA2000

CellsToAddModCDMA2000 ::=   SEQUENCE {
    cellIndex                           INTEGER (1..maxCellMeas),
    physCellId                          PhysCellIdCDMA2000
}

-- ASN1STOP
```

***MeasObjectCDMA2000* field descriptions**
carrierInfo Identifies CDMA2000 carrier frequency for which this configuration is valid.
cdma2000-Type The type of CDMA2000 network: CDMA2000 1xRTT or CDMA2000 HRPD.
cellIndex Entry index in the neighbouring cell list.
cellsToAddModList List of cells to add/ modify in the neighbouring cell list.
cellsToRemoveList List of cells to remove from the neighbouring cell list.
physCellId CDMA2000 Physical cell identity of a cell in neighbouring cell list expressed as PNOffset.
searchWindowSize Provides the search window size to be used by the UE for the neighbouring pilot, see C.S0005 [25].

– MeasObjectEUTRA

The IE *MeasObjectEUTRA* specifies information applicable for intra-frequency or inter-frequency E-UTRA cells.

MeasObjectEUTRA information element

```
-- ASN1START

MeasObjectEUTRA ::=                 SEQUENCE {
    carrierFreq                         ARFCN-ValueEUTRA,
    allowedMeasBandwidth                AllowedMeasBandwidth,
    presenceAntennaPort1                PresenceAntennaPort1,
    neighCellConfig                     NeighCellConfig,
    offsetFreq                          Q-OffsetRange               DEFAULT dB0,
    -- Cell list
    cellsToRemoveList                   CellIndexList               OPTIONAL,       -- Need ON
    cellsToAddModList                   CellsToAddModList           OPTIONAL,       -- Need ON
    -- Black list
    blackCellsToRemoveList              CellIndexList               OPTIONAL,       -- Need ON
    blackCellsToAddModList              BlackCellsToAddModList      OPTIONAL,       -- Need ON
```

```
    cellForWhichToReportCGI             PhysCellId                  OPTIONAL,       -- Need ON
    ...,
    [[measCycleSCell-r10                MeasCycleSCell-r10      OPTIONAL,       -- Need ON
        measSubframePatternConfigNeigh-r10  MeasSubframePatternConfigNeigh-r10  OPTIONAL
                -- Need ON
    ]],
    [[widebandRSRQ-Meas-r11             BOOLEAN OPTIONAL        -- Cond WB-RSRQ
    ]],
    [[  altTTT-CellsToRemoveList-r12    CellIndexList               OPTIONAL,       -- Need ON
        altTTT-CellsToAddModList-r12    AltTTT-CellsToAddModList-r12    OPTIONAL,       -- Need ON
        t312-r12                        CHOICE {
            release                         NULL,
            setup                           ENUMERATED {ms0, ms50, ms100, ms200,
                                             ms300, ms400, ms500, ms1000}
        }                                                       OPTIONAL,       -- Need ON
        reducedMeasPerformance-r12      BOOLEAN                     OPTIONAL,       -- Need ON
        measDS-Config-r12               MeasDS-Config-r12           OPTIONAL        -- Need ON
    ]]
}

MeasObjectEUTRA-v9e0 ::=            SEQUENCE {
    carrierFreq-v9e0                    ARFCN-ValueEUTRA-v9e0
}

CellsToAddModList ::=               SEQUENCE (SIZE (1..maxCellMeas)) OF CellsToAddMod

CellsToAddMod ::=   SEQUENCE {
    cellIndex                           INTEGER (1..maxCellMeas),
    physCellId                          PhysCellId,
    cellIndividualOffset                Q-OffsetRange
}

BlackCellsToAddModList ::=          SEQUENCE (SIZE (1..maxCellMeas)) OF BlackCellsToAddMod

BlackCellsToAddMod ::=  SEQUENCE {
    cellIndex                           INTEGER (1..maxCellMeas),
    physCellIdRange                     PhysCellIdRange
}

MeasCycleSCell-r10 ::=              ENUMERATED {sf160, sf256, sf320, sf512,
                                                sf640, sf1024, sf1280, spare1}

MeasSubframePatternConfigNeigh-r10 ::=  CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        measSubframePatternNeigh-r10            MeasSubframePattern-r10,
        measSubframeCellList-r10                MeasSubframeCellList-r10    OPTIONAL    -- Cond
always
    }
}

MeasSubframeCellList-r10 ::=    SEQUENCE (SIZE (1..maxCellMeas)) OF PhysCellIdRange

AltTTT-CellsToAddModList-r12 ::=    SEQUENCE (SIZE (1..maxCellMeas)) OF AltTTT-CellsToAddMod-r12

AltTTT-CellsToAddMod-r12 ::=    SEQUENCE {
    cellIndex-r12                       INTEGER (1..maxCellMeas),
    physCellIdRange-r12                 PhysCellIdRange
}

-- ASN1STOP
```

MeasObjectEUTRA field descriptions
altTTT-CellsToAddModList List of cells to add/ modify in the cell list for which the alternative time to trigger specified by *alternativeTimeToTrigger* in *reportConfigEUTRA*, if configured, applies.
altTTT-CellsToRemoveList List of cells to remove from the list of cells for alternative time to trigger.
blackCellsToAddModList List of cells to add/ modify in the black list of cells.
blackCellsToRemoveList List of cells to remove from the black list of cells.
carrierFreq Identifies E-UTRA carrier frequency for which this configuration is valid. E-UTRAN does not configure more than one measurement object for the same physical frequency regardless of the E-ARFCN used to indicate this.
cellIndex Entry index in the cell list. An entry may concern a range of cells, in which case this value applies to the entire range.
cellIndividualOffset Cell individual offset applicable to a specific cell. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.
cellsToAddModList List of cells to add/ modify in the cell list.
cellsToRemoveList List of cells to remove from the cell list.
measCycleSCell The parameter is used only when an SCell is configured on the frequency indicated by the *measObject* and is in deactivated state, see TS 36.133 [16, 8.3.3]. E-UTRAN configures the parameter whenever an SCell is configured on the frequency indicated by the *measObject*, but the field may also be signalled when an SCell is not configured. Value *sf160* corresponds to 160 sub-frames, *sf256* corresponds to 256 sub-frames and so on.
measDS-Config Parameters applicable to discovery signals measurement on the carrier frequency indicated by *carrierFreq*.
measSubframeCellList List of cells for which *measSubframePatternNeigh* is applied.
measSubframePatternNeigh Time domain measurement resource restriction pattern applicable to neighbour cell RSRP and RSRQ measurements on the carrier frequency indicated by *carrierFreq*. For cells in *measSubframeCellList* the UE shall assume that the subframes indicated by *measSubframePatternNeigh* are non-MBSFN subframes, and have the same special subframe configuration as PCell.
offsetFreq Offset value applicable to the carrier frequency. Value dB-24 corresponds to -24 dB, dB-22 corresponds to -22 dB and so on.
physCellId Physical cell identity of a cell in the cell list.
physCellIdRange Physical cell identity or a range of physical cell identities.
reducedMeasPerformance If set to *TRUE*, the EUTRA carrier frequency is configured for reduced measurement performance, otherwise it is configured for normal measurement performance, see TS 36.133 [16].
t312 The value of timer T312. Value *ms0* represents 0 ms, *ms50* represents 50 ms and so on.
widebandRSRQ-Meas If this field is set to *TRUE*, the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [16].

Conditional presence	Explanation
always	The field is mandatory present.
WB-RSRQ	The field is optionally present, need ON, if the measurement bandwidth indicated by *allowedMeasBandwidth* is 50 resource blocks or larger; otherwise it is not present and the UE shall delete any existing value for this field, if configured.

– *MeasObjectGERAN*

The IE *MeasObjectGERAN* specifies information applicable for inter-RAT GERAN neighbouring frequencies.

MeasObjectGERAN information element

```
-- ASN1START

MeasObjectGERAN ::=                 SEQUENCE {
    carrierFreqs                        CarrierFreqsGERAN,
    offsetFreq                          Q-OffsetRangeInterRAT       DEFAULT 0,
    ncc-Permitted                       BIT STRING(SIZE (8))        DEFAULT '11111111'B,
    cellForWhichToReportCGI             PhysCellIdGERAN             OPTIONAL,   -- Need ON
    ...
}

-- ASN1STOP
```

MeasObjectGERAN field descriptions
ncc-Permitted Field encoded as a bit map, where bit N is set to "0" if a BCCH carrier with NCC = N-1 is not permitted for monitoring and set to "1" if a BCCH carrier with NCC = N-1 is permitted for monitoring; N = 1 to 8; bit 1 of the bitmap is the leading bit of the bit string.
carrierFreqs If E-UTRAN includes *cellForWhichToReportCGI*, it includes only one GERAN ARFCN value in *carrierFreqs*.

– *MeasObjectId*

The IE *MeasObjectId* used to identify a measurement object configuration.

MeasObjectId information element

```
-- ASN1START

MeasObjectId ::=                    INTEGER (1..maxObjectId)

-- ASN1STOP
```

– *MeasObjectToAddModList*

The IE *MeasObjectToAddModList* concerns a list of measurement objects to add or modify

MeasObjectToAddModList information element

```
-- ASN1START

MeasObjectToAddModList ::=          SEQUENCE (SIZE (1..maxObjectId)) OF MeasObjectToAddMod

MeasObjectToAddModList-v9e0 ::=     SEQUENCE (SIZE (1..maxObjectId)) OF MeasObjectToAddMod-v9e0

MeasObjectToAddMod ::=  SEQUENCE {
    measObjectId                        MeasObjectId,
    measObject                          CHOICE {
        measObjectEUTRA                     MeasObjectEUTRA,
        measObjectUTRA                      MeasObjectUTRA,
        measObjectGERAN                     MeasObjectGERAN,
        measObjectCDMA2000                  MeasObjectCDMA2000,
        ...
    }
}

MeasObjectToAddMod-v9e0 ::= SEQUENCE {
    measObjectEUTRA-v9e0                MeasObjectEUTRA-v9e0        OPTIONAL    -- Cond eutra
}

-- ASN1STOP
```

Conditional presence	Explanation
eutra	The field is optional present, need OR, if for the corresponding entry in *MeasObjectToAddModList* field *measObject* is set to *measObjectEUTRA* and its sub-field *carrierFreq* is set to *maxEARFCN*. Otherwise the field is not present and the UE shall delete any existing value for this field.

– *MeasObjectUTRA*

The IE *MeasObjectUTRA* specifies information applicable for inter-RAT UTRA neighbouring cells.

MeasObjectUTRA information element

```
-- ASN1START

MeasObjectUTRA ::=                  SEQUENCE {
    carrierFreq                         ARFCN-ValueUTRA,
    offsetFreq                          Q-OffsetRangeInterRAT       DEFAULT 0,
    cellsToRemoveList                   CellIndexList               OPTIONAL,           -- Need ON
    cellsToAddModList                   CHOICE {
        cellsToAddModListUTRA-FDD           CellsToAddModListUTRA-FDD,
        cellsToAddModListUTRA-TDD           CellsToAddModListUTRA-TDD
    }                                                               OPTIONAL,           -- Need ON
    cellForWhichToReportCGI             CHOICE {
        utra-FDD                            PhysCellIdUTRA-FDD,
        utra-TDD                            PhysCellIdUTRA-TDD
    }                                                               OPTIONAL,   -- Need ON
    ...,
    [[  csg-allowedReportingCells-v930          CSG-AllowedReportingCells-r9    OPTIONAL        --
Need ON
    ]],
    [[  reducedMeasPerformance-r12              BOOLEAN             OPTIONAL        -- Need ON
    ]]
}

CellsToAddModListUTRA-FDD ::=       SEQUENCE (SIZE (1..maxCellMeas)) OF CellsToAddModUTRA-FDD

CellsToAddModUTRA-FDD ::=   SEQUENCE {
    cellIndex                           INTEGER (1..maxCellMeas),
    physCellId                          PhysCellIdUTRA-FDD
}

CellsToAddModListUTRA-TDD ::=       SEQUENCE (SIZE (1..maxCellMeas)) OF CellsToAddModUTRA-TDD

CellsToAddModUTRA-TDD ::=   SEQUENCE {
    cellIndex                           INTEGER (1..maxCellMeas),
    physCellId                          PhysCellIdUTRA-TDD
}

CSG-AllowedReportingCells-r9 ::=        SEQUENCE {
    physCellIdRangeUTRA-FDDList-r9          PhysCellIdRangeUTRA-FDDList-r9  OPTIONAL    -- Need OR
}
-- ASN1STOP
```

MeasObjectUTRA field descriptions
carrierFreq Identifies UTRA carrier frequency for which this configuration is valid. E-UTRAN does not configure more than one measurement object for the same physical frequency regardless of the ARFCN used to indicate this.
cellIndex Entry index in the neighbouring cell list.
cellsToAddModListUTRA-FDD List of UTRA FDD cells to add/ modify in the neighbouring cell list.
cellsToAddModListUTRA-TDD List of UTRA TDD cells to add/modify in the neighbouring cell list.
cellsToRemoveList List of cells to remove from the neighbouring cell list.
csg-allowedReportingCells One or more ranges of physical cell identities for which UTRA-FDD reporting is allowed.
reducedMeasPerformance If set to *TRUE* the UTRA carrier frequency is configured for reduced measurement performance, otherwise it is configured for normal measurement performance, see TS 36.133 [16].

– *MeasResults*

The IE *MeasResults* covers measured results for intra-frequency, inter-frequency and inter- RAT mobility.

***MeasResults* information element**

```
-- ASN1START

MeasResults ::=                     SEQUENCE {
    measId                              MeasId,
    measResultPCell                 SEQUENCE {
        rsrpResult                          RSRP-Range,
        rsrqResult                          RSRQ-Range
    },
    measResultNeighCells                CHOICE {
        measResultListEUTRA                 MeasResultListEUTRA,
        measResultListUTRA                  MeasResultListUTRA,
        measResultListGERAN                 MeasResultListGERAN,
        measResultsCDMA2000                 MeasResultsCDMA2000,
        ...
    }                                                                   OPTIONAL,
    ...,
    [[  measResultForECID-r9                MeasResultForECID-r9        OPTIONAL
    ]],
    [[  locationInfo-r10                    LocationInfo-r10            OPTIONAL,
        measResultServFreqList-r10          MeasResultServFreqList-r10  OPTIONAL
    ]],
    [[  measId-v1250                        MeasId-v1250                OPTIONAL,
        measResultPCell-v1250               RSRQ-Range-v1250            OPTIONAL,
        measResultCSI-RS-List-r12           MeasResultCSI-RS-List-r12   OPTIONAL
    ]]
}

MeasResultListEUTRA ::=             SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultEUTRA

MeasResultEUTRA ::= SEQUENCE {
    physCellId                          PhysCellId,
    cgi-Info                            SEQUENCE {
        cellGlobalId                        CellGlobalIdEUTRA,
        trackingAreaCode                    TrackingAreaCode,
        plmn-IdentityList                   PLMN-IdentityList2          OPTIONAL
    }                                                           OPTIONAL,
    measResult                          SEQUENCE {
        rsrpResult                          RSRP-Range                  OPTIONAL,
        rsrqResult                          RSRQ-Range                  OPTIONAL,
        ...,
        [[  additionalSI-Info-r9                AdditionalSI-Info-r9            OPTIONAL
        ]],
        [[  primaryPLMN-Suitable-r12            ENUMERATED {true}           OPTIONAL,
            measResult-v1250                    RSRQ-Range-v1250            OPTIONAL
        ]]
    }
}
```

```
MeasResultServFreqList-r10 ::=  SEQUENCE (SIZE (1..maxServCell-r10)) OF MeasResultServFreq-r10

MeasResultServFreq-r10 ::=          SEQUENCE {
    servFreqId-r10                      ServCellIndex-r10,
    measResultSCell-r10                 SEQUENCE {
        rsrpResultSCell-r10                 RSRP-Range,
        rsrqResultSCell-r10                 RSRQ-Range
    }                                                           OPTIONAL,
    measResultBestNeighCell-r10         SEQUENCE {
        physCellId-r10                      PhysCellId,
        rsrpResultNCell-r10                 RSRP-Range,
        rsrqResultNCell-r10                 RSRQ-Range
    }                                                           OPTIONAL,
    ...,
    [[  measResultSCell-v1250               RSRQ-Range-v1250    OPTIONAL,
        measResultBestNeighCell-v1250       RSRQ-Range-v1250    OPTIONAL
    ]]
}

MeasResultCSI-RS-List-r12 ::=   SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultCSI-RS-r12

MeasResultCSI-RS-r12 ::=        SEQUENCE {
    measCSI-RS-Id-r12               MeasCSI-RS-Id-r12,
    csi-RSRP-Result-r12             CSI-RSRP-Range-r12,
    ...
}

MeasResultListUTRA ::=              SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultUTRA

MeasResultUTRA ::=  SEQUENCE {
    physCellId                          CHOICE {
        fdd                                 PhysCellIdUTRA-FDD,
        tdd                                 PhysCellIdUTRA-TDD
    },
    cgi-Info                            SEQUENCE {
        cellGlobalId                        CellGlobalIdUTRA,
        locationAreaCode                    BIT STRING (SIZE (16))          OPTIONAL,
        routingAreaCode                     BIT STRING (SIZE (8))           OPTIONAL,
        plmn-IdentityList                   PLMN-IdentityList2              OPTIONAL
    }                                                           OPTIONAL,
    measResult                          SEQUENCE {
        utra-RSCP                           INTEGER (-5..91)                OPTIONAL,
        utra-EcN0                           INTEGER (0..49)                 OPTIONAL,
        ...,
        [[  additionalSI-Info-r9                AdditionalSI-Info-r9                OPTIONAL
        ]],
        [[  primaryPLMN-Suitable-r12            ENUMERATED {true}           OPTIONAL
        ]]
    }
}

MeasResultListGERAN ::=             SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultGERAN

MeasResultGERAN ::= SEQUENCE {
    carrierFreq                         CarrierFreqGERAN,
    physCellId                          PhysCellIdGERAN,
    cgi-Info                            SEQUENCE {
        cellGlobalId                        CellGlobalIdGERAN,
        routingAreaCode                     BIT STRING (SIZE (8))           OPTIONAL
    }                                                           OPTIONAL,
    measResult                          SEQUENCE {
        rssi                                INTEGER (0..63),
        ...
    }
}

MeasResultsCDMA2000 ::=             SEQUENCE {
    preRegistrationStatusHRPD           BOOLEAN,
    measResultListCDMA2000              MeasResultListCDMA2000
}

MeasResultListCDMA2000 ::=          SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultCDMA2000

MeasResultCDMA2000 ::=  SEQUENCE {
    physCellId                          PhysCellIdCDMA2000,
    cgi-Info                            CellGlobalIdCDMA2000            OPTIONAL,
    measResult                          SEQUENCE {
        pilotPnPhase                        INTEGER (0..32767)          OPTIONAL,
```

```
        pilotStrength                       INTEGER (0..63),
        ...
    }
}

MeasResultForECID-r9 ::=        SEQUENCE {
    ue-RxTxTimeDiffResult-r9                INTEGER (0..4095),
    currentSFN-r9                           BIT STRING (SIZE (10))
}

PLMN-IdentityList2 ::=              SEQUENCE (SIZE (1..5)) OF PLMN-Identity

AdditionalSI-Info-r9 ::=            SEQUENCE {
    csg-MemberStatus-r9             ENUMERATED {member}             OPTIONAL,
    csg-Identity-r9                     CSG-Identity                        OPTIONAL
}

-- ASN1STOP
```

***MeasResults* field descriptions**
csg-MemberStatus Indicates whether or not the UE is a member of the CSG of the neighbour cell.
currentSFN Indicates the current system frame number when receiving the UE Rx-Tx time difference measurement results from lower layer.
locationAreaCode A fixed length code identifying the location area within a PLMN, as defined in TS 23.003 [27].
measId Identifies the measurement identity for which the reporting is being performed. If the *measId-v1250* is included, the *measId* (i.e. without a suffix) is ignored by eNB.
measResult Measured result of an E-UTRA cell; Measured result of a UTRA cell; Measured result of a GERAN cell or frequency; or Measured result of a CDMA2000 cell. Measured result of UE Rx–Tx time difference.
measResultCSI-RS-List Measured results of the CSI-RS resources in discovery signals measurement.
measResultListCDMA2000 List of measured results for the maximum number of reported best cells for a CDMA2000 measurement identity.
measResultListEUTRA List of measured results for the maximum number of reported best cells for an E-UTRA measurement identity.
measResultListGERAN List of measured results for the maximum number of reported best cells or frequencies for a GERAN measurement identity.
measResultListUTRA List of measured results for the maximum number of reported best cells for a UTRA measurement identity.
measResultPCell Measured result of the PCell.
measResultsCDMA2000 Contains the CDMA2000 HRPD pre-registration status and the list of CDMA2000 measurements.
MeasResultServFreqList Measured results of the serving frequencies: the measurement result of each SCell, if any, and of the best neighbouring cell on each serving frequency.
pilotPnPhase Indicates the arrival time of a CDMA2000 pilot, measured relative to the UE's time reference in units of PN chips, see C.S0005 [25]. This information is used in either SRVCC handover or enhanced 1xRTT CS fallback procedure to CDMA2000 1xRTT.
pilotStrength CDMA2000 Pilot Strength, the ratio of pilot power to total power in the signal bandwidth of a CDMA2000 Forward Channel. See C.S0005 [25] for CDMA2000 1xRTT and C.S0024 [26] for CDMA2000 HRPD.
plmn-IdentityList The list of PLMN Identity read from broadcast information when the multiple PLMN Identities are broadcast.
preRegistrationStatusHRPD Set to TRUE if the UE is currently pre-registered with CDMA2000 HRPD. Otherwise set to FALSE. This can be ignored by the eNB for CDMA2000 1xRTT.

***MeasResults* field descriptions**
routingAreaCode The RAC identity read from broadcast information, as defined in TS 23.003 [27].
rsrpResult Measured RSRP result of an E-UTRA cell. The rsrpResult is only reported if configured by the eNB.
rsrqResult Measured RSRQ result of an E-UTRA cell. The rsrqResult is only reported if configured by the eNB.
rssi GERAN Carrier RSSI. RXLEV is mapped to a value between 0 and 63, TS 45.008 [28]. When mapping the RXLEV value to the RSSI bit string, the first/leftmost bit of the bit string contains the most significant bit.
ue-RxTxTimeDiffResult UE Rx-Tx time difference measurement result of the PCell, provided by lower layers. According to UE Rx-Tx time difference report mapping in TS 36.133 [16].
utra-EcN0 According to CPICH_Ec/No in TS 25.133 [29] for FDD. Fourteen spare values. The field is not present for TDD.
utra-RSCP According to CPICH_RSCP in TS 25.133 [29] for FDD and P-CCPCH_RSCP in TS 25.123 [30] for TDD. Thirty-one spare values.

– *MeasScaleFactor*

The IE *MeasScaleFactor* specifies the factor for scaling the measurement performance requirements in TS 36.133 [16].

MeasScaleFactor information element

```
-- ASN1START

MeasScaleFactor-r12 ::=         ENUMERATED {sf-EUTRA-cf1, sf-EUTRA-cf2}

-- ASN1STOP
```

NOTE: If the *reducedMeasPerformance* is not included in any *measObjectEUTRA* or *measObjectUTRA* and the *measScaleFactor* is included in the *measConfig*, E-UTRAN can configure any of the values for the *measScaleFactor* as specified in TS 36.133 [16].

– *QuantityConfig*

The IE *QuantityConfig* specifies the measurement quantities and layer 3 filtering coefficients for E-UTRA and inter-RAT measurements.

QuantityConfig information element

```
-- ASN1START

QuantityConfig ::=                  SEQUENCE {
    quantityConfigEUTRA                 QuantityConfigEUTRA                 OPTIONAL,   -- Need ON
    quantityConfigUTRA                  QuantityConfigUTRA                  OPTIONAL,   -- Need ON
    quantityConfigGERAN                 QuantityConfigGERAN                 OPTIONAL,   -- Need ON
    quantityConfigCDMA2000              QuantityConfigCDMA2000              OPTIONAL,   -- Need ON
    ...,
    [[  quantityConfigUTRA-v1020        QuantityConfigUTRA-v1020            OPTIONAL    -- Need ON
    ]],
    [[  quantityConfigEUTRA-v1250       QuantityConfigEUTRA-v1250           OPTIONAL    -- Need ON
    ]]
}

QuantityConfigEUTRA ::=             SEQUENCE {
    filterCoefficientRSRP               FilterCoefficient                   DEFAULT fc4,
    filterCoefficientRSRQ               FilterCoefficient                   DEFAULT fc4
}

QuantityConfigEUTRA-v1250 ::=       SEQUENCE {
```

```
    filterCoefficientCSI-RSRP-r12       FilterCoefficient                   OPTIONAL        -- Need
OR
}

QuantityConfigUTRA ::=              SEQUENCE {
    measQuantityUTRA-FDD                ENUMERATED {cpich-RSCP, cpich-EcN0},
    measQuantityUTRA-TDD                ENUMERATED {pccpch-RSCP},
    filterCoefficient                   FilterCoefficient                   DEFAULT fc4
}

QuantityConfigUTRA-v1020 ::=        SEQUENCE {
    filterCoefficient2-FDD-r10          FilterCoefficient                   DEFAULT fc4
}

QuantityConfigGERAN ::=             SEQUENCE {
    measQuantityGERAN                   ENUMERATED {rssi},
    filterCoefficient                   FilterCoefficient                   DEFAULT fc2
}

QuantityConfigCDMA2000 ::=          SEQUENCE {
    measQuantityCDMA2000                ENUMERATED {pilotStrength, pilotPnPhaseAndPilotStrength}
}

-- ASN1STOP
```

***QuantityConfig* field descriptions**
filterCoefficient2-FDD Specifies the filtering coefficient used for the UTRAN FDD measurement quantity, which is not included in *measQuantityUTRA-FDD*, when *reportQuantityUTRA-FDD* is present in *ReportConfigInterRAT*.
filterCoefficientCSI-RSRP Specifies the filtering coefficient used for CSI-RSRP.
filterCoefficientRSRP Specifies the filtering coefficient used for RSRP.
filterCoefficientRSRQ Specifies the filtering coefficient used for RSRQ.
measQuantityCDMA2000 Measurement quantity used for CDMA2000 measurements. *pilotPnPhaseAndPilotStrength* is only applicable for *MeasObjectCDMA2000* of *cdma2000-Type = type1XRTT*.
measQuantityGERAN Measurement quantity used for GERAN measurements.
measQuantityUTRA Measurement quantity used for UTRA measurements.
quantityConfigCDMA2000 Specifies quantity configurations for CDMA2000 measurements.
quantityConfigEUTRA Specifies filter configurations for E-UTRA measurements.
quantityConfigGERAN Specifies quantity and filter configurations for GERAN measurements.
quantityConfigUTRA Specifies quantity and filter configurations for UTRA measurements. Field *quantityConfigUTRA-v1020* is applicable only when reportQuantityUTRA-FDD is configured.

– *ReportConfigEUTRA*

The IE *ReportConfigEUTRA* specifies criteria for triggering of an E-UTRA measurement reporting event. The E-UTRA measurement reporting events concerning CRS are labelled A*N* with *N* equal to 1, 2 and so on.

Event A1: Serving becomes better than absolute threshold;

Event A2: Serving becomes worse than absolute threshold;

Event A3: Neighbour becomes amount of offset better than PCell/ PSCell;

Event A4: Neighbour becomes better than absolute threshold;

Event A5: PCell/ PSCell becomes worse than absolute threshold1 AND Neighbour becomes better than another absolute threshold2.

Event A6: Neighbour becomes amount of offset better than SCell.

The E-UTRA measurement reporting events concerning CSI-RS are labelled C*N* with *N* equal to 1 and 2.

Event C1: CSI-RS resource becomes better than absolute threshold;

Event C2: CSI-RS resource becomes amount of offset better than reference CSI-RS resource.

ReportConfigEUTRA information element

```
-- ASN1START

ReportConfigEUTRA ::=               SEQUENCE {
    triggerType                         CHOICE {
        event                               SEQUENCE {
            eventId                             CHOICE {
                eventA1                             SEQUENCE {
                    a1-Threshold                        ThresholdEUTRA
                },
                eventA2                             SEQUENCE {
                    a2-Threshold                        ThresholdEUTRA
                },
                eventA3                             SEQUENCE {
                    a3-Offset                           INTEGER (-30..30),
                    reportOnLeave                       BOOLEAN
                },
                eventA4                             SEQUENCE {
                    a4-Threshold                        ThresholdEUTRA
                },
                eventA5                             SEQUENCE {
                    a5-Threshold1                       ThresholdEUTRA,
                    a5-Threshold2                       ThresholdEUTRA
                },
                ...,
                eventA6-r10                         SEQUENCE {
                    a6-Offset-r10                       INTEGER (-30..30),
                    a6-ReportOnLeave-r10                BOOLEAN
                },
                eventC1-r12                         SEQUENCE {
                    c1-Threshold-r12                    ThresholdEUTRA-v1250,
                    c1-ReportOnLeave-r12                BOOLEAN
                },
                eventC2-r12                         SEQUENCE {
                    c2-RefCSI-RS-r12                    MeasCSI-RS-Id-r12,
                    c2-Offset-r12                       INTEGER (-30..30),
                    c2-ReportOnLeave-r12                BOOLEAN
                }
            },
            hysteresis                          Hysteresis,
            timeToTrigger                       TimeToTrigger
        },
        periodical                              SEQUENCE {
            purpose                                 ENUMERATED {
                                                        reportStrongestCells, reportCGI}
        }
    },
    triggerQuantity                     ENUMERATED {rsrp, rsrq},
    reportQuantity                      ENUMERATED {sameAsTriggerQuantity, both},
    maxReportCells                      INTEGER (1..maxCellReport),
    reportInterval                      ReportInterval,
    reportAmount                        ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    ...,
    [[  si-RequestForHO-r9                  ENUMERATED {setup}      OPTIONAL,   -- Cond reportCGI
        ue-RxTxTimeDiffPeriodical-r9        ENUMERATED {setup}      OPTIONAL    -- Need OR
```

```
    ]],
    [[  includeLocationInfo-r10             ENUMERATED {true}       OPTIONAL,   -- Need OR
        reportAddNeighMeas-r10              ENUMERATED {setup}      OPTIONAL    -- Need OR
    ]],
    [[  alternativeTimeToTrigger-r12    CHOICE {
            release                             NULL,
            setup                               TimeToTrigger
        }                                                   OPTIONAL,   -- Need ON
        useT312-r12                         BOOLEAN         OPTIONAL,   -- Need ON
        usePSCell-r12                       BOOLEAN         OPTIONAL,   -- Need ON
        aN-Threshold1-v1250                 RSRQ-RangeConfig-r12        OPTIONAL,   -- Need ON
        a5-Threshold2-v1250                 RSRQ-RangeConfig-r12        OPTIONAL,   -- Need ON
        reportStrongestCSI-RSs-r12          BOOLEAN     OPTIONAL,   -- Need ON
        reportCRS-Meas-r12                  BOOLEAN     OPTIONAL,   -- Need ON
        triggerQuantityCSI-RS-r12           BOOLEAN         OPTIONAL    -- Need ON
    ]]
}

RSRQ-RangeConfig-r12 ::=            CHOICE {
    release                             NULL,
    setup                               RSRQ-Range-v1250
}

ThresholdEUTRA ::=                  CHOICE{
    threshold-RSRP                      RSRP-Range,
    threshold-RSRQ                      RSRQ-Range
}

ThresholdEUTRA-v1250 ::=            CSI-RSRP-Range-r12

-- ASN1STOP
```

ReportConfigEUTRA field descriptions
a3-Offset/ a6-Offset/ c2-Offset Offset value to be used in EUTRA measurement report triggering condition for event a3/ a6/ c2. The actual value is IE value * 0.5 dB.
alternativeTimeToTrigger Indicates the time to trigger applicable for cells specified in *altTTT-CellsToAddModList* of the associated measurement object, if configured
aN-ThresholdM/ cN-ThresholdM Threshold to be used in EUTRA measurement report triggering condition for event number aN/ cN. If multiple thresholds are defined for event number aN/ cN, the thresholds are differentiated by M.
c1-ReportOnLeave/ c2-ReportOnLeave Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a CSI-RS resource in *csi-RS-TriggeredList*, as specified in 5.5.4.1.
c2-RefCSI-RS Identity of the CSI-RS resource from the *measCSI-RS-ToAddModList* of the associated *measObject*, to be used as the reference CSI-RS resource in EUTRA measurement report triggering condition for event c2.
eventId Choice of E-UTRA event triggered reporting criteria. EUTRAN may set this field to *eventC1* or *eventC2* only if *measDS-Config* is configured in the associated *measObject* with one or more CSI-RS resources.
maxReportCells Max number of cells, excluding the serving cell, to include in the measurement report concerning CRS, and max number of CSI-RS resources to include in the measurement report concerning CSI-RS.
reportAmount Number of measurement reports applicable for *triggerType event* as well as for *triggerType periodical*. In case *purpose* is set to *reportCGI* only value 1 applies.
reportCRS-Meas Inidicates that UE shall include rsrp, rsrq together with csi-rsrp in the measurement report, if possible.
reportOnLeave/ a6-ReportOnLeave Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in *cellsTriggeredList*, as specified in 5.5.4.1.
reportQuantity The quantities to be included in the measurement report***.*** The value both means that both the rsrp and rsrq quantities are to be included in the measurement report. In case *triggerQuantityCSI-RS* is included, only value *sameAsTriggerQuantity* applies.
reportStrongestCSI-RSs Indicates that periodical CSI-RS measurement report is performed. EUTRAN configures value *TRUE* only if *measDS-Config* is configured in the associated *measObject* with one or more CSI-RS resources.
si-RequestForHO The field applies to the *reportCGI* functionality, and when the field is included, the UE is allowed to use autonomous gaps in acquiring system information from the neighbour cell, applies a different value for T321, and includes different fields in the measurement report.
ThresholdEUTRA For RSRP: RSRP based threshold for event evaluation. The actual value is IE value – 140 dBm. For RSRQ: RSRQ based threshold for event evaluation. The actual value is (IE value – 40)/2 dB. For CSI-RSRP: CSI-RSRP based threshold for event evaluation. The actual value is IE value – 140 dBm. EUTRAN configures the same threshold quantity for all the thresholds of an event.
timeToTrigger Time during which specific criteria for the event needs to be met in order to trigger a measurement report.
triggerQuantity The quantity used to evaluate the triggering condition for the event concerning CRS***.*** EUTRAN sets the value according to the quantity of the *ThresholdEUTRA* for this event. The values rsrp and rsrq correspond to Reference Signal Received Power (RSRP) and Reference Signal Received Quality (RSRQ), see TS 36.214 [48].
triggerQuantityCSI-RS The quantity used to evaluate the triggering condition for the event concerning CSI-RS***.*** The value *TRUE* corresponds to CSI Reference Signal Received Power (CSI-RSRP), see TS 36.214 [48]. E-UTRAN configures value *TRUE* if and only if the measurement reporting event concerns CSI-RS.
ue-RxTxTimeDiffPeriodical If this field is present, the UE shall perform UE Rx-Tx time difference measurement reporting and ignore the fields *triggerQuantity*, *reportQuantity* and *maxReportCells*. If the field is present, the only applicable values for the corresponding *triggerType* and *purpose* are periodical and reportStrongestCells respectively.
usePSCell If this field is set to *TRUE* the UE shall use the PSCell instead of the PCell. E-UTRAN configures value *TRUE* only *TRU* events A3 and A5, see 5.5.4.4 and 5.5.4.6.
useT312 If value *TRUE* is configured, the UE shall use the timer T312 with the value *t312* as specified in the corresponding *measObject*. If the corresponding *measObject* does not include the timer T312 then the timer T312 is considered as not configured. E-UTRAN configures value *TRUE* only if *triggerType* is set to *event*.

Conditional presence	Explanation
reportCGI	The field is optional, need OR, in case *purpose* is included and set to *reportCGI*; otherwise the field is not present and the UE shall delete any existing value for this field.

– *ReportConfigId*

The IE *ReportConfigId* is used to identify a measurement reporting configuration.

***ReportConfigId* information element**

```
-- ASN1START

ReportConfigId ::=                  INTEGER (1..maxReportConfigId)

-- ASN1STOP
```

– *ReportConfigInterRAT*

The IE *ReportConfigInterRAT* specifies criteria for triggering of an inter-RAT measurement reporting event. The inter-RAT measurement reporting events are labelled B*N* with *N* equal to 1, 2 and so on.

Event B1: Neighbour becomes better than absolute threshold;

Event B2: PCell becomes worse than absolute threshold1 AND Neighbour becomes better than another absolute threshold2.

The b1 and b2 event thresholds for CDMA2000 are the CDMA2000 pilot detection thresholds are expressed as an unsigned binary number equal to [-2 x 10 log 10 E_c/I_o] in units of 0.5dB, see C.S0005 [25] for details.

***ReportConfigInterRAT* information element**

```
-- ASN1START

ReportConfigInterRAT ::=            SEQUENCE {
    triggerType                         CHOICE {
        event                               SEQUENCE {
            eventId                             CHOICE {
                eventB1                             SEQUENCE {
                    b1-Threshold                        CHOICE {
                        b1-ThresholdUTRA                    ThresholdUTRA,
                        b1-ThresholdGERAN                   ThresholdGERAN,
                        b1-ThresholdCDMA2000                ThresholdCDMA2000
                    }
                },
                eventB2                             SEQUENCE {
                    b2-Threshold1                       ThresholdEUTRA,
                    b2-Threshold2                       CHOICE {
                        b2-Threshold2UTRA                   ThresholdUTRA,
                        b2-Threshold2GERAN                  ThresholdGERAN,
                        b2-Threshold2CDMA2000               ThresholdCDMA2000
                    }
                },
                ...
            },
            hysteresis                      Hysteresis,
            timeToTrigger                   TimeToTrigger
        },
        periodical                              SEQUENCE {
            purpose                             ENUMERATED {
                                                    reportStrongestCells,
                                                    reportStrongestCellsForSON,
                                                    reportCGI}
        }
    },
    maxReportCells                      INTEGER (1..maxCellReport),
    reportInterval                      ReportInterval,
    reportAmount                        ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
```

```
    ...,
    [[  si-RequestForHO-r9                  ENUMERATED {setup}      OPTIONAL    -- Cond reportCGI
    ]],
    [[  reportQuantityUTRA-FDD-r10          ENUMERATED {both}       OPTIONAL    -- Need OR
    ]],
    [[  includeLocationInfo-r11             BOOLEAN                 OPTIONAL    -- Need ON
    ]],
    [[  b2-Threshold1-v1250                 CHOICE {
            release                             NULL,
            setup                               RSRQ-Range-v1250
        }                                                           OPTIONAL    -- Need ON
    ]]
}

ThresholdUTRA ::=                   CHOICE{
    utra-RSCP                           INTEGER (-5..91),
    utra-EcN0                           INTEGER (0..49)
}

ThresholdGERAN ::=              INTEGER (0..63)

ThresholdCDMA2000 ::=           INTEGER (0..63)

-- ASN1STOP
```

***ReportConfigInterRAT* field descriptions**
bN-ThresholdM Threshold to be used in inter RAT measurement report triggering condition for event number bN. If multiple thresholds are defined for event number bN, the thresholds are differentiated by M.
eventId Choice of inter-RAT event triggered reporting criteria.
maxReportCells Max number of cells, excluding the serving cell, to include in the measurement report. In case *purpose* is set to *reportStrongestCellsForSON* only value 1 applies.
Purpose reportStrongestCellsForSON applies only in case *reportConfig* is linked to a *measObject* set to *measObjectUTRA* or *measObjectCDMA2000*.
reportAmount Number of measurement reports applicable for *triggerType event* as well as for *triggerType periodical*. In case *purpose* is set to *reportCGI* or reportStrongestCellsForSON only value 1 applies.
reportQuantityUTRA-FDD The quantities to be included in the UTRA measurement report**.** The value *both* means that both the cpich RSCP and cpich EcN0 quantities are to be included in the measurement report.
si-RequestForHO The field applies to the *reportCGI* functionality, and when the field is included, the UE is allowed to use autonomous gaps in acquiring system information from the neighbour cell, applies a different value for T321, and includes different fields in the measurement report.
ThresholdGERAN The actual value is IE value – 110 dBm.
ThresholdUTRA *utra-RSCP* corresponds to CPICH_RSCP in TS 25.133 [29] for FDD and P-CCPCH_RSCP in TS 25.123 [30] for TDD. *utra-EcN0* corresponds to CPICH_Ec/No in TS 25.133 [29] for FDD, and is not applicable for TDD. For *utra-RSCP*: The actual value is IE value – 115 dBm. For *utra-EcN0*: The actual value is (IE value – 49)/2 dB.
timeToTrigger Time during which specific criteria for the event needs to be met in order to trigger a measurement report.

Conditional presence	Explanation
reportCGI	The field is optional, need OR, in case *purpose* is included and set to *reportCGI*; otherwise the field is not present and the UE shall delete any existing value for this field.

– *ReportConfigToAddModList*

The IE *ReportConfigToAddModList* concerns a list of reporting configurations to add or modify

***ReportConfigToAddModList* information element**

```
-- ASN1START

ReportConfigToAddModList ::=        SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod

ReportConfigToAddMod ::=    SEQUENCE {
    reportConfigId                      ReportConfigId,
    reportConfig                        CHOICE {
        reportConfigEUTRA                   ReportConfigEUTRA,
        reportConfigInterRAT                ReportConfigInterRAT
    }
}


-- ASN1STOP
```

– *ReportInterval*

The *ReportInterval* indicates the interval between periodical reports. The *ReportInterval* is applicable if the UE performs periodical reporting (i.e. when *reportAmount* exceeds 1), for *triggerType event* as well as for *triggerType periodical*. Value ms120 corresponds with 120 ms, ms240 corresponds with 240 ms and so on, while value min1 corresponds with 1 min, min6 corresponds with 6 min and so on.

***ReportInterval* information element**

```
-- ASN1START

ReportInterval ::=                  ENUMERATED {
                                        ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240,
                                        min1, min6, min12, min30, min60, spare3, spare2, spare1}

-- ASN1STOP
```

– *RSRP-Range*

The IE *RSRP-Range* specifies the value range used in RSRP measurements and thresholds. Integer value for RSRP measurements according to mapping table in TS 36.133 [16].

***RSRP-Range* information element**

```
-- ASN1START

RSRP-Range ::=                      INTEGER(0..97)

RSRP-RangeSL-r12 ::=                INTEGER(0..13)

RSRP-RangeSL2-r12 ::=               INTEGER(0..7)

RSRP-RangeSL3-r12 ::=               INTEGER(0..11)

-- ASN1STOP
```

***RSRP-Range* field descriptions**
RSRP-RangeSL Value 0 corresponds to -infinity, value 1 to -115dBm, value 2 to -110dBm, and so on (i.e. in steps of 5dBm) until value 12, which corresponds to -60dBm, while value 13 corresponds to +infinity.
RSRP-RangeSL2 Value 0 corresponds to -infinity, value 1 to -110dBm, value 2 to -100dBm, and so on (i.e. in steps of 10dBm) until value 6, which corresponds to -60dBm, while value 7 corresponds to +infinity.
RSRP-RangeSL3 Value 0 corresponds to -110dBm, value 1 to -105dBm, value 2 to -100dBm, and so on (i.e. in steps of 5dBm) until value 10, which corresponds to -60dBm, while value 11 corresponds to +infinity.

– *RSRQ-Range*

The IE *RSRQ-Range* specifies the value range used in RSRQ measurements and thresholds. Integer value for RSRQ measurements is according to mapping table in TS 36.133 [16]. A given field using *RSRQ-Range-v1250* shall only be signalled if the corresponding original field (using *RSRQ-Range* i.e. without suffix) is set to value 0 or 34. Only a UE indicating support of *extendedRSRQ-LowerRange-r12* or *rsrq-OnAllSymbols-r12* may report *RSRQ-Range-v1250*, and this may be done without explicit configuration from the E-UTRAN. If received, the UE shall use the value indicated by the *RSRQ-Range-v1250* and ignore the value signalled by *RSRQ-Range* (without the suffix).

RSRQ-Range information element

```
-- ASN1START

RSRQ-Range ::=                      INTEGER(0..34)

RSRQ-Range-v1250 ::=                INTEGER(-30..46)


-- ASN1STOP
```

– *RSRQ-Type*

The IE *RSRQ-Type* specifies the RSRQ value type used in RSRQ measurements, see TS 36.214 [48].

RSRQ-Type information element

```
-- ASN1START

RSRQ-Type-r12 ::=                   SEQUENCE {
    allSymbols-r12                          BOOLEAN,
    wideBand-r12                            BOOLEAN
}

-- ASN1STOP
```

***RSRQ-Type* field descriptions**
allSymbols   Value TRUE indicates use of all OFDM symbols when performing RSRQ measurements.
wideBand   Value TRUE indicates use of a wider bandwidth when performing RSRQ measurements.

– *TimeToTrigger*

The IE *TimeToTrigger* specifies the value range used for time to trigger parameter, which concerns the time during which specific criteria for the event needs to be met in order to trigger a measurement report. Value ms0 corresponds to 0 ms, ms40 corresponds to 40 ms, and so on.

TimeToTrigger information element

```
-- ASN1START

TimeToTrigger ::=                   ENUMERATED {
                                        ms0, ms40, ms64, ms80, ms100, ms128, ms160, ms256,
                                        ms320, ms480, ms512, ms640, ms1024, ms1280, ms2560,
                                        ms5120}

-- ASN1STOP
```

6.3.6 Other information elements

– *AbsoluteTimeInfo*

The IE *AbsoluteTimeInfo* indicates an absolute time in a format YY-MM-DD HH:MM:SS and using BCD encoding. The first/ leftmost bit of the bit string contains the most significant bit of the most significant digit of the year and so on.

***AbsoluteTimeInfo* information element**

```
-- ASN1START

AbsoluteTimeInfo-r10 ::=                BIT STRING (SIZE (48))

-- ASN1STOP
```

– *AreaConfiguration*

The *AreaConfiguration* indicates area for which UE is requested to perform measurement logging. If not configured, measurement logging is not restricted to specific cells or tracking areas but applies as long as the RPLMN is contained in *plmn-IdentityList* stored in *VarLogMeasReport*.

***AreaConfiguration* information element**

```
-- ASN1START

AreaConfiguration-r10 ::=   CHOICE {
    cellGlobalIdList-r10            CellGlobalIdList-r10,
    trackingAreaCodeList-r10        TrackingAreaCodeList-r10
}

AreaConfiguration-v1130 ::=     SEQUENCE {
    trackingAreaCodeList-v1130      TrackingAreaCodeList-v1130
}

CellGlobalIdList-r10 ::=                SEQUENCE (SIZE (1..32)) OF CellGlobalIdEUTRA

TrackingAreaCodeList-r10 ::=            SEQUENCE (SIZE (1..8)) OF TrackingAreaCode

TrackingAreaCodeList-v1130 ::=  SEQUENCE {
    plmn-Identity-perTAC-List-r11           SEQUENCE (SIZE (1..8)) OF PLMN-Identity
}

-- ASN1STOP
```

***AreaConfiguration* field descriptions**
plmn-Identity-perTAC-List   Includes the PLMN identity for each of the TA codes included in *trackingAreaCodeList*. The PLMN identity listed first in *plmn-Identity-perTAC-List* corresponds with the TA code listed first in *trackingAreaCodeList* and so on.

– *C-RNTI*

The IE *C-RNTI* identifies a UE having a RRC connection within a cell.

***C-RNTI* information element**

```
-- ASN1START

C-RNTI ::=                          BIT STRING (SIZE (16))

-- ASN1STOP
```

– *DedicatedInfoCDMA2000*

The *DedicatedInfoCDMA2000* is used to transfer UE specific CDMA2000 information between the network and the UE. The RRC layer is transparent for this information.

DedicatedInfoCDMA2000 information element

```
-- ASN1START

DedicatedInfoCDMA2000 ::=               OCTET STRING

-- ASN1STOP
```

– *DedicatedInfoNAS*

The IE *DedicatedInfoNAS* is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for this information.

***DedicatedInfoNAS* information element**

```
-- ASN1START

DedicatedInfoNAS ::=        OCTET STRING

-- ASN1STOP
```

– *FilterCoefficient*

The IE *FilterCoefficient* specifies the measurement filtering coefficient. Value *fc0* corresponds to k = 0, *fc1* corresponds to k = 1, and so on.

***FilterCoefficient* information element**

```
-- ASN1START

FilterCoefficient ::=                   ENUMERATED {
                                            fc0, fc1, fc2, fc3, fc4, fc5,
                                            fc6, fc7, fc8, fc9, fc11, fc13,
                                            fc15, fc17, fc19, spare1, ...}

-- ASN1STOP
```

– *LoggingDuration*

The *LoggingDuration* indicates the duration for which UE is requested to perform measurement logging. Value min10 corresponds to 10 minutes, value min20 corresponds to 20 minutes and so on.

***LoggingDuration* information element**

```
-- ASN1START

LoggingDuration-r10 ::=         ENUMERATED {
                                    min10, min20, min40, min60, min90, min120, spare2, spare1}

-- ASN1STOP
```

– *LoggingInterval*

The *LoggingInterval* indicates the periodicity for logging measurement results. Value ms1280 corresponds to 1.28s, value ms2560 corresponds to 2.56s and so on.

LoggingInterval information element

```
-- ASN1START

LoggingInterval-r10 ::=         ENUMERATED {
                                    ms1280, ms2560, ms5120, ms10240, ms20480,
                                    ms30720, ms40960, ms61440}

-- ASN1STOP
```

– *MeasSubframePattern*

The IE *MeasSubframePattern* is used to specify a subframe pattern. The first/leftmost bit corresponds to the subframe #0 of the radio frame satisfying SFN mod x = 0, where SFN is that of PCell and x is the size of the bit string divided by 10. "1" denotes that the corresponding subframe is used.

MeasSubframePattern information element

```
-- ASN1START

MeasSubframePattern-r10 ::= CHOICE {
    subframePatternFDD-r10              BIT STRING (SIZE (40)),
    subframePatternTDD-r10              CHOICE {
        subframeConfig1-5-r10                   BIT STRING (SIZE (20)),
        subframeConfig0-r10                     BIT STRING (SIZE (70)),
        subframeConfig6-r10                     BIT STRING (SIZE (60)),
        ...
    },
    ...
}

-- ASN1STOP
```

– *MMEC*

The IE *MMEC* identifies an MME within the scope of an MME Group within a PLMN, see TS 23.003 [27].

MMEC information element

```
-- ASN1START

MMEC ::=                            BIT STRING (SIZE (8))

-- ASN1STOP
```

– *NeighCellConfig*

The IE *NeighCellConfig* is used to provide the information related to MBSFN and TDD UL/DL configuration of neighbour cells.

NeighCellConfig information element

```
-- ASN1START

NeighCellConfig ::=         BIT STRING (SIZE (2))

-- ASN1STOP
```

***NeighCellConfig* field descriptions**
neighCellConfig
Provides information related to MBSFN and TDD UL/DL configuration of neighbour cells of this frequency 00: Not all neighbour cells have the same MBSFN subframe allocation as the serving cell on this frequency, if configured, and as the PCell otherwise 10: The MBSFN subframe allocations of all neighbour cells are identical to or subsets of that in the serving cell on this frequency, if configured, and of that in the PCell otherwise 01: No MBSFN subframes are present in all neighbour cells 11: Different UL/DL allocation in neighbouring cells for TDD compared to the serving cell on this frequency, if configured, and compared to the PCell otherwise For TDD, 00, 10 and 01 are only used for same UL/DL allocation in neighbouring cells compared to the serving cell on this frequency, if configured, and compared to the PCell otherwise.

– *OtherConfig*

The IE *OtherConfig* contains configuration related to other configuration

OtherConfig information element

```
-- ASN1START

OtherConfig-r9 ::= SEQUENCE {
    reportProximityConfig-r9            ReportProximityConfig-r9        OPTIONAL,   -- Need ON
    ...,
    [[  idc-Config-r11                  IDC-Config-r11                  OPTIONAL,   -- Need ON
        powerPrefIndicationConfig-r11   PowerPrefIndicationConfig-r11   OPTIONAL,   -- Need ON
        obtainLocationConfig-r11        ObtainLocationConfig-r11        OPTIONAL    -- Need ON
    ]]
}

IDC-Config-r11 ::=              SEQUENCE {
    idc-Indication-r11                  ENUMERATED {setup}      OPTIONAL,       -- Need OR
    autonomousDenialParameters-r11      SEQUENCE {
            autonomousDenialSubframes-r11           ENUMERATED {n2, n5, n10, n15,
                                                        n20, n30, spare2, spare1},
            autonomousDenialValidity-r11            ENUMERATED {
                                                        sf200, sf500, sf1000, sf2000,
                                                        spare4, spare3, spare2, spare1}
    }       OPTIONAL,       -- Need OR
    ...,
    [[  idc-Indication-UL-CA-r11        ENUMERATED {setup}      OPTIONAL        -- Cond idc-Ind
    ]]
}

ObtainLocationConfig-r11 ::= SEQUENCE {
    obtainLocation-r11              ENUMERATED {setup}              OPTIONAL        -- Need OR
}

PowerPrefIndicationConfig-r11 ::= CHOICE{
    release                 NULL,
    setup                   SEQUENCE{
        powerPrefIndicationTimer-r11        ENUMERATED {s0, s0dot5, s1, s2, s5, s10, s20,
                                            s30, s60, s90, s120, s300, s600, spare3,
                                            spare2, spare1}
    }
}

ReportProximityConfig-r9 ::= SEQUENCE {
    proximityIndicationEUTRA-r9     ENUMERATED {enabled}            OPTIONAL,       -- Need OR
    proximityIndicationUTRA-r9      ENUMERATED {enabled}            OPTIONAL        -- Need OR
}

-- ASN1STOP
```

OtherConfig field descriptions
autonomousDenialSubframes Indicates the maximum number of the UL subframes for which the UE is allowed to deny any UL transmission. Value n2 corresponds to 2 subframes, n5 to 5 subframes and so on. E-UTRAN does not configure autonomous denial for frequencies on which SCG cells are configured.
autonomousDenialValidity Indicates the validity period over which the UL autonomous denial subframes shall be counted. Value sf200 corresponds to 200 subframes, sf500 corresponds to 500 subframes and so on.
idc-Indication The field is used to indicate whether the UE is configured to initiate transmission of the *InDeviceCoexIndication* message to the network.
idc-Indication-UL-CA The field is used to indicate whether the UE is configured to provide IDC indications for UL CA using the *InDeviceCoexIndication* message.
obtainLocation Requests the UE to attempt to have detailed location information available using GNSS. E-UTRAN configures the field only if *includeLocationInfo* is configured for one or more measurements.
powerPrefIndicationTimer Prohibit timer for Power Preference Indication reporting. Value in seconds. Value s0 means prohibit timer is set to 0 second or not set, value s0dot5 means prohibit timer is set to 0.5 second, value s1 means prohibit timer is set to 1 second and so on.
reportProximityConfig Indicates, for each of the applicable RATs (EUTRA, UTRA), whether or not proximity indication is enabled for CSG member cell(s) of the concerned RAT. Note.

NOTE: Enabling/ disabling of proximity indication includes enabling/ disabling of the related functionality e.g. autonomous search in connected mode.

Conditional presence	Explanation
idc-Ind	The field is optionally present if *idc-Indication* is present, need OR. Otherwise the field is not present.

– *RAND-CDMA2000 (1xRTT)*

The *RAND-CDMA200*0 concerns a random value, generated by the eNB, to be passed to the CDMA2000 upper layers.

***RAND-CDMA2000* information element**

```
-- ASN1START

RAND-CDMA2000 ::=                       BIT STRING (SIZE (32))

-- ASN1STOP
```

– *RAT-Type*

The IE *RAT-Type* is used to indicate the radio access technology (RAT), including E-UTRA, of the requested/ transferred UE capabilities.

***RAT-Type* information element**

```
-- ASN1START

RAT-Type ::=                            ENUMERATED {
                                            eutra, utra, geran-cs, geran-ps, cdma2000-1XRTT,
                                            spare3, spare2, spare1, ...}

-- ASN1STOP
```

– *RRC-TransactionIdentifier*

The IE *RRC-TransactionIdentifier* is used, together with the message type, for the identification of an RRC procedure (transaction).

RRC-TransactionIdentifier information element

```
-- ASN1START

RRC-TransactionIdentifier ::=       INTEGER (0..3)

-- ASN1STOP
```

– *S-TMSI*

The IE *S-TMSI* contains an S-Temporary Mobile Subscriber Identity, a temporary UE identity provided by the EPC which uniquely identifies the UE within the tracking area, see TS 23.003 [27].

S-TMSI information element

```
-- ASN1START

S-TMSI ::=                          SEQUENCE {
    mmec                                MMEC,
    m-TMSI                              BIT STRING (SIZE (32))
}

-- ASN1STOP
```

***S-TMSI* field descriptions**
m-TMSI   The first/leftmost bit of the bit string contains the most significant bit of the M-TMSI.

– *TraceReference*

The *TraceReference* contains parameter Trace Reference as defined in TS 32.422 [58].

TraceReference information element

```
-- ASN1START

TraceReference-r10 ::=          SEQUENCE {
    plmn-Identity-r10               PLMN-Identity,
    traceId-r10                     OCTET STRING (SIZE (3))
}

-- ASN1STOP
```

– *UE-CapabilityRAT-ContainerList*

The IE *UE-CapabilityRAT-ContainerList* contains list of containers, one for each RAT for which UE capabilities are transferred, if any.

UE-CapabilityRAT-ContainerList information element

```
-- ASN1START

UE-CapabilityRAT-ContainerList ::=SEQUENCE (SIZE (0..maxRAT-Capabilities)) OF UE-CapabilityRAT-
Container

UE-CapabilityRAT-Container ::= SEQUENCE {
    rat-Type                            RAT-Type,
    ueCapabilityRAT-Container           OCTET STRING
}
```

```
-- ASN1STOP
```

UECapabilityRAT-ContainerList field descriptions
ueCapabilityRAT-Container
Container for the UE capabilities of the indicated RAT. The encoding is defined in the specification of each RAT: For E-UTRA: the encoding of UE capabilities is defined in IE *UE-EUTRA-Capability*. For UTRA: the octet string contains the INTER RAT HANDOVER INFO message defined in TS 25.331 [19]. For GERAN CS: the octet string contains the concatenated string of the Mobile Station Classmark 2 and Mobile Station Classmark 3. The first 5 octets correspond to Mobile Station Classmark 2 and the following octets correspond to Mobile Station Classmark 3. The Mobile Station Classmark 2 is formatted as 'TLV' and is coded in the same way as the *Mobile Station Classmark 2* information element in TS 24.008 [49]. The first octet is the *Mobile station classmark 2 IEI* and its value shall be set to 33H. The second octet is the *Length of mobile station classmark 2* and its value shall be set to 3. The octet 3 contains the first octet of the value part of the *Mobile Station Classmark 2* information element, the octet 4 contains the second octet of the value part of the *Mobile Station Classmark 2* information element and so on. For each of these octets, the first/ leftmost/ most significant bit of the octet contains b8 of the corresponding octet of the Mobile Station Classmark 2. The Mobile Station Classmark 3 is formatted as 'V' and is coded in the same way as the value part in the *Mobile station classmark 3* information element in TS 24.008 [49]. The sixth octet of this octet string contains octet 1 of the value part of *Mobile station classmark 3*, the seventh of octet of this octet string contains octet 2 of the value part of *Mobile station classmark 3* and so on. Note. For GERAN PS: the encoding of UE capabilities is formatted as 'V' and is coded in the same way as the value part in the *MS Radio Access Capability* information element in TS 24.008 [49]. For CDMA2000-1XRTT: the octet string contains the A21 Mobile Subscription Information and the encoding of this is defined in A.S0008 [33]. The A21 Mobile Subscription Information contains the supported CDMA2000 1xRTT band class and band sub-class information.

NOTE: The value part is specified by means of CSN.1, which encoding results in a bit string, to which final padding may be appended up to the next octet boundary TS 24.008 [49]. The first/ leftmost bit of the CSN.1 bit string is placed in the first/ leftmost/ most significant bit of the first octet. This continues until the last bit of the CSN.1 bit string, which is placed in the last/ rightmost/ least significant bit of the last octet.

– *UE-EUTRA-Capability*

The IE *UE-EUTRA-Capability* is used to convey the E-UTRA UE Radio Access Capability Parameters, see TS 36.306 [5], and the Feature Group Indicators for mandatory features (defined in Annexes B.1 and C.1) to the network. The IE *UE-EUTRA-Capability* is transferred in E-UTRA or in another RAT.

UE-EUTRA-Capability information element

```
-- ASN1START

UE-EUTRA-Capability ::=         SEQUENCE {
    accessStratumRelease                AccessStratumRelease,
    ue-Category                         INTEGER (1..5),
    pdcp-Parameters                     PDCP-Parameters,
    phyLayerParameters                  PhyLayerParameters,
    rf-Parameters                       RF-Parameters,
    measParameters                      MeasParameters,
    featureGroupIndicators              BIT STRING (SIZE (32))              OPTIONAL,
    interRAT-Parameters             SEQUENCE {
        utraFDD                             IRAT-ParametersUTRA-FDD             OPTIONAL,
        utraTDD128                          IRAT-ParametersUTRA-TDD128              OPTIONAL,
        utraTDD384                          IRAT-ParametersUTRA-TDD384              OPTIONAL,
        utraTDD768                          IRAT-ParametersUTRA-TDD768              OPTIONAL,
        geran                               IRAT-ParametersGERAN                    OPTIONAL,
        cdma2000-HRPD                       IRAT-ParametersCDMA2000-HRPD            OPTIONAL,
        cdma2000-1xRTT                      IRAT-ParametersCDMA2000-1XRTT           OPTIONAL
    },
    nonCriticalExtension                UE-EUTRA-Capability-v920-IEs        OPTIONAL
}

-- Late non critical extensions
UE-EUTRA-Capability-v9a0-IEs ::=    SEQUENCE {
    featureGroupIndRel9Add-r9           BIT STRING (SIZE (32))              OPTIONAL,
    fdd-Add-UE-EUTRA-Capabilities-r9    UE-EUTRA-CapabilityAddXDD-Mode-r9   OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-r9    UE-EUTRA-CapabilityAddXDD-Mode-r9   OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v9c0-IEs        OPTIONAL
}

UE-EUTRA-Capability-v9c0-IEs ::=        SEQUENCE {
```

```
    interRAT-ParametersUTRA-v9c0        IRAT-ParametersUTRA-v9c0        OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v9d0-IEs    OPTIONAL
}

UE-EUTRA-Capability-v9d0-IEs ::=        SEQUENCE {
    phyLayerParameters-v9d0             PhyLayerParameters-v9d0         OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v9e0-IEs    OPTIONAL
}

UE-EUTRA-Capability-v9e0-IEs ::=    SEQUENCE {
    rf-Parameters-v9e0                  RF-Parameters-v9e0                      OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v9h0-IEs            OPTIONAL
}

UE-EUTRA-Capability-v9h0-IEs ::=    SEQUENCE {
    interRAT-ParametersUTRA-v9h0        IRAT-ParametersUTRA-v9h0            OPTIONAL,
    -- Following field is only to be used for late REL-9 extensions
    lateNonCriticalExtension            OCTET STRING                            OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v10c0-IEs           OPTIONAL
}

UE-EUTRA-Capability-v10c0-IEs ::=   SEQUENCE {
    otdoa-PositioningCapabilities-r10   OTDOA-PositioningCapabilities-r10       OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v10f0-IEs           OPTIONAL
}

UE-EUTRA-Capability-v10f0-IEs ::=   SEQUENCE {
    rf-Parameters-v10f0                 RF-Parameters-v10f0                     OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v10i0-IEs           OPTIONAL
}

UE-EUTRA-Capability-v10i0-IEs ::=   SEQUENCE {
    rf-Parameters-v10i0                 RF-Parameters-v10i0                     OPTIONAL,
    -- Following field is only to be used for late REL-10 extensions
    lateNonCriticalExtension            OCTET STRING (CONTAINING UE-EUTRA-Capability-v10j0-IEs)
    OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v11d0-IEs           OPTIONAL
}

UE-EUTRA-Capability-v10j0-IEs ::=   SEQUENCE {
    rf-Parameters-v10j0                 RF-Parameters-v10j0                     OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                             OPTIONAL
}

UE-EUTRA-Capability-v11d0-IEs ::=   SEQUENCE {
    rf-Parameters-v11d0                 RF-Parameters-v11d0                     OPTIONAL,
    otherParameters-v11d0               Other-Parameters-v11d0                  OPTIONAL,
    -- Following field is only to be used for late REL-11 extensions
    nonCriticalExtension                SEQUENCE {}                             OPTIONAL
}

-- Regular non critical extensions
UE-EUTRA-Capability-v920-IEs ::=        SEQUENCE {
    phyLayerParameters-v920             PhyLayerParameters-v920,
    interRAT-ParametersGERAN-v920           IRAT-ParametersGERAN-v920,
    interRAT-ParametersUTRA-v920            IRAT-ParametersUTRA-v920            OPTIONAL,
    interRAT-ParametersCDMA2000-v920        IRAT-ParametersCDMA2000-1XRTT-v920  OPTIONAL,
    deviceType-r9                           ENUMERATED {noBenFromBatConsumpOpt} OPTIONAL,
    csg-ProximityIndicationParameters-r9    CSG-ProximityIndicationParameters-r9,
    neighCellSI-AcquisitionParameters-r9    NeighCellSI-AcquisitionParameters-r9,
    son-Parameters-r9                       SON-Parameters-r9,
    nonCriticalExtension                    UE-EUTRA-Capability-v940-IEs        OPTIONAL
}

UE-EUTRA-Capability-v940-IEs ::=    SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING UE-EUTRA-Capability-v9a0-IEs)
                                                                            OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1020-IEs       OPTIONAL
}

UE-EUTRA-Capability-v1020-IEs ::=   SEQUENCE {
    ue-Category-v1020                   INTEGER (6..8)                          OPTIONAL,
    phyLayerParameters-v1020            PhyLayerParameters-v1020                OPTIONAL,
    rf-Parameters-v1020                 RF-Parameters-v1020                     OPTIONAL,
    measParameters-v1020                MeasParameters-v1020                    OPTIONAL,
    featureGroupIndRel10-r10            BIT STRING (SIZE (32))                  OPTIONAL,
    interRAT-ParametersCDMA2000-v1020   IRAT-ParametersCDMA2000-1XRTT-v1020     OPTIONAL,
    ue-BasedNetwPerfMeasParameters-r10  UE-BasedNetwPerfMeasParameters-r10      OPTIONAL,
```

```
    interRAT-ParametersUTRA-TDD-v1020   IRAT-ParametersUTRA-TDD-v1020           OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1060-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1060-IEs ::=   SEQUENCE {
    fdd-Add-UE-EUTRA-Capabilities-v1060 UE-EUTRA-CapabilityAddXDD-Mode-v1060    OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-v1060 UE-EUTRA-CapabilityAddXDD-Mode-v1060    OPTIONAL,
    rf-Parameters-v1060                 RF-Parameters-v1060                     OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1090-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1090-IEs ::=   SEQUENCE {
    rf-Parameters-v1090                 RF-Parameters-v1090                     OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1130-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1130-IEs ::=   SEQUENCE {
    pdcp-Parameters-v1130               PDCP-Parameters-v1130,
    phyLayerParameters-v1130            PhyLayerParameters-v1130                OPTIONAL,
    rf-Parameters-v1130                 RF-Parameters-v1130,
    measParameters-v1130                MeasParameters-v1130,
    interRAT-ParametersCDMA2000-v1130   IRAT-ParametersCDMA2000-v1130,
    otherParameters-r11                 Other-Parameters-r11,
    fdd-Add-UE-EUTRA-Capabilities-v1130 UE-EUTRA-CapabilityAddXDD-Mode-v1130    OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-v1130 UE-EUTRA-CapabilityAddXDD-Mode-v1130    OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1170-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1170-IEs ::=   SEQUENCE {
    phyLayerParameters-v1170            PhyLayerParameters-v1170                OPTIONAL,
    ue-Category-v1170                   INTEGER (9..10)                         OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1180-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1180-IEs ::=   SEQUENCE {
    rf-Parameters-v1180                 RF-Parameters-v1180                     OPTIONAL,
    mbms-Parameters-r11                 MBMS-Parameters-r11                     OPTIONAL,
    fdd-Add-UE-EUTRA-Capabilities-v1180 UE-EUTRA-CapabilityAddXDD-Mode-v1180    OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-v1180 UE-EUTRA-CapabilityAddXDD-Mode-v1180    OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v11a0-IEs           OPTIONAL
}

UE-EUTRA-Capability-v11a0-IEs ::=   SEQUENCE {
    ue-Category-v11a0                   INTEGER (11..12)                        OPTIONAL,
    measParameters-v11a0                MeasParameters-v11a0                    OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1250-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1250-IEs ::=   SEQUENCE {
    phyLayerParameters-v1250            PhyLayerParameters-v1250                OPTIONAL,
    rf-Parameters-v1250                 RF-Parameters-v1250                     OPTIONAL,
    rlc-Parameters-r12                  RLC-Parameters-r12                      OPTIONAL,
    ue-BasedNetwPerfMeasParameters-v1250    UE-BasedNetwPerfMeasParameters-v1250    OPTIONAL,
    ue-CategoryDL-r12                   INTEGER (0..14)                         OPTIONAL,
    ue-CategoryUL-r12                   INTEGER (0..13)                         OPTIONAL,
    wlan-IW-Parameters-r12              WLAN-IW-Parameters-r12                  OPTIONAL,
    measParameters-v1250                MeasParameters-v1250                    OPTIONAL,
    dc-Parameters-r12                   DC-Parameters-r12                       OPTIONAL,
    mbms-Parameters-v1250               MBMS-Parameters-v1250                   OPTIONAL,
    mac-Parameters-r12                  MAC-Parameters-r12                      OPTIONAL,
    fdd-Add-UE-EUTRA-Capabilities-v1250 UE-EUTRA-CapabilityAddXDD-Mode-v1250    OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-v1250 UE-EUTRA-CapabilityAddXDD-Mode-v1250    OPTIONAL,
    sl-Parameters-r12               SL-Parameters-r12                       OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1260-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1260-IEs ::=   SEQUENCE {
    ue-CategoryDL-v1260                 INTEGER (15..16)                        OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1270-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1270-IEs ::= SEQUENCE {
    rf-Parameters-v1270                 RF-Parameters-v1270                     OPTIONAL,
    nonCriticalExtension                UE-EUTRA-Capability-v1280-IEs           OPTIONAL
}

UE-EUTRA-Capability-v1280-IEs ::= SEQUENCE {
    phyLayerParameters-v1280            PhyLayerParameters-v1280                OPTIONAL,
```

```
    nonCriticalExtension                SEQUENCE {}                                 OPTIONAL
}

UE-EUTRA-CapabilityAddXDD-Mode-r9 ::=   SEQUENCE {
    phyLayerParameters-r9               PhyLayerParameters                  OPTIONAL,
    featureGroupIndicators-r9           BIT STRING (SIZE (32))              OPTIONAL,
    featureGroupIndRel9Add-r9           BIT STRING (SIZE (32))              OPTIONAL,
    interRAT-ParametersGERAN-r9         IRAT-ParametersGERAN                OPTIONAL,
    interRAT-ParametersUTRA-r9          IRAT-ParametersUTRA-v920            OPTIONAL,
    interRAT-ParametersCDMA2000-r9      IRAT-ParametersCDMA2000-1XRTT-v920  OPTIONAL,
    neighCellSI-AcquisitionParameters-r9    NeighCellSI-AcquisitionParameters-r9    OPTIONAL,
    ...
}

UE-EUTRA-CapabilityAddXDD-Mode-v1060 ::=    SEQUENCE {
    phyLayerParameters-v1060            PhyLayerParameters-v1020            OPTIONAL,
    featureGroupIndRel10-v1060          BIT STRING (SIZE (32))              OPTIONAL,
    interRAT-ParametersCDMA2000-v1060   IRAT-ParametersCDMA2000-1XRTT-v1020 OPTIONAL,
    interRAT-ParametersUTRA-TDD-v1060   IRAT-ParametersUTRA-TDD-v1020       OPTIONAL,
    ...,
    [[  otdoa-PositioningCapabilities-r10   OTDOA-PositioningCapabilities-r10   OPTIONAL
    ]]
}

UE-EUTRA-CapabilityAddXDD-Mode-v1130 ::=    SEQUENCE {
    phyLayerParameters-v1130            PhyLayerParameters-v1130            OPTIONAL,
    measParameters-v1130                MeasParameters-v1130                OPTIONAL,
    otherParameters-r11                 Other-Parameters-r11                OPTIONAL,
    ...
}

UE-EUTRA-CapabilityAddXDD-Mode-v1180 ::=    SEQUENCE {
    mbms-Parameters-r11                 MBMS-Parameters-r11
}

UE-EUTRA-CapabilityAddXDD-Mode-v1250 ::=    SEQUENCE {
    phyLayerParameters-v1250            PhyLayerParameters-v1250            OPTIONAL,
    measParameters-v1250                MeasParameters-v1250                OPTIONAL
}

AccessStratumRelease ::=            ENUMERATED {
                                        rel8, rel9, rel10, rel11, rel12, spare3,
                                        spare2, spare1, ...}

DC-Parameters-r12 ::=           SEQUENCE {
    drb-TypeSplit-r12                   ENUMERATED {supported}          OPTIONAL,
    drb-TypeSCG-r12                     ENUMERATED {supported}          OPTIONAL
}

MAC-Parameters-r12 ::=              SEQUENCE {
    logicalChannelSR-ProhibitTimer-r12  ENUMERATED {supported}              OPTIONAL,
    longDRX-Command-r12             ENUMERATED {supported}                  OPTIONAL
}

RLC-Parameters-r12 ::=              SEQUENCE {
    extended-RLC-LI-Field-r12           ENUMERATED {supported}
}

PDCP-Parameters ::=             SEQUENCE {
    supportedROHC-Profiles              SEQUENCE {
        profile0x0001                       BOOLEAN,
        profile0x0002                       BOOLEAN,
        profile0x0003                       BOOLEAN,
        profile0x0004                       BOOLEAN,
        profile0x0006                       BOOLEAN,
        profile0x0101                       BOOLEAN,
        profile0x0102                       BOOLEAN,
        profile0x0103                       BOOLEAN,
        profile0x0104                       BOOLEAN
    },
    maxNumberROHC-ContextSessions       ENUMERATED {
                                            cs2, cs4, cs8, cs12, cs16, cs24, cs32,
                                            cs48, cs64, cs128, cs256, cs512, cs1024,
                                            cs16384, spare2, spare1}                DEFAULT cs16,
    ...
}

PDCP-Parameters-v1130 ::=       SEQUENCE {
```

```
    pdcp-SN-Extension-r11                   ENUMERATED {supported}          OPTIONAL,
    supportRohcContextContinue-r11          ENUMERATED {supported}          OPTIONAL
}

PhyLayerParameters ::=              SEQUENCE {
    ue-TxAntennaSelectionSupported      BOOLEAN,
    ue-SpecificRefSigsSupported     BOOLEAN
}

PhyLayerParameters-v920 ::=     SEQUENCE {
    enhancedDualLayerFDD-r9         ENUMERATED {supported}          OPTIONAL,
    enhancedDualLayerTDD-r9         ENUMERATED {supported}          OPTIONAL
}

PhyLayerParameters-v9d0 ::=         SEQUENCE {
    tm5-FDD-r9                      ENUMERATED {supported}          OPTIONAL,
    tm5-TDD-r9                      ENUMERATED {supported}          OPTIONAL
}

PhyLayerParameters-v1020 ::=            SEQUENCE {
    twoAntennaPortsForPUCCH-r10             ENUMERATED {supported}                  OPTIONAL,
    tm9-With-8Tx-FDD-r10                    ENUMERATED {supported}                  OPTIONAL,
    pmi-Disabling-r10                       ENUMERATED {supported}                  OPTIONAL,
    crossCarrierScheduling-r10              ENUMERATED {supported}                  OPTIONAL,
    simultaneousPUCCH-PUSCH-r10             ENUMERATED {supported}                  OPTIONAL,
    multiClusterPUSCH-WithinCC-r10          ENUMERATED {supported}                  OPTIONAL,
    nonContiguousUL-RA-WithinCC-List-r10    NonContiguousUL-RA-WithinCC-List-r10    OPTIONAL
}

PhyLayerParameters-v1130 ::=            SEQUENCE {
    crs-InterfHandl-r11                     ENUMERATED {supported}                  OPTIONAL,
    ePDCCH-r11                              ENUMERATED {supported}                  OPTIONAL,
    multiACK-CSI-Reporting-r11              ENUMERATED {supported}                  OPTIONAL,
    ss-CCH-InterfHandl-r11                  ENUMERATED {supported}                  OPTIONAL,
    tdd-SpecialSubframe-r11                 ENUMERATED {supported}                  OPTIONAL,
    txDiv-PUCCH1b-ChSelect-r11              ENUMERATED {supported}                  OPTIONAL,
    ul-CoMP-r11                             ENUMERATED {supported}                  OPTIONAL
}

PhyLayerParameters-v1170 ::=            SEQUENCE {
    interBandTDD-CA-WithDifferentConfig-r11 BIT STRING (SIZE (2))           OPTIONAL
}

PhyLayerParameters-v1250 ::=            SEQUENCE {
    e-HARQ-Pattern-FDD-r12                  ENUMERATED {supported}          OPTIONAL,
    enhanced-4TxCodebook-r12                ENUMERATED {supported}          OPTIONAL,
    tdd-FDD-CA-PCellDuplex-r12              BIT STRING (SIZE (2))           OPTIONAL,
    phy-TDD-ReConfig-TDD-PCell-r12          ENUMERATED {supported}          OPTIONAL,
    phy-TDD-ReConfig-FDD-PCell-r12          ENUMERATED {supported}          OPTIONAL,
    pusch-FeedbackMode-r12                  ENUMERATED {supported}          OPTIONAL,
    pusch-SRS-PowerControl-SubframeSet-r12  ENUMERATED {supported}          OPTIONAL,
    csi-SubframeSet-r12                     ENUMERATED {supported}          OPTIONAL,
    noResourceRestrictionForTTIBundling-r12 ENUMERATED {supported}          OPTIONAL,
    discoverySignalsInDeactSCell-r12        ENUMERATED {supported}          OPTIONAL,
    naics-Capability-List-r12               NAICS-Capability-List-r12       OPTIONAL
}

PhyLayerParameters-v1280 ::=            SEQUENCE {
    alternativeTBS-Indices-r12              ENUMERATED {supported}          OPTIONAL
}

NonContiguousUL-RA-WithinCC-List-r10 ::= SEQUENCE (SIZE (1..maxBands)) OF NonContiguousUL-RA-
WithinCC-r10

NonContiguousUL-RA-WithinCC-r10 ::=     SEQUENCE {
    nonContiguousUL-RA-WithinCC-Info-r10    ENUMERATED {supported}                  OPTIONAL
}

RF-Parameters ::=                   SEQUENCE {
    supportedBandListEUTRA              SupportedBandListEUTRA
}

RF-Parameters-v9e0 ::=                  SEQUENCE {
    supportedBandListEUTRA-v9e0             SupportedBandListEUTRA-v9e0             OPTIONAL
}

RF-Parameters-v1020 ::=             SEQUENCE {
    supportedBandCombination-r10            SupportedBandCombination-r10
```

```
}

RF-Parameters-v1060 ::=             SEQUENCE {
    supportedBandCombinationExt-r10         SupportedBandCombinationExt-r10
}

RF-Parameters-v1090 ::=                 SEQUENCE {
    supportedBandCombination-v1090          SupportedBandCombination-v1090          OPTIONAL
}

RF-Parameters-v10f0 ::=                 SEQUENCE {
    modifiedMPR-Behavior-r10                    BIT STRING (SIZE (32))              OPTIONAL
}

RF-Parameters-v10i0 ::=                 SEQUENCE {
    supportedBandCombination-v10i0          SupportedBandCombination-v10i0          OPTIONAL
}

RF-Parameters-v10j0 ::=                 SEQUENCE {
    multiNS-Pmax-r10                        ENUMERATED {supported}                  OPTIONAL
}

RF-Parameters-v1130 ::=             SEQUENCE {
    supportedBandCombination-v1130          SupportedBandCombination-v1130          OPTIONAL
}

RF-Parameters-v1180 ::=             SEQUENCE {
    freqBandRetrieval-r11                   ENUMERATED {supported}          OPTIONAL,
    requestedBands-r11                      SEQUENCE (SIZE (1.. maxBands)) OF FreqBandIndicator-r11
                        OPTIONAL,
    supportedBandCombinationAdd-r11         SupportedBandCombinationAdd-r11     OPTIONAL
}

RF-Parameters-v11d0 ::=                 SEQUENCE {
    supportedBandCombinationAdd-v11d0       SupportedBandCombinationAdd-v11d0       OPTIONAL
}

RF-Parameters-v1250 ::=             SEQUENCE {
    supportedBandListEUTRA-v1250            SupportedBandListEUTRA-v1250        OPTIONAL,
    supportedBandCombination-v1250          SupportedBandCombination-v1250          OPTIONAL,
    supportedBandCombinationAdd-v1250       SupportedBandCombinationAdd-v1250       OPTIONAL,
    freqBandPriorityAdjustment-r12          ENUMERATED {supported}                  OPTIONAL
}

RF-Parameters-v1270 ::=             SEQUENCE {
    supportedBandCombination-v1270          SupportedBandCombination-v1270          OPTIONAL,
    supportedBandCombinationAdd-v1270       SupportedBandCombinationAdd-v1270       OPTIONAL
}

SupportedBandCombination-r10 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF BandCombinationParameters-
r10

SupportedBandCombinationExt-r10 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParametersExt-r10

SupportedBandCombination-v1090 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParameters-v1090

SupportedBandCombination-v10i0 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParameters-v10i0

SupportedBandCombination-v1130 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParameters-v1130

SupportedBandCombination-v1250 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParameters-v1250

SupportedBandCombination-v1270 ::= SEQUENCE (SIZE (1..maxBandComb-r10)) OF
BandCombinationParameters-v1270

SupportedBandCombinationAdd-r11 ::= SEQUENCE (SIZE (1..maxBandComb-r11)) OF
BandCombinationParameters-r11

SupportedBandCombinationAdd-v11d0 ::= SEQUENCE (SIZE (1..maxBandComb-r11)) OF
BandCombinationParameters-v10i0

SupportedBandCombinationAdd-v1250 ::= SEQUENCE (SIZE (1..maxBandComb-r11)) OF
BandCombinationParameters-v1250
```

```
SupportedBandCombinationAdd-v1270 ::= SEQUENCE (SIZE (1..maxBandComb-r11)) OF
BandCombinationParameters-v1270

BandCombinationParameters-r10 ::= SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF BandParameters-
r10

BandCombinationParametersExt-r10 ::= SEQUENCE {
    supportedBandwidthCombinationSet-r10    SupportedBandwidthCombinationSet-r10    OPTIONAL
}

BandCombinationParameters-v1090 ::= SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF BandParameters-
v1090

BandCombinationParameters-v10i0::= SEQUENCE {
bandParameterList-v10i0         SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF
            BandParameters-v10i0    OPTIONAL
}

BandCombinationParameters-v1130 ::= SEQUENCE {
    multipleTimingAdvance-r11       ENUMERATED {supported}                  OPTIONAL,
    simultaneousRx-Tx-r11           ENUMERATED {supported}                  OPTIONAL,
    bandParameterList-r11           SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF BandParameters-
v1130   OPTIONAL,
    ...
}

BandCombinationParameters-r11 ::=   SEQUENCE {
    bandParameterList-r11           SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF
            BandParameters-r11,
    supportedBandwidthCombinationSet-r11    SupportedBandwidthCombinationSet-r10    OPTIONAL,
    multipleTimingAdvance-r11       ENUMERATED {supported}                  OPTIONAL,
    simultaneousRx-Tx-r11           ENUMERATED {supported}                  OPTIONAL,
    bandInfoEUTRA-r11               BandInfoEUTRA,
    ...
}

BandCombinationParameters-v1250::= SEQUENCE {
    dc-Support-r12                  SEQUENCE {
        asynchronous-r12            ENUMERATED {supported}          OPTIONAL,
        supportedCellGrouping-r12       CHOICE {
                threeEntries-r12            BIT STRING (SIZE(3)),
                fourEntries-r12                 BIT STRING (SIZE(7)),
                fiveEntries-r12                 BIT STRING (SIZE(15))
        }                                                               OPTIONAL
    }                                                                   OPTIONAL,
    supportedNAICS-2CRS-AP-r12      BIT STRING (SIZE (1..maxNAICS-Entries-r12))     OPTIONAL,
    commSupportedBandsPerBC-r12             BIT STRING (SIZE (1.. maxBands))        OPTIONAL,
    ...
}

BandCombinationParameters-v1270 ::= SEQUENCE {
    bandParameterList-v1270         SEQUENCE (SIZE (1..maxSimultaneousBands-r10)) OF
            BandParameters-v1270        OPTIONAL
}

SupportedBandwidthCombinationSet-r10 ::=    BIT STRING (SIZE (1..maxBandwidthCombSet-r10))

BandParameters-r10 ::= SEQUENCE {
    bandEUTRA-r10                   FreqBandIndicator,
    bandParametersUL-r10            BandParametersUL-r10                    OPTIONAL,
    bandParametersDL-r10            BandParametersDL-r10                    OPTIONAL
}

BandParameters-v1090 ::= SEQUENCE {
    bandEUTRA-v1090                 FreqBandIndicator-v9e0                  OPTIONAL,
    ...
}

BandParameters-v10i0::= SEQUENCE {
    bandParametersDL-v10i0      SEQUENCE (SIZE (1..maxBandwidthClass-r10)) OF CA-MIMO-ParametersDL-
v10i0
}

BandParameters-v1130 ::= SEQUENCE {
    supportedCSI-Proc-r11           ENUMERATED {n1, n3, n4}
}
```

```
BandParameters-r11 ::= SEQUENCE {
    bandEUTRA-r11                   FreqBandIndicator-r11,
    bandParametersUL-r11            BandParametersUL-r10                    OPTIONAL,
    bandParametersDL-r11            BandParametersDL-r10                    OPTIONAL,
    supportedCSI-Proc-r11           ENUMERATED {n1, n3, n4}                 OPTIONAL
}

BandParameters-v1270 ::= SEQUENCE {
    bandParametersDL-v1270          SEQUENCE (SIZE (1..maxBandwidthClass-r10)) OF CA-MIMO-
ParametersDL-v1270
}

BandParametersUL-r10 ::= SEQUENCE (SIZE (1..maxBandwidthClass-r10)) OF CA-MIMO-ParametersUL-r10

CA-MIMO-ParametersUL-r10 ::= SEQUENCE {
    ca-BandwidthClassUL-r10             CA-BandwidthClass-r10,
    supportedMIMO-CapabilityUL-r10      MIMO-CapabilityUL-r10               OPTIONAL
}

BandParametersDL-r10 ::= SEQUENCE (SIZE (1..maxBandwidthClass-r10)) OF CA-MIMO-ParametersDL-r10

CA-MIMO-ParametersDL-r10 ::= SEQUENCE {
    ca-BandwidthClassDL-r10             CA-BandwidthClass-r10,
    supportedMIMO-CapabilityDL-r10      MIMO-CapabilityDL-r10               OPTIONAL
}

CA-MIMO-ParametersDL-v10i0 ::= SEQUENCE {
    fourLayerTM3-TM4-r10                ENUMERATED {supported}              OPTIONAL
}

CA-MIMO-ParametersDL-v1270 ::= SEQUENCE {
    intraBandContiguousCC-InfoList-r12          SEQUENCE (SIZE (1..maxServCell-r10)) OF
IntraBandContiguousCC-Info-r12
}

IntraBandContiguousCC-Info-r12 ::= SEQUENCE {
    fourLayerTM3-TM4-perCC-r12          ENUMERATED {supported}              OPTIONAL,
    supportedMIMO-CapabilityDL-r12      MIMO-CapabilityDL-r10               OPTIONAL,
    supportedCSI-Proc-r12               ENUMERATED {n1, n3, n4}             OPTIONAL
}

CA-BandwidthClass-r10 ::= ENUMERATED {a, b, c, d, e, f, ...}

MIMO-CapabilityUL-r10 ::= ENUMERATED {twoLayers, fourLayers}

MIMO-CapabilityDL-r10 ::= ENUMERATED {twoLayers, fourLayers, eightLayers}

SupportedBandListEUTRA ::=          SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA

SupportedBandListEUTRA-v9e0::=          SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA-v9e0

SupportedBandListEUTRA-v1250 ::=        SEQUENCE (SIZE (1..maxBands)) OF SupportedBandEUTRA-v1250

SupportedBandEUTRA ::=              SEQUENCE {
    bandEUTRA                           FreqBandIndicator,
    halfDuplex                          BOOLEAN
}

SupportedBandEUTRA-v9e0 ::=     SEQUENCE {
    bandEUTRA-v9e0                      FreqBandIndicator-v9e0      OPTIONAL
}

SupportedBandEUTRA-v1250 ::=        SEQUENCE {
    dl-256QAM-r12                       ENUMERATED {supported}      OPTIONAL,
    ul-64QAM-r12                        ENUMERATED {supported}      OPTIONAL
}

MeasParameters ::=                  SEQUENCE {
    bandListEUTRA                       BandListEUTRA
}

MeasParameters-v1020 ::=            SEQUENCE {
    bandCombinationListEUTRA-r10            BandCombinationListEUTRA-r10
}

MeasParameters-v1130 ::=            SEQUENCE {
    rsrqMeasWideband-r11            ENUMERATED {supported}                  OPTIONAL
}
```

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MeasParameters-v11a0 ::=            SEQUENCE {
    benefitsFromInterruption-r11            ENUMERATED {true}               OPTIONAL
}

MeasParameters-v1250 ::=            SEQUENCE {
    timerT312-r12                       ENUMERATED {supported}      OPTIONAL,
    alternativeTimeToTrigger-r12        ENUMERATED {supported}      OPTIONAL,
    incMonEUTRA-r12                     ENUMERATED {supported}      OPTIONAL,
    incMonUTRA-r12                      ENUMERATED {supported}      OPTIONAL,
    extendedMaxMeasId-r12               ENUMERATED {supported}      OPTIONAL,
    extendedRSRQ-LowerRange-r12         ENUMERATED {supported}      OPTIONAL,
    rsrq-OnAllSymbols-r12               ENUMERATED {supported}      OPTIONAL,
    crs-DiscoverySignalsMeas-r12        ENUMERATED {supported}      OPTIONAL,
    csi-RS-DiscoverySignalsMeas-r12     ENUMERATED {supported}      OPTIONAL
}

BandListEUTRA ::=                   SEQUENCE (SIZE (1..maxBands)) OF BandInfoEUTRA

BandCombinationListEUTRA-r10 ::=    SEQUENCE (SIZE (1..maxBandComb-r10)) OF BandInfoEUTRA

BandInfoEUTRA ::=                   SEQUENCE {
    interFreqBandList                   InterFreqBandList,
    interRAT-BandList                   InterRAT-BandList       OPTIONAL
}

InterFreqBandList ::=               SEQUENCE (SIZE (1..maxBands)) OF InterFreqBandInfo

InterFreqBandInfo ::=               SEQUENCE {
    interFreqNeedForGaps                BOOLEAN
}

InterRAT-BandList ::=               SEQUENCE (SIZE (1..maxBands)) OF InterRAT-BandInfo

InterRAT-BandInfo ::=               SEQUENCE {
    interRAT-NeedForGaps                BOOLEAN
}

IRAT-ParametersUTRA-FDD ::=     SEQUENCE {
    supportedBandListUTRA-FDD           SupportedBandListUTRA-FDD
}

IRAT-ParametersUTRA-v920 ::=        SEQUENCE {
    e-RedirectionUTRA-r9                ENUMERATED {supported}
}

IRAT-ParametersUTRA-v9c0 ::=        SEQUENCE {
    voiceOverPS-HS-UTRA-FDD-r9                  ENUMERATED {supported}      OPTIONAL,
    voiceOverPS-HS-UTRA-TDD128-r9               ENUMERATED {supported}      OPTIONAL,
    srvcc-FromUTRA-FDD-ToUTRA-FDD-r9            ENUMERATED {supported}      OPTIONAL,
    srvcc-FromUTRA-FDD-ToGERAN-r9               ENUMERATED {supported}      OPTIONAL,
    srvcc-FromUTRA-TDD128-ToUTRA-TDD128-r9      ENUMERATED {supported}      OPTIONAL,
    srvcc-FromUTRA-TDD128-ToGERAN-r9            ENUMERATED {supported}      OPTIONAL
}

IRAT-ParametersUTRA-v9h0 ::=        SEQUENCE {
    mfbi-UTRA-r9                        ENUMERATED {supported}
}

SupportedBandListUTRA-FDD ::=       SEQUENCE (SIZE (1..maxBands)) OF SupportedBandUTRA-FDD

SupportedBandUTRA-FDD ::=           ENUMERATED {
                                        bandI, bandII, bandIII, bandIV, bandV, bandVI,
                                        bandVII, bandVIII, bandIX, bandX, bandXI,
                                        bandXII, bandXIII, bandXIV, bandXV, bandXVI, ...,
                                        bandXVII-8a0, bandXVIII-8a0, bandXIX-8a0, bandXX-8a0,
                                        bandXXI-8a0, bandXXII-8a0, bandXXIII-8a0, bandXXIV-8a0,
                                        bandXXV-8a0, bandXXVI-8a0, bandXXVII-8a0, bandXXVIII-8a0,
                                        bandXXIX-8a0, bandXXX-8a0, bandXXXI-8a0, bandXXXII-8a0}

IRAT-ParametersUTRA-TDD128 ::=      SEQUENCE {
    supportedBandListUTRA-TDD128        SupportedBandListUTRA-TDD128
}

SupportedBandListUTRA-TDD128 ::=    SEQUENCE (SIZE (1..maxBands)) OF SupportedBandUTRA-TDD128

SupportedBandUTRA-TDD128 ::=        ENUMERATED {
                                        a, b, c, d, e, f, g, h, i, j, k, l, m, n,
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                                        o, p, ...}

IRAT-ParametersUTRA-TDD384 ::=      SEQUENCE {
    supportedBandListUTRA-TDD384        SupportedBandListUTRA-TDD384
}

SupportedBandListUTRA-TDD384 ::=    SEQUENCE (SIZE (1..maxBands)) OF SupportedBandUTRA-TDD384

SupportedBandUTRA-TDD384 ::=        ENUMERATED {
                                            a, b, c, d, e, f, g, h, i, j, k, l, m, n,
                                            o, p, ...}

IRAT-ParametersUTRA-TDD768 ::=      SEQUENCE {
    supportedBandListUTRA-TDD768        SupportedBandListUTRA-TDD768
}

SupportedBandListUTRA-TDD768 ::=    SEQUENCE (SIZE (1..maxBands)) OF SupportedBandUTRA-TDD768

SupportedBandUTRA-TDD768 ::=        ENUMERATED {
                                        a, b, c, d, e, f, g, h, i, j, k, l, m, n,
                                        o, p, ...}

IRAT-ParametersUTRA-TDD-v1020 ::=       SEQUENCE {
    e-RedirectionUTRA-TDD-r10               ENUMERATED {supported}
}

IRAT-ParametersGERAN ::=            SEQUENCE {
    supportedBandListGERAN              SupportedBandListGERAN,
    interRAT-PS-HO-ToGERAN              BOOLEAN
}

IRAT-ParametersGERAN-v920 ::=       SEQUENCE {
    dtm-r9                              ENUMERATED {supported}          OPTIONAL,
    e-RedirectionGERAN-r9               ENUMERATED {supported}          OPTIONAL
}

SupportedBandListGERAN ::=          SEQUENCE (SIZE (1..maxBands)) OF SupportedBandGERAN

SupportedBandGERAN ::=              ENUMERATED {
                                        gsm450, gsm480, gsm710, gsm750, gsm810, gsm850,
                                        gsm900P, gsm900E, gsm900R, gsm1800, gsm1900,
                                        spare5, spare4, spare3, spare2, spare1, ...}

IRAT-ParametersCDMA2000-HRPD ::=    SEQUENCE {
    supportedBandListHRPD               SupportedBandListHRPD,
    tx-ConfigHRPD                       ENUMERATED {single, dual},
    rx-ConfigHRPD                       ENUMERATED {single, dual}
}

SupportedBandListHRPD ::=           SEQUENCE (SIZE (1..maxCDMA-BandClass)) OF BandclassCDMA2000

IRAT-ParametersCDMA2000-1XRTT ::=   SEQUENCE {
    supportedBandList1XRTT              SupportedBandList1XRTT,
    tx-Config1XRTT                      ENUMERATED {single, dual},
    rx-Config1XRTT                      ENUMERATED {single, dual}
}

IRAT-ParametersCDMA2000-1XRTT-v920 ::=  SEQUENCE {
    e-CSFB-1XRTT-r9                     ENUMERATED {supported},
    e-CSFB-ConcPS-Mob1XRTT-r9           ENUMERATED {supported}          OPTIONAL
}

IRAT-ParametersCDMA2000-1XRTT-v1020 ::= SEQUENCE {
    e-CSFB-dual-1XRTT-r10               ENUMERATED {supported}
}

IRAT-ParametersCDMA2000-v1130 ::=       SEQUENCE {
    cdma2000-NW-Sharing-r11                 ENUMERATED {supported}      OPTIONAL
}

SupportedBandList1XRTT ::=          SEQUENCE (SIZE (1..maxCDMA-BandClass)) OF BandclassCDMA2000

CSG-ProximityIndicationParameters-r9 ::=    SEQUENCE {
    intraFreqProximityIndication-r9 ENUMERATED {supported}          OPTIONAL,
    interFreqProximityIndication-r9 ENUMERATED {supported}          OPTIONAL,
    utran-ProximityIndication-r9        ENUMERATED {supported}          OPTIONAL
}
```

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NeighCellSI-AcquisitionParameters-r9 ::=    SEQUENCE {
    intraFreqSI-AcquisitionForHO-r9 ENUMERATED {supported}          OPTIONAL,
    interFreqSI-AcquisitionForHO-r9 ENUMERATED {supported}          OPTIONAL,
    utran-SI-AcquisitionForHO-r9        ENUMERATED {supported}          OPTIONAL
}

SON-Parameters-r9 ::=               SEQUENCE {
    rach-Report-r9                      ENUMERATED {supported}          OPTIONAL
}

UE-BasedNetwPerfMeasParameters-r10 ::=  SEQUENCE {
    loggedMeasurementsIdle-r10              ENUMERATED {supported}      OPTIONAL,
    standaloneGNSS-Location-r10             ENUMERATED {supported}      OPTIONAL
}

UE-BasedNetwPerfMeasParameters-v1250 ::=    SEQUENCE {
    loggedMBSFNMeasurements-r12             ENUMERATED {supported}
}

OTDOA-PositioningCapabilities-r10 ::=   SEQUENCE {
    otdoa-UE-Assisted-r10                   ENUMERATED {supported},
    interFreqRSTD-Measurement-r10           ENUMERATED {supported}      OPTIONAL
}

Other-Parameters-r11 ::=                SEQUENCE {
    inDeviceCoexInd-r11                     ENUMERATED {supported}      OPTIONAL,
    powerPrefInd-r11                        ENUMERATED {supported}      OPTIONAL,
    ue-Rx-TxTimeDiffMeasurements-r11        ENUMERATED {supported}      OPTIONAL
}

Other-Parameters-v11d0 ::=              SEQUENCE {
    inDeviceCoexInd-UL-CA-r11               ENUMERATED {supported}      OPTIONAL
}

MBMS-Parameters-r11 ::=             SEQUENCE {
    mbms-SCell-r11                          ENUMERATED {supported}      OPTIONAL,
    mbms-NonServingCell-r11                 ENUMERATED {supported}      OPTIONAL
}

MBMS-Parameters-v1250 ::=               SEQUENCE {
    mbms-AsyncDC-r12                        ENUMERATED {supported}      OPTIONAL
}

WLAN-IW-Parameters-r12 ::=  SEQUENCE {
    wlan-IW-RAN-Rules-r12                   ENUMERATED {supported}      OPTIONAL,
    wlan-IW-ANDSF-Policies-r12                      ENUMERATED {supported}      OPTIONAL
}

NAICS-Capability-List-r12 ::= SEQUENCE (SIZE (1..maxNAICS-Entries-r12)) OF NAICS-Capability-Entry-
r12


NAICS-Capability-Entry-r12  ::= SEQUENCE {
    numberOfNAICS-CapableCC-r12             INTEGER(1..5),
    numberOfAggregatedPRB-r12               ENUMERATED {
                                                n50, n75, n100, n125, n150, n175,
                                                n200, n225, n250, n275, n300, n350,
                                                n400, n450, n500, spare},
    ...
}

SL-Parameters-r12 ::=               SEQUENCE {
    commSimultaneousTx-r12                  ENUMERATED {supported}      OPTIONAL,
    commSupportedBands-r12                  FreqBandIndicatorListEUTRA-r12  OPTIONAL,
    discSupportedBands-r12                  SupportedBandInfoList-r12   OPTIONAL,
    discScheduledResourceAlloc-r12          ENUMERATED {supported}      OPTIONAL,
    disc-UE-SelectedResourceAlloc-r12       ENUMERATED {supported}      OPTIONAL,
    disc-SLSS-r12                           ENUMERATED {supported}      OPTIONAL,
    discSupportedProc-r12                   ENUMERATED {n50, n400}      OPTIONAL
}

SupportedBandInfoList-r12 ::=       SEQUENCE (SIZE (1..maxBands)) OF SupportedBandInfo-r12

SupportedBandInfo-r12 ::=           SEQUENCE {
    support-r12                             ENUMERATED {supported}  OPTIONAL
}

FreqBandIndicatorListEUTRA-r12 ::=      SEQUENCE (SIZE (1..maxBands)) OF FreqBandIndicator-r11
```

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-- ASN1STOP
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UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
accessStratumRelease Set to rel12 in this version of the specification.	-
alternativeTBS-Indices Indicates whether the UE supports alternative TBS indices for I_{TBS} 26 and 33 as specified in TS 36.213 [23].	-
alternativeTimeToTrigger Indicates whether the UE supports alternativeTimeToTrigger.	No
bandCombinationListEUTRA One entry corresponding to each supported band combination listed in the same order as in *supportedBandCombination.*	-
BandCombinationParameters-v1090 If included, the UE shall include the same number of entries, and listed in the same order, as in *BandCombinationParameters-r10*.	-
BandCombinationParameters-v1130 The field is applicable to each supported CA bandwidth class combination (i.e. CA configuration in TS 36.101 [42, Section 5.6A.1]) indicated in the corresponding band combination. If included, the UE shall include the same number of entries, and listed in the same order, as in *BandCombinationParameters-r10*.	-
bandEUTRA E-UTRA band as defined in TS 36.101 [42]. In case the UE includes *bandEUTRA-v9e0* or *bandEUTRA-v1090*, the UE shall set the corresponding entry of *bandEUTRA* (i.e. without suffix) or *bandEUTRA-r10* respectively to *maxFBI*.	-
bandListEUTRA One entry corresponding to each supported E-UTRA band listed in the same order as in *supportedBandListEUTRA*.	-
bandParametersUL, bandParametersDL Indicates the supported parameters for the band. UE shall indicate parameters for only one CA uplink or downlink bandwidth class in a single band entry for one band combination entry.	-
benefitsFromInterruption Indicates whether the UE power consumption would benefit from being allowed to cause interruptions to serving cells when performing measurements of deactivated SCell carriers for *measCycleSCell* of less than 640ms, as specified in TS 36.133 [16].	No
CA-BandwidthClass The CA bandwidth class supported by the UE as defined in TS 36.101 [42, Table 5.6A-1]. The UE explicitly includes all the supported CA bandwidth class combinations in the band combination signalling. Support for one CA bandwidth class does not implicitly indicate support for another CA bandwidth class.	-
cdma2000-NW-Sharing Indicates whether the UE supports network sharing for CDMA2000.	-
commSimultaneousTx Indicates whether the UE supports simultaneous transmission of EUTRA and sidelink communication (on different carriers) in all bands for which the UE indicated sidelink support in a band combination (using *commSupportedBandsPerBC*).	-
commSupportedBands Indicates the bands on which the UE supports sidelink communication, by an independent list of bands i.e. separate from the list of supported E UTRA band, as indicated in *supportedBandListEUTRA*.	-
commSupportedBandsPerBC Indicates, for a particular band combination, the bands on which the UE supports simultaneous reception of EUTRA and sidelink communication. If the UE indicates support simultaneous transmission (using *commSimultaneousTx*), it also indicates, for a particular band combination, the bands on which the UE supports simultaneous transmission of EUTRA and sidelink communication. The first bit refers to the first band included in *commSupportedBands*, with value 1 indicating sidelink is supported.	-
crossCarrierScheduling	Yes
crs-DiscoverySignalsMeas Indicates whether the UE supports CRS based discovery signals measurement, and PDSCH/EPDCCH RE mapping with zero power CSI-RS configured for discovery signals.	FFS
crs-InterfHandl Indicates whether the UE supports CRS interference handling.	No
csi-RS-DiscoverySignalsMeas Indicates whether the UE supports CSI-RS based discovery signals measurement. If this field is included, the UE shall also include *crs-DiscoverySignalsMeas*.	FFS

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
csi-SubframeSet Indicates whether the UE supports REL-12 DL CSI subframe set configuration, REL-12 DL CSI subframe set dependent CSI measurement/feedback, configuration of up to 2 CSI-IM resources for a CSI process with no more than 4 CSI-IM resources for all CSI processes of one frequency if the UE supports tm10, configuration of two ZP-CSI-RS for tm1 to tm9, PDSCH RE mapping with two ZP-CSI-RS configurations, and EPDCCH RE mapping with two ZP-CSI-RS configurations if the UE supports EPDCCH. This field is only applicable for UEs supporting TDD.	-
dc-Support Including this field indicates that the UE supports synchronous DC and power control mode 1. Including this field for a band combination entry comprising of single band entry indicates that the UE supports intra-band contiguous DC. Including this field for a band combination entry comprising of two or more band entries, indicates that the UE supports DC for these bands and that the serving cells corresponding to a band entry shall belong to one cell group (i.e. MCG or SCG). Including field *asynchronous* indicates that the UE supports asynchronous DC and power control mode 2. Including this field for a TDD/FDD band combination indicates that the UE supports TDD/FDD DC for this band combination.	-
deviceType UE may set the value to "*noBenFromBatConsumpOpt*" when it does not foresee to particularly benefit from NW-based battery consumption optimisation. Absence of this value means that the device does benefit from NW-based battery consumption optimisation.	-
discoverySignalsInDeactSCell Indicates whether the UE supports the behaviour on DL signals and physical channels when SCell is deactivated and discovery signals measurement is configured as specified in TS 36.211 [17, 6.11A]. This field is included only if UE supports carrier aggregation and includes *crs-DiscoverySignalsMeas*.	FFS
discScheduledResourceAlloc Indicates whether the UE supports transmission of discovery announcements based on network scheduled resource allocation.	-
disc-UE-SelectedResourceAlloc Indicates whether the UE supports transmission of discovery announcements based on UE autonomous resource selection.	-
disc-SLSS Indicates whether the UE supports Sidelink Synchronization Signal (SLSS) transmission and reception for sidelink discovery.	-
discSupportedBands Indicates the bands on which the UE supports sidelink discovery. One entry corresponding to each supported E UTRA band, listed in the same order as in *supportedBandListEUTRA*.	-
discSupportedProc Indicates the number of processes supported by the UE for sidelink discovery.	-
dl-256QAM Indicates whether the UE supports 256QAM in DL on the band.	-
dtm Indicates whether the UE supports DTM in GERAN.	-
e-CSFB-1XRTT Indicates whether the UE supports enhanced CS fallback to CDMA2000 1xRTT or not.	Yes
e-CSFB-ConcPS-Mob1XRTT Indicates whether the UE supports concurrent enhanced CS fallback to CDMA2000 1xRTT and PS handover/ redirection to CDMA2000 HRPD.	Yes
e-CSFB-dual-1XRTT Indicates whether the UE supports enhanced CS fallback to CDMA2000 1xRTT for dual Rx/Tx configuration. This bit can only be set to supported if *tx-Config1XRTT* and *rx-Config1XRTT* are both set to dual.	Yes
e-HARQ-Pattern-FDD Indicates whether the UE supports enhanced HARQ pattern for TTI bundling operation for FDD.	-
Enhanced-4TxCodebook Indicates whether the UE supports enhanced 4Tx codebook.	No
enhancedDualLayerTDD Indicates whether the UE supports enhanced dual layer (PDSCH transmission mode 8) for TDD or not.	-
ePDCCH Indicates whether the UE can receive DCI on UE specific search space on Enhanced PDCCH.	Yes
e-RedirectionUTRA	Yes
e-RedirectionUTRA-TDD	Yes

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
Indicates whether the UE supports enhanced redirection to UTRA TDD to multiple carrier frequencies both with and without using related SIB provided by *RRCConnectionRelease* or not.	
extendedMaxMeasId Indicates whether the UE supports extended number of measurement identies as defined by *maxMeasId-r12*.	No
extended-RLC-LI-Field Indicates whether the UE supports 15 bit RLC length indicator.	-
extendedRSRQ-LowerRange Indicates whether the UE supports the extended RSRQ lower value range from -34dB to -19.5dB in measurement configuration and reporting as specified in TS 36.133 [16].	No
featureGroupIndicators, featureGroupIndRel9Add, featureGroupIndRel10 The definitions of the bits in the bit string are described in Annex B.1 (for *featureGroupIndicators* and *featureGroupIndRel9Add*) and in Annex C.1.(for *featureGroupIndRel10*)	Yes
fourLayerTM3-TM4 Indicates whether the UE supports 4-layer spatial multiplexing for TM3 and TM4.	-
fourLayerTM3-TM4-perCC Indicates whether the UE supports 4-layer spatial multiplexing for TM3 and TM4 for the component carrier.	-
freqBandPriorityAdjustment Indicates whether the UE supports the prioritization of frequency bands in *multiBandInfoList* over the band in *freqBandIndicator* as defined by *freqBandIndicatorPriority-r12*.	-
freqBandRetrieval Indicates whether the UE supports reception of *requestedFrequencyBands.*	-
halfDuplex If *halfDuplex* is set to true, only half duplex operation is supported for the band, otherwise full duplex operation is supported.	-
incMonEUTRA Indicates whether the UE supports increased number of E-UTRA carrier monitoring in RRC_IDLE and RRC_CONNECTED, as specified in TS 36.133 [16].	No
incMonUTRA Indicates whether the UE supports increased number of UTRA carrier monitoring in RRC_IDLE and RRC_CONNECTED, as specified in TS 36.133 [16].	No
inDeviceCoexInd Indicates whether the UE supports in-device coexistence indication as well as autonomous denial functionality.	Yes
inDeviceCoexInd-UL-CA Indicates whether the UE supports UL CA related in-device coexistence indication. This field can be included only if *inDeviceCoexInd* is included. The UE supports *inDeviceCoexInd-UL-CA* in the same duplexing modes as it supports *inDeviceCoexInd*.	-
interBandTDD-CA-WithDifferentConfig Indicates whether the UE supports inter-band TDD carrier aggregation with different UL/DL configuration combinations. The first bit indicates UE supports the configuration combination of SCell DL subframes are a subset of PCell and PSCell by SIB1 configuration and the configuration combination of SCell DL subframes are a superset of PCell and PSCell by SIB1 configuration; the second bit indicates UE supports the configuration combination of SCell DL subframes are neither superset nor subset of PCell and PSCell by SIB1 configuration. This field is included only if UE supports inter-band TDD carrier aggregation.	-
interFreqBandList One entry corresponding to each supported E-UTRA band listed in the same order as in *supportedBandListEUTRA*.	-
interFreqNeedForGaps Indicates need for measurement gaps when operating on the E-UTRA band given by the entry in *bandListEUTRA or on the E-UTRA band combination given by the entry in bandCombinationListEUTRA* and measuring on the E-UTRA band given by the entry in *interFreqBandList*.	-
interFreqProximityIndication Indicates whether the UE supports proximity indication for inter-frequency E-UTRAN CSG member cells.	-
interFreqRSTD-Measurement Indicates whether the UE supports inter-frequency RSTD measurements for OTDOA positioning [54].	Yes
interFreqSI-AcquisitionForHO Indicates whether the UE supports, upon configuration of si-RequestForHO by the network,	Yes

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
acquisition and reporting of relevant information using autonomous gaps by reading the SI from a neighbouring inter-frequency cell.	
interRAT-BandList One entry corresponding to each supported band of another RAT listed in the same order as in the *interRAT-Parameters*.	-
interRAT-NeedForGaps Indicates need for DL measurement gaps when operating on the E-UTRA band given by the entry in *bandListEUTRA or on the E-UTRA band combination given by the entry in bandCombinationListEUTRA* and measuring on the inter-RAT band given by the entry in the *interRAT-BandList*.	-
interRAT-PS-HO-ToGERAN Indicates whether the UE supports inter-RAT PS handover to GERAN or not.	Yes
intraBandContiguousCC-InfoList Indicates, per serving carrier of which the corresponding bandwidth class includes multiple serving carriers (i.e. bandwidth class B, C, D and so on), the maximum number of supported layers for spatial multiplexing in DL and the maximum number of CSI processes supported. The number of entries is equal to the number of component carriers in the corresponding bandwidth class. The UE shall support the setting indicated in each entry of the list regardless of the order of entries in the list.The UE shall include the field only if it supports 4-layer spatial multiplexing in transmission mode3/4 for a subset of component carriers in the corresponding bandwidth class, or if the maximum number of supported layers for at least one component carrier is higher than *supportedMIMO-CapabilityDL-r10* in the corresponding bandwidth class, or if the number of CSI processes for at least one component carrier is higher than *supportedCSI-Proc-r11* in the corresponding band.	-
intraFreqProximityIndication Indicates whether the UE supports proximity indication for intra-frequency E-UTRAN CSG member cells.	-
intraFreqSI-AcquisitionForHO Indicates whether the UE supports, upon configuration of si-RequestForHO by the network, acquisition and reporting of relevant information using autonomous gaps by reading the SI from a neighbouring intra-frequency cell.	Yes
loggedMBSFNMeasurements Indicates whether the UE supports logged measurements for MBSFN. A UE indicating support for logged measurements for MBSFN shall also indicate support for logged measurements in Idle mode.	-
loggedMeasurementsIdle Indicates whether the UE supports logged measurements in Idle mode.	-
logicalChannelSR-ProhibitTimer Indicates whether the UE supports the *logicalChannelSR-ProhibitTimer* as defined in TS 36.321 [6].	-
longDRX-Command Indicates whether the UE supports Long DRX Command MAC Control Element.	-
maxNumberROHC-ContextSessions Set to the maximum number of concurrently active ROHC contexts supported by the UE, excluding context sessions that leave all headers uncompressed. cs2 corresponds with 2 (context sessions), cs4 corresponds with 4 and so on. The network ignores this field if the UE supports none of the ROHC profiles in *supportedROHC-Profiles*.	-
mbms-AsyncDC Indicates whether the UE in RRC_CONNECTED supports MBMS reception on a frequency indicated in an *MBMSInterestIndication* message, where (according to *supportedBandCombination*) the carriers that are or can be configured as serving cells in the MCG and the SCG are not synchronized. If this field is included, the UE shall also include *mbms-SCell* and *mbms-NonServingCell*.	TBD
mbms-SCell Indicates whether the UE in RRC_CONNECTED supports MBMS reception on a frequency indicated in an *MBMSInterestIndication* message, when an SCell is configured on that frequency (regardless of whether the SCell is activated or deactivated).	Yes
mbms-NonServingCell Indicates whether the UE in RRC_CONNECTED supports MBMS reception on a frequency indicated in an *MBMSInterestIndication* message, where (according to *supportedBandCombination* and to network synchronization properties) a serving cell may be additionally configured. If this field is included, the UE shall also include the *mbms-SCell* field.	Yes
mfbi-UTRA It indicates if the UE supports the signalling requirements of multiple radio frequency bands in a UTRA FDD cell, as defined in TS 25.307 [65].	-

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
MIMO-CapabilityDL The number of supported layers for spatial multiplexing in DL. The field may be absent for category 0 and category 1 UE in which case the number of supported layers is 1.	-
MIMO-CapabilityUL The number of supported layers for spatial multiplexing in UL. Absence of the field means that the number of supported layers is 1.	-
modifiedMPR-Behavior Field encoded as a bit map, where at least one bit N is set to "1" if UE supports modified MPR/A-MPR behaviour N, see TS 36.101 [42]. All remaining bits of the field are set to "0". The leading / leftmost bit (bit 0) corresponds to modified MPR/A-MPR behaviour 0, the next bit corresponds to modified MPR/A-MPR behaviour 1 and so on. Absence of this field means that UE does not support any modified MPR/A-MPR behaviour.	-
multiACK-CSIreporting Indicates whether the UE supports multi-cell HARQ ACK and periodic CSI reporting and SR on PUCCH format 3.	Yes
multiClusterPUSCH-WithinCC	Yes
multiNS-Pmax Indicates whether the UE supports the mechanisms defined for cells broadcasting *NS-PmaxList*.	-
multipleTimingAdvance Indicates whether the UE supports multiple timing advances for each band combination listed in *supportedBandCombination*. If the band combination comprised of more than one band entry (i.e., inter-band or intra-band non-contiguous band combination), the field indicates that the same or different timing advances on different band entries are supported. If the band combination comprised of one band entry (i.e., intra-band contiguous band combination), the field indicates that the same or different timing advances across component carriers of the band entry are supported.	-
naics-Capability-List Indicates that UE supports NAICS, i.e. receiving assistance information from serving cell and using it to cancel or suppress interference of neighbouring cell(s) for at least one band combination. If not present, UE does not support NAICS for any band combination. The field *numberOfNAICS-CapableCC* indicates the maximum number of component carriers where the NAICS processing is supported and the field *numberOfAggregatedPRB* indicates the maximum aggregated bandwidth across these of component carriers (expressed as a number of PRBs) with the restriction that NAICS is only supported over the full carrier bandwidth. - For *numberOfNAICS-CapableCC* = 1, UE signals one value for *numberOfAggregatedPRB* from the range {50, 75, 100}; - For *numberOfNAICS-CapableCC* = 2, UE signals one value for *numberOfAggregatedPRB* from the range {50, 75, 100, 125, 150, 175, 200}; - For *numberOfNAICS-CapableCC* = 3, UE signals one value for *numberOfAggregatedPRB* from the range {50, 75, 100, 125, 150, 175, 200, 225, 250, 275, 300}; - For *numberOfNAICS-CapableCC* = 4, UE signals one value for *numberOfAggregatedPRB* from the range {50, 100, 150, 200, 250, 300, 350, 400}; For *numberOfNAICS-CapableCC* = 5, UE signals one value for *numberOfAggregatedPRB* from the range {50, 100, 150, 200, 250, 300, 350, 400, 450, 500}.	-
NonContiguousUL-RA-WithinCC-List One entry corresponding to each supported E-UTRA band listed in the same order as in *supportedBandListEUTRA*.	No
noResourceRestrictionForTTIBundling Indicate wheter the UE supports TTI bundling operation without resource allocation restriction.	-
otdoa-UE-Assisted Indicates whether the UE supports UE-assisted OTDOA positioning [54].	Yes
pdcp-SN-Extension Indicates whether the UE supports 15 bit length of PDCP sequence number.	-
phy-TDD-ReConfig-FDD-PCell Indicates whether the UE supports TDD UL/DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI on a FDD PCell, and HARQ feedback according to UL and DL HARQ reference configurations. This bit can only be set to supported only if the UE supports FDD PCell and *phy-TDD-ReConfig-TDD-PCell* is set to supported.	-
phy-TDD-ReConfig-TDD-PCell Indicates whether the UE supports TDD UL/DL reconfiguration for TDD serving cell(s) via monitoring PDCCH with eIMTA-RNTI on a TDD PCell, and HARQ feedback according to UL and DL HARQ reference configurations, and PUCCH format 3.	-
pmi-Disabling	Yes

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
powerPrefInd Indicates whether the UE supports power preference indication.	No
pusch-FeedbackMode Indicates whether the UE supports PUSCH feedback mode 3-2.	No
pusch-SRS-PowerControl-SubframeSet Indicates whether the UE supports subframe set dependent UL power control for PUSCH and SRS. This field is only applicable for UEs supporting TDD.	-
rach-Report Indicates whether the UE supports delivery of rachReport.	-
requestedBands Indicates the frequency bands requested by E-UTRAN.	-
rsrqMeasWideband Indicates whether the UE can perform RSRQ measurements with wider bandwidth.	Yes
rsrq-OnAllSymbols Indicates whether the UE can perform RSRQ measurement on all OFDM symbols and also support the extended RSRQ upper value range from -3dB to 2.5dB in measurement configuration and reporting as specified in TS 36.133 [16].	No
simultaneousPUCCH-PUSCH	Yes
simultaneousRx-Tx Indicates whether the UE supports simultaneous reception and transmission on different bands for each band combination listed in *supportedBandCombination*. This field is only applicable for inter-band TDD band combinations. A UE indicating support of *simultaneousRx-Tx* and *dc-Support-r12* shall support different UL/DL configurations between PCell and PSCell.	-
srvcc-FromUTRA-FDD-ToGERAN Indicates whether UE supports SRVCC handover from UTRA FDD PS HS to GERAN CS.	-
srvcc-FromUTRA-FDD-ToUTRA-FDD Indicates whether UE supports SRVCC handover from UTRA FDD PS HS to UTRA FDD CS.	-
srvcc-FromUTRA-TDD128-ToGERAN Indicates whether UE supports SRVCC handover from UTRA TDD 1.28Mcps PS HS to GERAN CS.	-
srvcc-FromUTRA-TDD128-ToUTRA-TDD128 Indicates whether UE supports SRVCC handover from UTRA TDD 1.28Mcps PS HS to UTRA TDD 1.28Mcps CS.	-
ss-CCH-InterfHandl Indicates whether the UE supports synchronisation signal and common channel interference handling.	Yes
standaloneGNSS-Location Indicates whether the UE is equipped with a standalone GNSS receiver that may be used to provide detailed location information in RRC measurement report and logged measurements.	-
supportedBandCombination Includes the supported CA band combinations, if any, and may include all the supported non-CA bands.	-
supportedBandCombinationAdd-r11 Includes additional supported CA band combinations in case maximum number of CA band combinations of *supportedBandCombination* is exceeded.	-
SupportedBandCombinationAdd-v11d0, SupportedBandCombinationAdd-v1250, SupportedBandCombinationAdd-v1270 If included, the UE shall include the same number of entries, and listed in the same order, as in *SupportedBandCombinationAdd-r11*.	-
SupportedBandCombinationExt, SupportedBandCombination-v1090, SupportedBandCombination-v10i0, SupportedBandCombination-v1130, SupportedBandCombination-v1250, SupportedBandCombination-v1270 If included, the UE shall include the same number of entries, and listed in the same order, as in *supportedBandCombination-r10*.	-
SupportedBandGERAN GERAN band as defined in TS 45.005 [20].	No
SupportedBandList1XRTT One entry corresponding to each supported CDMA2000 1xRTT band class.	-
SupportedBandListEUTRA Includes the supported E-UTRA bands. This field shall include all bands which are indicated in *BandCombinationParameters*.	-
SupportedBandListEUTRA-v9e0, SupportedBandListEUTRA-v1250 If included, the UE shall include the same number of entries, and listed in the same order, as in *supportedBandListEUTRA* (i.e. without suffix).	-
SupportedBandListGERAN	No

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
SupportedBandListHRPD One entry corresponding to each supported CDMA2000 HRPD band class.	-
SupportedBandUTRA-FDD UTRA band as defined in TS 25.101 [17].	-
SupportedBandUTRA-TDD128 UTRA band as defined in TS 25.102 [18].	-
SupportedBandUTRA-TDD384 UTRA band as defined in TS 25.102 [18].	-
SupportedBandUTRA-TDD768 UTRA band as defined in TS 25.102 [18].	-
supportedBandwidthCombinationSet The *supportedBandwidthCombinationSet* indicated for a band combination is applicable to all bandwidth classes indicated by the UE in this band combination. Field encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination, see 36.101 [42]. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. The UE shall neither include the field for a non-CA band combination, nor for a CA band combination for which the UE only supports Bandwidth Combination Set 0.	-
supportedCellGrouping This field indicates for which mapping of serving cells to cell groups (i.e. MCG or SCG) the UE supports asynchronous DC. This field is only present for a band combination with more than two band entries where the UE supports asynchronous DC. If this field is not present but asynchronous operation is supported, the UE supports all possible mappings of serving cells to cell groups for the band combination. The bitmap size is selected based on the number of entries in the combinations, i.e., in case of three entries, the bitmap corresponding to *threeEntries* is selected and so on. A bit in the bit string set to 1 indicates that the UE supports asynchronous DC for the cell grouping option represented by the concerned bit position. Each bit position represents a different cell grouping option, as illustrated by a table, see NOTE 5. A cell grouping option is represented by a number of bits, each representing a particular band entry in the band combination with the left-most bit referring to the band listed first in the band combination, etc. Value 0 indicates that the carriers of the corresponding band entry are mapped to a first cell group, while value 1 indicates that the carriers of the corresponding band entry are mapped to a second cell group. It is noted that the mapping table does not include entries with all bits set to the same value (0 or 1) as this does not represent a DC scenario (i.e. indicating that the UE supports that all carriers of the corresponding band entry are in one cell group).	-
supportedCSI-Proc Indicates the maximum number of CSI processes supported on a component carrier within a band. Value n1 corresponds to 1 CSI process, value n3 corresponds to 3 CSI processes, and value n4 corresponds to 4 CSI processes. If this field is included, the UE shall include the same number of entries listed in the same order as in *BandParameters*. If the UE supports at least 1 CSI process on any component carrier, then the UE shall include this field in all bands in all band combinations.	-
supportedNAICS-2CRS-AP If included, the UE supports NAICS for the band combination. The UE shall include a bitmap of the same length, and in the same order, as in *naics-Capability-List,* to indicate 2 CRS AP NAICS capability of the band combination. The first/ leftmost bit points to the first entry of *naics-Capability-List*, the second bit points to the second entry of *naics-Capability-List*, and so on. For band combinations with a single component carrier, UE is only allowed to indicate {*numberOfNAICS-CapableCC*, *numberOfAggregatedPRB*} = {1, 100} if NAICS is supported.	-
supportRohcContextContinue Indicates whether the UE supports ROHC context continuation operation where the UE does not reset the current ROHC context upon handover.	-
tdd-SpecialSubframe Indicates whether the UE supports TDD special subframe defined in TS 36.211 [21].	No
tdd-FDD-CA-PCellDuplex The presence of this field indicates that the UE supports TDD/FDD CA in any supported band combination including at least one FDD band with *bandParametersUL* and at least one TDD band with *bandParametersUL*. The first bit is set to "1" if UE supports the TDD PCell. The second bit is set to “1” if UE supports FDD PCell. This field is included only if the UE supports band combination including at least one FDD band with *bandParametersUL* and at least one TDD band with *bandParametersUL*. If this field is included, the UE shall set at least one of the bits as “1”. If this field is included with DC, then it is applicable within a CG, and the presence of this field indicates the capability of the UE to support TDD/FDD CA with at least one FDD band	-

UE-EUTRA-Capability field descriptions	*FDD/ TDD diff*
and at least one TDD band in the same CG, with the value indicating the support for TDD/FDD PCell (PSCell).	
timerT312 Indicates whether the UE supports T312.	No
tm5-FDD Indicates whether the UE supports the PDSCH transmission mode 5 in FDD.	-
tm5-TDD Indicates whether the UE supports the PDSCH transmission mode 5 in TDD.	-
tm9-With-8Tx-FDD	No
twoAntennaPortsForPUCCH	No
txDiv-PUCCH1b-ChSelect Indicates whether the UE supports transmit diversity for PUCCH format 1b with channel selection.	Yes
ue-Category UE category as defined in TS 36.306 [5]. Set to values 1 to 12 in this version of the specification.	-
ue-CategoryDL UE DL category as defined in TS 36.306 [5]. For ASN.1 compatibility, a UE indicating DL category 0 shall also indicate any of the categories (1..5) in *ue-Category* (without suffix), which is ignored by the eNB. The field *ue-CategoryDL* is set to values 0, 6, 7, 9 to 16 in this version of the specification.	-
ue-CategoryUL UE UL category as defined in TS 36.306 [5]. The field *ue-CategoryUL-r12* is set to values 0, 3, 5, 7, 8 and 13 in this version of the specification.	-
ue-Rx-TxTimeDiffMeasurements Indicates whether the UE supports Rx - Tx time difference measurements.	No
ue-SpecificRefSigsSupported	No
ue-TxAntennaSelectionSupported TRUE indicates that the UE is capable of supporting UE transmit antenna selection as described in TS 36.213 [23, 8.7].	Yes
ul-CoMP Indicates whether the UE supports UL Coordinated Multi-Point operation.	No
utran-ProximityIndication Indicates whether the UE supports proximity indication for UTRAN CSG member cells.	-
ul-64QAM Indicates whether the UE supports 64QAM in UL on the band. This field is only present when the field ue-*CategoryUL* is set to 5, 8 or 13.	-
utran-SI-AcquisitionForHO Indicates whether the UE supports, upon configuration of si-RequestForHO by the network, acquisition and reporting of relevant information using autonomous gaps by reading the SI from a neighbouring UMTS cell.	Yes
voiceOverPS-HS-UTRA-FDD Indicates whether UE supports IMS voice according to GSMA IR.58 profile in UTRA FDD.	-
voiceOverPS-HS-UTRA-TDD128 Indicates whether UE supports IMS voice in UTRA TDD 1.28Mcps.	-
wlan-IW-RAN-Rules Indicates whether the UE supports RAN-assisted WLAN interworking based on access network selection and traffic steering rules.	-
wlan-IW-ANDSF-Policies Indicates whether the UE supports RAN-assisted WLAN interworking based on ANDSF policies.	-

NOTE 1: The IE *UE-EUTRA-Capability* does not include AS security capability information, since these are the same as the security capabilities that are signalled by NAS. Consequently AS need not provide "man-in-the-middle" protection for the security capabilities.

NOTE 2: The column FDD/ TDD diff indicates if the UE is allowed to signal, as part of the additional capabilities for an XDD mode i.e. within *UE-EUTRA-CapabilityAddXDD-Mode-xNM*, a different value compared to the value signalled elsewhere within *UE-EUTRA-Capability* (i.e. the common value, supported for both XDD modes). A '-' is used to indicate that it is not possible to signal different values (used for fields for which the field description is provided for other reasons). Annex E specifies for which TDD and FDD serving cells a UE supporting TDD/FDD CA shall support a capability for which it indicates support within the capability signalling.

NOTE 3: All the combinations of *CA-MIMO-ParametersUL* and *CA-MIMO-ParametersDL* for one band and across all the bands in each *BandCombinationParameters* are supported by the UE and have the same measurement gap requirement (i.e. the same *BandInfoEUTRA* applies). The *BandCombinationParameters* for the same band combination can be included more than once.

NOTE 4: UE CA and measurement capabilities indicate the combinations of frequencies that can be configured as serving frequencies.

NOTE 5: The grouping of the cells to the first and second cell group, as indicated by *supportedCellGrouping*, is shown in the table below.

Nr of Band Entries:	5	4	3
Length of Bit-String:	15	7	3
Bit String Position	**Cell grouping option (0= first cell group, 1= second cell group)**		
1	00001	0001	001
2	00010	0010	010
3	00011	0011	011
4	00100	0100	
5	00101	0101	
6	00110	0110	
7	00111	0111	
8	01000		
9	01001		
10	01010		
11	01011		
12	01100		
13	01101		
14	01110		
15	01111		

– *UE-RadioPagingInfo*

The *UE-RadioPagingInfo* IE contains information needed for paging of category 0 UE.

UE-RadioPagingInfo information element

```
-- ASN1START

UE-RadioPagingInfo-r12 ::=              SEQUENCE {
    ue-Category-v1250                   INTEGER (0)         OPTIONAL,
    ...
}

-- ASN1STOP
```

– *UE-TimersAndConstants*

The IE *UE-TimersAndConstants* contains timers and constants used by the UE in either RRC_CONNECTED or RRC_IDLE.

***UE-TimersAndConstants* information element**

```
-- ASN1START

UE-TimersAndConstants ::=           SEQUENCE {
    t300                                ENUMERATED {
                                            ms100, ms200, ms300, ms400, ms600, ms1000, ms1500,
                                            ms2000},
    t301                                ENUMERATED {
                                            ms100, ms200, ms300, ms400, ms600, ms1000, ms1500,
                                            ms2000},
    t310                                ENUMERATED {
                                            ms0, ms50, ms100, ms200, ms500, ms1000, ms2000},
    n310                                ENUMERATED {
                                            n1, n2, n3, n4, n6, n8, n10, n20},
    t311                                ENUMERATED {
                                            ms1000, ms3000, ms5000, ms10000, ms15000,
                                            ms20000, ms30000},
    n311                                ENUMERATED {
                                            n1, n2, n3, n4, n5, n6, n8, n10},
    ...
}

-- ASN1STOP
```

***UE-TimersAndConstants* field descriptions**
n3xy Constants are described in section 7.4. n1 corresponds with 1, n2 corresponds with 2 and so on.
t3xy Timers are described in section 7.3. Value ms0 corresponds with 0 ms, ms50 corresponds with 50 ms and so on.

– *VisitedCellInfoList*

The IE *VisitedCellInfoList* includes the mobility history information of maximum of 16 most recently visited cells or time spent outside E-UTRA. The most recently visited cell is stored first in the list. The list includes cells visited in RRC_IDLE and RRC_CONNECTED states.

***VisitedCellInfoList* information element**

```
-- ASN1START

VisitedCellInfoList-r12 ::= SEQUENCE (SIZE (1..maxCellHistory-r12)) OF VisitedCellInfo-r12

VisitedCellInfo-r12 ::=             SEQUENCE {
    visitedCellId-r12                   CHOICE {
        cellGlobalId-r12                        CellGlobalIdEUTRA,
        pci-arfcn-r12                           SEQUENCE {
            physCellId-r12                          PhysCellId,
            carrierFreq-r12                         ARFCN-ValueEUTRA-r9
        }
    }                                                               OPTIONAL,
    timeSpent-r12                       INTEGER (0..4095),
    ...
}

-- ASN1STOP
```

***VisitedCellInfoList* field descriptions**
timeSpent This field indicates the duration of stay in the cell or outside E-UTRA approximated to the closest second. If the duration of stay exceeds 4095s, the UE shall set it to 4095s.

– *WLAN-OffloadConfig*

The IE *WLAN-OffloadConfig* includes information for traffic steering between E-UTRAN and WLAN. The fields are applicable to both RAN-assisted WLAN interworking based on access network selection and traffic steering rules and RAN-assisted WLAN interworking based on ANDSF policies unless stated otherwise in the field description.

WLAN-OffloadConfig information element

```
-- ASN1START

WLAN-OffloadConfig-r12 ::=              SEQUENCE {
    thresholdRSRP-r12                       SEQUENCE {
        thresholdRSRP-Low-r12                   RSRP-Range,
        thresholdRSRP-High-r12                  RSRP-Range
    }                                                               OPTIONAL, -- Need OR
    thresholdRSRQ-r12                       SEQUENCE {
        thresholdRSRQ-Low-r12                   RSRQ-Range,
        thresholdRSRQ-High-r12                  RSRQ-Range
    }                                                               OPTIONAL, -- Need OR
    thresholdRSRQ-OnAllSymbolsWithWB-r12    SEQUENCE {
        thresholdRSRQ-OnAllSymbolsWithWB-Low-r12            RSRQ-Range,
        thresholdRSRQ-OnAllSymbolsWithWB-High-r12           RSRQ-Range
    }                                                               OPTIONAL, -- Need OP
    thresholdRSRQ-OnAllSymbols-r12          SEQUENCE {
         thresholdRSRQ-OnAllSymbolsLow-r12                  RSRQ-Range,
         thresholdRSRQ-OnAllSymbolsHigh-r12                 RSRQ-Range
    }                                                               OPTIONAL, -- Need OP
    thresholdRSRQ-WB-r12                    SEQUENCE {
        thresholdRSRQ-WB-Low-r12                            RSRQ-Range,
        thresholdRSRQ-WB-High-r12                           RSRQ-Range
    }                                                               OPTIONAL, -- Need OP

    thresholdChannelUtilization-r12         SEQUENCE {
        thresholdChannelUtilizationLow-r12      INTEGER (0..255),
        thresholdChannelUtilizationHigh-r12     INTEGER (0..255)
    }                                                               OPTIONAL, -- Need OR
    thresholdBackhaul-Bandwidth-r12         SEQUENCE {
        thresholdBackhaulDL-BandwidthLow-r12    WLAN-backhaulRate-r12,
        thresholdBackhaulDL-BandwidthHigh-r12   WLAN-backhaulRate-r12,
        thresholdBackhaulUL-BandwidthLow-r12    WLAN-backhaulRate-r12,
        thresholdBackhaulUL-BandwidthHigh-r12   WLAN-backhaulRate-r12
    }                                                               OPTIONAL, -- Need OR
    thresholdBeaconRSSI-r12                     SEQUENCE {
        thresholdBeaconRSSI-Low-r12                 INTEGER (0..255),
        thresholdBeaconRSSI-High-r12                    INTEGER (0..255)
    }                                                               OPTIONAL, -- Need OR
    offloadPreferenceIndicator-r12          BIT STRING (SIZE (16))      OPTIONAL, -- Need OR
    t-SteeringWLAN-r12                      T-Reselection               OPTIONAL, -- Need OR
    ...
}

WLAN-backhaulRate-r12 ::=                   ENUMERATED
                                        {r0, r4, r8, r16, r32, r64, r128, r256, r512,
                                        r1024, r2048, r4096, r8192, r16384, r32768, r65536,
r131072,
                                        r262144, r524288, r1048576, r2097152, r4194304, r8388608,
                                        r16777216, r33554432, r67108864, r134217728, r268435456,
                                        r536870912, r1073741824, r2147483648, r4294967296}

-- ASN1STOP
```

***WLAN-OffloadConfig* field descriptions**
offloadPreferenceIndicator Indicates the offload preference indicator. Parameter: OPI in TS 24.312 [66]. Only applicable to RAN-assisted WLAN interworking based on ANDSF policies.
thresholdBackhaulDLBandwidth-High Indicates the backhaul available downlink bandwidth threshold used by the UE for traffic steering to WLAN. Parameter: $Thresh_{BackhRateDLWLAN, High}$ in TS 36.304 [4]. Value in kilobits/second. Value rN corresponds to N kbps.
thresholdBackhaulDLBandwidth-Low Indicates the backhaul available downlink bandwidth threshold used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{BackhRateDLWLAN, Low}$ in TS 36.304 [4]. Value in kilobits/second. Value rN corresponds to N kbps.

thresholdBackhaulULBandwidth-High Indicates the backhaul available uplink bandwidth threshold used by the UE for traffic steering to WLAN. Parameter: $Thresh_{BackhRateULWLAN, High}$ in TS 36.304 [4]. Value in kilobits/second. Value rN corresponds to N kbps.
thresholdBackhaulULBandwidth-Low Indicates the backhaul available uplink bandwidth threshold used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{BackhRateULWLAN, Low}$ in TS 36.304 [4]. Value in kilobits/second. Value rN corresponds to N kbps.
thresholdBeaconRSSI-High Indicates the Beacon RSSI threshold used by the UE for traffic steering to WLAN. Parameter: $Thresh_{BeaconRSSIWLAN, High}$ in TS 36.304 [4]. Value 0 corresponds to -128dBm, 1 corresponds to -127dBm and so on.
thresholdBeaconRSSI-Low Indicates the Beacon RSSI threshold used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{BeaconRSSIWLAN, Low}$ in TS 36.304 [4]. Value 0 corresponds to -128dBm, 1 corresponds to -127dBm and so on.
thresholdChannelUtilization-High Indicates the WLAN channel utilization (BSS load) threshold used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{ChUtilWLAN, High}$ in TS 36.304 [4].
thresholdChannelUtilization-Low Indicates the WLAN channel utilization (BSS load) threshold used by the UE for traffic steering to WLAN. Parameter: $Thresh_{ChUtilWLAN, Low}$ in TS 36.304 [4].
thresholdRSRP-High Indicates the RSRP threshold (in dBm) used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{ServingOffloadWLAN, HighP}$ in TS 36.304 [4].
thresholdRSRP-Low Indicates the RSRP threshold (in dBm) used by the UE for traffic steering to WLAN. Parameter: $Thresh_{ServingOffloadWLAN, LowP}$ in TS 36.304 [4].
thresholdRSRQ-High,thresholdRSRQ-OnAllSymbolsHigh, thresholdRSRQ-WB-High, thresholdRSRQ-OnAllSymbolsWithWB-High Indicates the RSRQ threshold (in dB) used by the UE for traffic steering to E-UTRAN. Parameter: $Thresh_{ServingOffloadWLAN, HighQ}$ in TS 36.304 [4]. The UE shall only apply one of threshold values of *thresholdRSRQ-OnAllSymbolsWithWB-High, thresholdRSRQ-OnAllSymbolsHigh, thresholdRSRQ-WB-High* and *thresholdRSRQ-High* as present in *wlan-OffloadConfigCommon* and forward this to upper layer. NOTE 1.
thresholdRSRQ-Low,thresholdRSRQ-OnAllSymbolsLow, thresholdRSRQ-WB-Low, thresholdRSRQ-OnAllSymbolsWithWB-Low Indicates the RSRQ threshold (in dB) used by the UE for traffic steering to WLAN. Parameter: $Thresh_{ServingOffloadWLAN, LowQ}$ in TS 36.304 [4]. The UE shall only apply one of threshold values of *thresholdRSRQ-OnAllSymbolsWithWB-Low, thresholdRSRQ-OnAllSymbolsLow, thresholdRSRQ-WB-Low* and *thresholdRSRQ-Low* as present in *wlan-OffloadConfigCommon* and forward this to upper layer. NOTE 1.
t-SteeringWLAN Indicates the timer value during which the rules should be fulfilled before starting traffic steering between E-UTRAN and WLAN. Parameter: $Tsteering_{WLAN}$ in TS 36.304 [4]. Only applicable to RAN-assisted WLAN interworking based on access network selection and traffic steering rules.

NOTE 1: Within SIB17, E-UTRAN includes the fields corresponding to same RSRQ types as included in SIB1. E.g. if E-UTRAN includes *q-QualMinRSRQ-OnAllSymbols* in SIB1 it also includes *thresholdRSRQ-OnAllSymbols* in SIB17. Within the *RRCConnectionReconfiguration* message E-UTRAN only includes *thresholdRSRQ*, setting the value according to the RSRQ type used for E-UTRAN. The UE shall apply the RSRQ fields (RSRQ threshold, high and low) corresponding to one RSRQ type i.e. the same as it applies for E-UTRAN.

6.3.7 MBMS information elements

– *MBMS-NotificationConfig*

The IE *MBMS-NotificationConfig* specifies the MBMS notification related configuration parameters, that are applicable for all MBSFN areas.

MBMS-NotificationConfig information element

```
-- ASN1START

MBMS-NotificationConfig-r9 ::=              SEQUENCE {
    notificationRepetitionCoeff-r9      ENUMERATED {n2, n4},
    notificationOffset-r9               INTEGER (0..10),
    notificationSF-Index-r9             INTEGER (1..6)
}

-- ASN1STOP
```

***MBMS-NotificationConfig* field descriptions**
notificationOffset
Indicates, together with the *notificationRepetitionCoeff*, the radio frames in which the MCCH information change notification is scheduled i.e. the MCCH information change notification is scheduled in radio frames for which: SFN mod notification repetition period = *notificationOffset*.
notificationRepetitionCoeff
Actual change notification repetition period common for all MCCHs that are configured= shortest modification period/ *notificationRepetitionCoeff*. The 'shortest modificaton period' corresponds with the lowest value of *mcch-ModificationPeriod* of all MCCHs that are configured. Value n2 corresponds to coefficient 2, and so on.
notificationSF-Index
Indicates the subframe used to transmit MCCH change notifications on PDCCH. FDD: Value 1, 2, 3, 4, 5 and 6 correspond with subframe #1, #2, #3 #6, #7, and #8 respectively. TDD: Value 1, 2, 3, 4, and 5 correspond with subframe #3, #4, #7, #8, and #9 respectively.

– *MBSFN-AreaId*

The IE *MBSFN-AreaId* identifies an MBSFN area by means of a locally unique value at lower layers i.e. it concerns parameter N_{ID}^{MBSFN} in TS 36.211 [21, 6.10.2.1].

MBSFN-AreaId information element

```
-- ASN1START

MBSFN-AreaId-r12 ::=                    INTEGER (0..255)

-- ASN1STOP
```

– *MBSFN-AreaInfoList*

The IE *MBSFN-AreaInfoList* contains the information required to acquire the MBMS control information associated with one or more MBSFN areas.

MBSFN-AreaInfoList information element

```
-- ASN1START

MBSFN-AreaInfoList-r9 ::=           SEQUENCE (SIZE(1..maxMBSFN-Area)) OF MBSFN-AreaInfo-r9

MBSFN-AreaInfo-r9 ::=               SEQUENCE {
    mbsfn-AreaId-r9                     MBSFN-AreaId-r12,
    non-MBSFNregionLength               ENUMERATED {s1, s2},
    notificationIndicator-r9                INTEGER (0..7),
    mcch-Config-r9                      SEQUENCE {
        mcch-RepetitionPeriod-r9            ENUMERATED {rf32, rf64, rf128, rf256},
        mcch-Offset-r9                      INTEGER (0..10),
        mcch-ModificationPeriod-r9          ENUMERATED {rf512, rf1024},
        sf-AllocInfo-r9                     BIT STRING (SIZE(6)),
        signallingMCS-r9                    ENUMERATED {n2, n7, n13, n19}
    },
    ...
}

-- ASN1STOP
```

***MBSFN-AreaInfoList* field descriptions**
mcch-ModificationPeriod Defines periodically appearing boundaries, i.e. radio frames for which SFN mod *mcch-ModificationPeriod* = 0. The contents of different transmissions of MCCH information can only be different if there is at least one such boundary in-between them.
mcch-Offset Indicates, together with the *mcch-RepetitionPeriod*, the radio frames in which MCCH is scheduled i.e. MCCH is scheduled in radio frames for which: SFN mod *mcch-RepetitionPeriod* = *mcch-Offset*.
mcch-RepetitionPeriod Defines the interval between transmissions of MCCH information, in radio frames, Value rf32 corresponds to 32 radio frames, rf64 corresponds to 64 radio frames and so on.
non-MBSFNregionLength Indicates how many symbols from the beginning of the subframe constitute the non-MBSFN region. This value applies in all subframes of the MBSFN area used for PMCH transmissions as indicated in the MSI. The values s1 and s2 correspond with 1 and 2 symbols, respectively: see TS 36.211 [21, Table 6.7-1].
notificationIndicator Indicates which PDCCH bit is used to notify the UE about change of the MCCH applicable for this MBSFN area. Value 0 corresponds with the least significant bit as defined in TS 36.212 [22, Section 5.3.3.1] and so on.
sf-AllocInfo Indicates the subframes of the radio frames indicated by the *mcch-RepetitionPeriod* and the *mcch-Offset*, that may carry MCCH. Value "1" indicates that the corresponding subframe is allocated. The following mapping applies: FDD: The first/ leftmost bit defines the allocation for subframe #1 of the radio frame indicated by *mcch-RepetitionPeriod* and *mcch-Offset*, the second bit for #2, the third bit for #3 , the fourth bit for #6, the fifth bit for #7 and the sixth bit for #8. TDD: The first/leftmost bit defines the allocation for subframe #3 of the radio frame indicated by *mcch-RepetitionPeriod* and *mcch-Offset*, the second bit for #4, third bit for #7, fourth bit for #8, fifth bit for #9. Uplink subframes are not allocated. The last bit is not used.
signallingMCS Indicates the Modulation and Coding Scheme (MCS) applicable for the subframes indicated by the field *sf-AllocInfo* and for each (P)MCH that is configured for this MBSFN area, for the first subframe allocated to the (P)MCH within each MCH scheduling period (which may contain the MCH scheduling information provided by MAC). Value n2 corresponds with the value 2 for parameter I_{MCS} in TS 36.213 [23, Table 7.1.7.1-1], and so on.

– *MBSFN-SubframeConfig*

The IE *MBSFN-SubframeConfig* defines subframes that are reserved for MBSFN in downlink.

MBSFN-SubframeConfig information element

```
-- ASN1START

MBSFN-SubframeConfig ::=            SEQUENCE {
    radioframeAllocationPeriod          ENUMERATED {n1, n2, n4, n8, n16, n32},
    radioframeAllocationOffset          INTEGER (0..7),
    subframeAllocation                  CHOICE {
        oneFrame                            BIT STRING (SIZE(6)),
        fourFrames                          BIT STRING (SIZE(24))
    }
}
-- ASN1STOP
```

***MBSFN-SubframeConfig* field descriptions**
fourFrames A bit-map indicating MBSFN subframe allocation in four consecutive radio frames, "1" denotes that the corresponding subframe is allocated for MBSFN. The bitmap is interpreted as follows: FDD: Starting from the first radioframe and from the first/leftmost bit in the bitmap, the allocation applies to subframes #1, #2, #3 , #6, #7, and #8 in the sequence of the four radio-frames. TDD: Starting from the first radioframe and from the first/leftmost bit in the bitmap, the allocation applies to subframes #3, #4, #7, #8, and #9 in the sequence of the four radio-frames. The last four bits are not used. E-UTRAN allocates uplink subframes only if *eimta-MainConfig* is configured.
oneFrame "1" denotes that the corresponding subframe is allocated for MBSFN. The following mapping applies: FDD: The first/leftmost bit defines the MBSFN allocation for subframe #1, the second bit for #2, third bit for #3 , fourth bit for #6, fifth bit for #7, sixth bit for #8. TDD: The first/leftmost bit defines the allocation for subframe #3, the second bit for #4, third bit for #7, fourth bit for #8, fifth bit for #9. E-UTRAN allocates uplink subframes only if *eimta-MainConfig* is configured. The last bit is not used.
radioFrameAllocationPeriod, radioFrameAllocationOffset Radio-frames that contain MBSFN subframes occur when equation *SFN* mod *radioFrameAllocationPeriod* = *radioFrameAllocationOffset* is satisfied. Value n1 for *radioframeAllocationPeriod* denotes value 1, n2 denotes value 2, and so on. When *fourFrames* is used for *subframeAllocation*, the equation defines the first radio frame referred to in the description below. Values *n1* and *n2* are not applicable when *fourFrames* is used.
subframeAllocation Defines the subframes that are allocated for MBSFN within the radio frame allocation period defined by the *radioFrameAllocationPeriod* and the *radioFrameAllocationOffset*.

– *PMCH-InfoList*

The IE *PMCH-InfoList* specifies configuration of all PMCHs of an MBSFN area, while IE *PMCH-InfoListExt* includes additional PMCHs, i.e. extends the PMCH list using the general principles specified in 5.1.2. The information provided for an individual PMCH includes the configuration parameters of the sessions that are carried by the concerned PMCH. For all PMCH that E-UTRAN includes in *PMCH-InfoList*, the list of ongoing sessions has at least one entry.

PMCH-InfoList information element

```
-- ASN1START

PMCH-InfoList-r9 ::=                SEQUENCE (SIZE (0..maxPMCH-PerMBSFN)) OF PMCH-Info-r9

PMCH-InfoListExt-r12 ::=            SEQUENCE (SIZE (0..maxPMCH-PerMBSFN)) OF PMCH-InfoExt-r12

PMCH-Info-r9 ::=                    SEQUENCE {
    pmch-Config-r9                      PMCH-Config-r9,
    mbms-SessionInfoList-r9         MBMS-SessionInfoList-r9,
    ...
}

PMCH-InfoExt-r12 ::=                SEQUENCE {
    pmch-Config-r12                     PMCH-Config-r12,
    mbms-SessionInfoList-r12            MBMS-SessionInfoList-r9,
    ...
}

MBMS-SessionInfoList-r9 ::=     SEQUENCE (SIZE (0..maxSessionPerPMCH)) OF MBMS-SessionInfo-r9

MBMS-SessionInfo-r9 ::=         SEQUENCE {
    tmgi-r9                             TMGI-r9,
    sessionId-r9                        OCTET STRING (SIZE (1))         OPTIONAL,   -- Need OR
    logicalChannelIdentity-r9           INTEGER (0..maxSessionPerPMCH-1),
    ...
}

PMCH-Config-r9 ::=                  SEQUENCE {
    sf-AllocEnd-r9                      INTEGER (0..1535),
    dataMCS-r9                          INTEGER (0..28),
    mch-SchedulingPeriod-r9         ENUMERATED {
                                        rf8, rf16, rf32, rf64, rf128, rf256, rf512, rf1024},
    ...
}

PMCH-Config-r12 ::=                 SEQUENCE {
    sf-AllocEnd-r12                     INTEGER (0..1535),
    dataMCS-r12                         CHOICE {
```

```
        normal-r12                          INTEGER (0..28),
        higerOrder-r12                      INTEGER (0..27)
    },
    mch-SchedulingPeriod-r12        ENUMERATED {
                                        rf4, rf8, rf16, rf32, rf64, rf128, rf256, rf512, rf1024},
    ...
}

TMGI-r9 ::=                     SEQUENCE {
    plmn-Id-r9                          CHOICE {
        plmn-Index-r9                       INTEGER (1..maxPLMN-r11),
        explicitValue-r9                    PLMN-Identity
    },
    serviceId-r9                        OCTET STRING (SIZE (3))
}


-- ASN1STOP
```

***PMCH-InfoList* field descriptions**
dataMCS   Indicates the value for parameter I_{MCS} in TS 36.213 [23], which defines the Modulation and Coding Scheme (MCS) applicable for the subframes of this (P)MCH as indicated by the field *commonSF-Alloc*. Value *normal* corresponds to Table 7.1.7.1-1 and value *higherOrder* corresponds to Table 7.1.7.1-1A. The MCS does however neither apply to the subframes that may carry MCCH i.e. the subframes indicated by the field *sf-AllocInfo* within *SystemInformationBlockType13* nor for the first subframe allocated to this (P)MCH within each MCH scheduling period (which may contain the MCH scheduling information provided by MAC).
mch-SchedulingPeriod   Indicates the MCH scheduling period i.e. the periodicity used for providing MCH scheduling information at lower layers (MAC) applicable for an MCH. Value rf8 corresponds to 8 radio frames, rf16 corresponds to 16 radio frames and so on. The *mch-SchedulingPeriod* starts in the radio frames for which: SFN mod *mch-SchedulingPeriod* = 0. E-UTRAN configures *mch-SchedulingPeriod* of the (P)MCH listed first in *PMCH-InfoList* to be smaller than or equal to *mcch-RepetitionPeriod.*
plmn-Index   Index of the entry in field *plmn-IdentityList* within *SystemInformationBlockType1*.
sessionId   Indicates the optional MBMS Session Identity, which together with TMGI identifies a transmission or a possible retransmission of a specific MBMS session: see TS 29.061 [51, Sections 20.5, 17.7.11, 17.7.15]. The field is included whenever upper layers have assigned a session identity i.e. one is available for the MBMS session in E-UTRAN.
serviceId   Uniquely identifies the identity of an MBMS service within a PLMN. The field contains octet 3- 5 of the IE Temporary Mobile Group Identity (TMGI) as defined in TS 24.008 [49]. The first octet contains the third octet of the TMGI, the second octet contains the fourth octet of the TMGI and so on.
sf-AllocEnd   Indicates the last subframe allocated to this (P)MCH within a period identified by field *commonSF-AllocPeriod*. The subframes allocated to (P)MCH corresponding with the nth entry in *pmch-InfoList* are the subsequent subframes starting from either the next subframe after the subframe identified by *sf-AllocEnd* of the $(n-1)^{th}$ listed (P)MCH or, for n=1, the first subframe defined by field *commonSF-Alloc*, through the subframe identified by *sf-AllocEnd* of the nth listed (P)MCH. Value 0 corresponds with the first subframe defined by field *commonSF-Alloc*.

6.3.8 Sidelink information elements

– *SL-CommConfig*

The IE *SL-CommConfig* specifies the dedicated configuration information for sidelink communication. In particular it concerns the transmission resource configuration for sidelink communication on the primary frequency.

***SL-CommConfig* information element**

```
-- ASN1START

SL-CommConfig-r12 ::=               SEQUENCE    {
    commTxResources-r12                 CHOICE {
        release                             NULL,
        setup                               CHOICE {
            scheduled-r12                   SEQUENCE {
```

```
                sl-RNTI-r12                     C-RNTI,
                mac-MainConfig-r12              MAC-MainConfigSL-r12,
                sc-CommTxConfig-r12             SL-CommResourcePool-r12,
                mcs-r12                         INTEGER (0..28)                 OPTIONAL    -- Need
OP
            },
            ue-Selected-r12                 SEQUENCE {
                -- Pool for normal usage
                commTxPoolNormalDedicated-r12   SEQUENCE {
                    poolToReleaseList-r12           SL-TxPoolToReleaseList-r12 OPTIONAL,    -- Need
ON
                    poolToAddModList-r12            SL-CommTxPoolToAddModList-r12 OPTIONAL  -- Need
ON
                }
            }
        }
    }                                                                       OPTIONAL,   -- Need ON
    ...
}

SL-CommTxPoolToAddModList-r12 ::=       SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-
CommTxPoolToAddMod-r12

SL-CommTxPoolToAddMod-r12 ::=       SEQUENCE    {
    poolIdentity-r12                    SL-TxPoolIdentity-r12,
    pool-r12                            SL-CommResourcePool-r12
}

MAC-MainConfigSL-r12 ::=        SEQUENCE    {
    periodic-BSR-TimerSL                PeriodicBSR-Timer-r12       OPTIONAL,   -- Need ON
    retx-BSR-TimerSL                    RetxBSR-Timer-r12
}

-- ASN1STOP
```

***SL-CommConfig* field descriptions**
commTxPoolNormalDedicated Indicates a pool of transmission resources the UE is allowed to use while in RRC_CONNECTED.
mcs Indicates the Modulation and Coding Scheme as defined in TS 36.212 [23, 14.2.1]. If not configured, the selection of Modulation and Coding Scheme is up to UE implementation.
sc-CommTxConfig Indicates a pool of resources for SC when E-UTRAN schedules Tx resources (i.e. when indices included in DCI format 5 indicate the actual data resources to be used as specified in TS 36.212 [22, 5.3.3.1.9]).
scheduled Indicates the configuration for the case E-UTRAN schedules the transmission resources based on sidelink specific BSR from the UE.
ue-Selected Indicates the configuration for the case the UE selects the transmission resources from a pool of resources configured by E-UTRAN.

– *SL-CommResourcePool*

The IE *SL-CommResourcePool* specifies the configuration information for an individual pool of resources for sidelink communication. The IE covers the configuration of both the sidelink control information and the data.

SL-CommResourcePool information element

```
-- ASN1START

SL-CommTxPoolList-r12 ::=       SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-CommResourcePool-r12

SL-CommRxPoolList-r12 ::=       SEQUENCE (SIZE (1..maxSL-RxPool-r12)) OF SL-CommResourcePool-r12

SL-CommResourcePool-r12 ::=     SEQUENCE {
    sc-CP-Len-r12                       SL-CP-Len-r12,
    sc-Period-r12                       SL-PeriodComm-r12,
    sc-TF-ResourceConfig-r12            SL-TF-ResourceConfig-r12,
    data-CP-Len-r12                     SL-CP-Len-r12,
    dataHoppingConfig-r12               SL-HoppingConfigComm-r12,
    ue-SelectedResourceConfig-r12           SEQUENCE {
```

```
        data-TF-ResourceConfig-r12              SL-TF-ResourceConfig-r12,
        trpt-Subset-r12                     SL-TRPT-Subset-r12  OPTIONAL    -- Need OP
    }                                                                       OPTIONAL,   -- Need OR
    rxParametersNCell-r12               SEQUENCE {
        tdd-Config-r12                  TDD-Config                  OPTIONAL,   -- Need OP
        syncConfigIndex-r12         INTEGER (0..15)
    }                                                                       OPTIONAL,   -- Need OR
    txParameters-r12                    SEQUENCE {
        sc-TxParameters-r12             SL-TxParameters-r12,
        dataTxParameters-r12            SL-TxParameters-r12
    }                                                                       OPTIONAL,   -- Cond Tx
    ...
}

SL-TRPT-Subset-r12 ::=          BIT STRING (SIZE (3..5))

-- ASN1STOP
```

***SL-CommResourcePool* field descriptions**
sc-Period Indicates the period over which resources are allocated in a cell for SC and over which scheduled and UE selected data transmissions occur, see PSCCH period in TS 36.213 [23]. Value in number of subframes. Value sf40 corresponds to 40 subframes, sf80 corresponds to 80 subframes and so on. E-UTRAN configures values sf40, sf80, sf160 and sf320 for FDD and for TDD config 1 to 5, values sf70, sf140 and sf280 for TDD config 0, and finally values sf60, sf120 and sf240 for TDD config 6.
syncConfigIndex Indicates the synchronisation configuration that is associated with a reception pool, by means of an index to the corresponding entry of *commSyncConfig* in *SystemInformationBlockType18*.
tdd-Config TDD configuration associated with the reception pool of the cell indicated by *syncConfigIndex*. Absence of the field indicates the same duplex mode as the cell providing this field and the same UL/DL configuration as indicated by *subframeAssignment* in *SystemInformationBlockType1* in case of TDD.
trpt-Subset Indicates the subset of T-RPT available (see TS 36.213 [23, 14.1.1.1.1]). Consists of a bitmap which is used to indicate the set of available 'k' values to be used for sidelink communication (see TS 36.213 [23, 14.1.1.3]). If T-RPT subset configuration is not signaled/ preconfigured then UE assumes the whole T-RPT set is available.

Conditional presence	Explanation
Tx	The field is mandatory present when included in *commTxPoolNormalDedicated*, *commTxPoolNormalCommon* or *commTxPoolExceptional*. Otherwise the field is not present.

– *SL-CP-Len*

The IE *SL-CP-Len* indicates the cyclic prefix length, see TS 36.211 [21].

SL-CP-Len information element

```
-- ASN1START

SL-CP-Len-r12 ::=               ENUMERATED {normal, extended}

-- ASN1STOP
```

– *SL-DiscConfig*

The IE *SL-DiscConfig* specifies the dedicated configuration information for sidelink discovery.

SL-DiscConfig information element

```
-- ASN1START

SL-DiscConfig-r12 ::=                   SEQUENCE {
    discTxResources-r12                     CHOICE {
        release                             NULL,
```

```
        setup                                   CHOICE {
            scheduled-r12                       SEQUENCE {
                discTxConfig-r12                        SL-DiscResourcePool-r12 OPTIONAL, -- Need ON
                discTF-IndexList-r12                    SL-TF-IndexPairList-r12     OPTIONAL, -- Need ON
                discHoppingConfig-r12                   SL-HoppingConfigDisc-r12
                                                            OPTIONAL    -- Need ON
            },
            ue-Selected-r12                     SEQUENCE {
                discTxPoolDedicated-r12             SEQUENCE {
                    poolToReleaseList-r12               SL-TxPoolToReleaseList-r12 OPTIONAL,    -- Need
ON
                    poolToAddModList-r12                SL-DiscTxPoolToAddModList-r12 OPTIONAL  -- Need
ON
                }                                                       OPTIONAL    -- Need ON
            }
        }
    }                                                                   OPTIONAL,   -- Need ON
    ...,
    [[  discTF-IndexList-v1260              CHOICE {
            release                             NULL,
            setup                               SEQUENCE {
                discTF-IndexList-r12b               SL-TF-IndexPairList-r12b
            }
        }                                                               OPTIONAL    -- Need ON
    ]]
}

SL-DiscTxPoolToAddModList-r12 ::=       SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-
DiscTxPoolToAddMod-r12

SL-DiscTxPoolToAddMod-r12 ::=       SEQUENCE    {
    poolIdentity-r12                    SL-TxPoolIdentity-r12,
    pool-r12                            SL-DiscResourcePool-r12
}

SL-TF-IndexPairList-r12 ::=     SEQUENCE (SIZE (1..maxSL-TF-IndexPair-r12)) OF SL-TF-IndexPair-r12

SL-TF-IndexPair-r12 ::=     SEQUENCE    {
    discSF-Index-r12                    INTEGER (1.. 200)       OPTIONAL,   -- Need ON
    discPRB-Index-r12                   INTEGER (1.. 50)        OPTIONAL    -- Need ON
}

SL-TF-IndexPairList-r12b ::=        SEQUENCE (SIZE (1..maxSL-TF-IndexPair-r12)) OF SL-TF-IndexPair-
r12b

SL-TF-IndexPair-r12b ::=        SEQUENCE    {
    discSF-Index-r12b                   INTEGER (0..209)        OPTIONAL,    -- Need ON
    discPRB-Index-r12b                  INTEGER (0..49)         OPTIONAL     -- Need ON
}

-- ASN1STOP
```

***SL-DiscConfig* field descriptions**
discTF-IndexList Indicates a list of time-frequency resource indices pair where each pair of indices corresponds to one discovery message. E-UTRAN only configures *discTF-IndexList-r12b* when configuring the UE with scheduled SL discovery Tx resources. When receiving *discTF-IndexList-r12b*, the UE shall only consider this field (and hence ignore *discTF-IndexList-r12*, if included or previously configured).
discTxResources Indicates the resources assigned to the UE for discovery announcements, which can either be a pool from which the UE may select or a set of resources specifically assigned for use by the UE.
discTxConfig Indicates the resources configuration used when E-UTRAN schedules Tx resources (i.e. the fields *discSF-Index* and *discPRB-Index* indicate the actual resources to be used).
SL-TF-IndexPair A pair of indices, one for the time domain and one for the frequency domain, indicating the start of resources within the pool covered by *discTxConfig*, see TS 36.211 [21, 9.5.6] for one discovery message. The upper limits of *discSF-Index* and *discPRB-Index* are defined in TS 36.213 [23, 14.3.1].

– *SL-DiscResourcePool*

The IE *SL-DiscResourcePool* specifies the configuration information for an individual pool of resources for sidelink discovery.

SL-DiscResourcePool information element

```
-- ASN1START

SL-DiscTxPoolList-r12 ::=       SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-DiscResourcePool-r12

SL-DiscRxPoolList-r12 ::=       SEQUENCE (SIZE (1..maxSL-RxPool-r12)) OF SL-DiscResourcePool-r12

SL-DiscResourcePool-r12 ::=     SEQUENCE    {
    cp-Len-r12                      SL-CP-Len-r12,
    discPeriod-r12                  ENUMERATED {rf32, rf64, rf128,
                                                rf256, rf512, rf1024, spare2, spare},
    numRetx-r12                     INTEGER (0..3),
    numRepetition-r12               INTEGER (1..50),
    tf-ResourceConfig-r12           SL-TF-ResourceConfig-r12,
    txParameters-r12                SEQUENCE {
        txParametersGeneral-r12     SL-TxParameters-r12,
        ue-SelectedResourceConfig-r12   SEQUENCE {
            poolSelection-r12               CHOICE {
                rsrpBased-r12                   SL-PoolSelectionConfig-r12,
                random-r12                      NULL
            },
            txProbability-r12           ENUMERATED {p25, p50, p75, p100}
        }                                                       OPTIONAL    -- Need OR
    }                                                           OPTIONAL,   -- Cond Tx
    rxParameters-r12                SEQUENCE {
        tdd-Config-r12                  TDD-Config              OPTIONAL,   -- Need OR
        syncConfigIndex-r12         INTEGER (0..15)
    }                                                           OPTIONAL,   -- Need OR
    ...
}

SL-PoolSelectionConfig-r12 ::=      SEQUENCE {
    threshLow-r12                           RSRP-RangeSL2-r12,
    threshHigh-r12                          RSRP-RangeSL2-r12
}

-- ASN1STOP
```

***SL-DiscResourcePool* field descriptions**
discPeriod   Indicates the period over which resources are allocated in a cell for discovery message transmission/reception, see PSDCH period in TS 36.213 [23]. Value in number of radio frames. Value rf32 corresponds to 32 radio frames, rf64 corresponds to 64 radio frames and so on.
numRepetition   Indicates the number of times *subframeBitmap* is repeated for mapping to subframes that occurs within a *discPeriod*. The highest value E-UTRAN uses is value 5 for FDD and TDD configuration 0, value 13 for TDD configuration 1, value 25 for TDD configuration 2, value 17 for TDD configuration 3, value 25 for TDD configuration 4, value 50 for TDD configuration 5 and value 7 for TDD configuration 6. E-UTRAN configures *numRepetition* and *subframeBitmap* such that the mapped subframes do not exceed the *discPeriod*.
poolSelection   Indicates the mechanism for selecting a (transmission) pool when multiple candidates are provided. E-UTRAN configures the same value (i.e. a pool selection method) for all candidate pools within one pool list (*discTxPoolCommon* or *discTxPoolDedicated*) but the pool selection method in different pool lists may or may not be the same.
syncConfigIndex   Indicates the synchronisation configuration that is associated with a reception pool, by means of an index to the corresponding entry of *discSyncConfig* in *SystemInformationBlockType19*.
threshLow, threshHigh   Specifies the thresholds used to select a resource pool in RSRP based pool selection. The E-UTRAN should configure *threshLow* and *threshHigh* such that the UE selects only one resource pool upon RSRP based pool selection.
txProbability   Indicates the probability of transmitting announcement in a discovery period when configured with a pool of resources, see TS 36.321 [6].

Conditional presence	Explanation
Tx	The field is mandatory present when included in *discTxPoolDedicated* or *discTxPoolCommon*. Otherwise the field is not present.

– *SL-DiscTxPowerInfo*

The IE *SL-DiscTxPowerInfo* specifies power control parameters for one or more power classes.

SL-DiscTxPowerInfo information element

```
-- ASN1START

SL-DiscTxPowerInfoList-r12 ::=  SEQUENCE (SIZE (maxSL-DiscPowerClass-r12)) OF SL-DiscTxPowerInfo-r12

SL-DiscTxPowerInfo-r12 ::=              SEQUENCE    {
    discMaxTxPower-r12                          P-Max,
    ...
}

-- ASN1STOP
```

SL-DiscTxPowerInfo field descriptions
discMaxTxPower
Indicates the P-Max parameter used to calculate the maximum transmit power a UE configured with the concerned range class, see TS 24.333 [70, 4.2.11]. The first entry in *SL-DiscTxPowerInfoList* corresponds to UE range class 'short', the second entry corresponds to 'medium' and the third entry corresponds to 'long'.

– *SL-HoppingConfig*

The IE *SL-HoppingConfig* indicates the hopping configuration used for sidelink.

SL-HoppingConfig information element

```
-- ASN1START

SL-HoppingConfigComm-r12 ::=        SEQUENCE    {
    hoppingParameter-r12                INTEGER (0..504),
    numSubbands-r12                     ENUMERATED {ns1, ns2, ns4},
    rb-Offset-r12                       INTEGER (0..110)
}

SL-HoppingConfigDisc-r12 ::=    SEQUENCE    {
    a-r12                               INTEGER (1..200),
    b-r12                               INTEGER (1..10),
    c-r12                               ENUMERATED {n1, n5}
}

-- ASN1STOP
```

***SL-HoppingConfig* field descriptions**
a Per cell parameter: $N_{PSDCH}^{(1)}$ see TS 36.213 [23, 14.3.1].
b Per UE parameter: $N_{PSDCH}^{(2)}$ see TS 36.213 [23, 14.3.1].
c Per cell parameter: $N_{PSDCH}^{(3)}$ see TS36.213 [23, 14.3.1]
hoppingParameter Affects the hopping performed as specificed in TS 36.213 [23, 14.1.1.2 and 14.1.1.4]. In case value 504 is received, the value used by the UE is 510.
numSubbands Parameter: N_{sb} see TS 36.211 [21, 9.3.6].
rb-Offset Parameter: $N_{\mathrm{RB}}^{\mathrm{HO}}$, see TS 36.211 [21, 9.3.6].

– *SL-OffsetIndicator*

The IE *SL-OffsetIndicator* indicates the offset of the pool of resources relative to SFN 0 of the cell from which it was obtained or, when out of coverage, relative to DFN 0.

SL-OffsetIndicator information element

```
-- ASN1START

SL-OffsetIndicator-r12 ::=          CHOICE {
    small-r12                               INTEGER (0..319),
    large-r12                               INTEGER (0..10239)
}

SL-OffsetIndicatorSync-r12 ::=          INTEGER (0..39)

-- ASN1STOP
```

***SL-OffsetIndicator* field descriptions**
SL-OffsetIndicator In *sc-TF-ResourceConfig*, it indicates the offset of the first period of pool of resources within a SFN cycle. For *data-TF-ResourceConfig*, it corresponds to the *offsetIndicator* as defined in TS 36.213 [23, 14.1.3].
SL-OffsetIndicatorSync Synchronisation resources are present in those SFN and subframes which satisfy the relation: (SFN*10+ *Subframe Number*) mod 40 = *SL-OffsetIndicatorSync*.

– *SL-PeriodComm*

The IE *SL-PeriodComm* indicates the period over which resources allocated in a cell for sidelink communication.

SL-PeriodComm information element

```
-- ASN1START

SL-PeriodComm-r12 ::=                   ENUMERATED {sf40, sf60, sf70, sf80, sf120, sf140,
                                                    sf160, sf240, sf280, sf320, spare6, spare5,
                                                    spare4, spare3, spare2, spare}

-- ASN1STOP
```

– *SLSSID*

The IE *SLSSID* identifies a cell and is used by the receiving UE to detect asynchronous neighbouring cells, and by transmitting UEs to extend the synchronisation signals beyond the cell's coverage area.

SLSSID information element

```
-- ASN1START

SLSSID-r12 ::=                  INTEGER (0..167)

-- ASN1STOP
```

– *SL-SyncConfig*

The IE *SL-SyncConfig* specifies the configuration information concerning reception of synchronisation signals from neighbouring cells as well as concerning the transmission of synchronisation signals for sidelink communication and sidelink discovery.

SL-SyncConfig information element

```
-- ASN1START

SL-SyncConfigList-r12 ::=       SEQUENCE (SIZE (1..maxSL-SyncConfig-r12)) OF SL-SyncConfig-r12

SL-SyncConfig-r12 ::=                   SEQUENCE {
    syncCP-Len-r12                          SL-CP-Len-r12,
    syncOffsetIndicator-r12             SL-OffsetIndicatorSync-r12,
    slssid-r12                              SLSSID-r12,
    txParameters-r12                            SEQUENCE {
        syncTxParameters-r12                    SL-TxParameters-r12,
        syncTxThreshIC-r12                      RSRP-RangeSL-r12,
        syncInfoReserved-r12                    BIT STRING (SIZE (19))  OPTIONAL    -- Need OR
    }                                                                   OPTIONAL,   -- Need OR
    rxParamsNCell-r12                       SEQUENCE {
        physCellId-r12                          PhysCellId,
        discSyncWindow-r12              ENUMERATED {w1, w2}
    }                                                                   OPTIONAL,   -- Need OR
    ...
}

-- ASN1STOP
```

SL-SyncConfig field descriptions
discSyncWindow Indicates the synchronization window over which the UE expects that SLSS or discovery resources indicated by the pool configuration (see TS 36.213 [23, 14.4]). The value *w1* denotes 5 milliseconds. The value *w2* denotes the length corresponding to normal cyclic prefix divided by 2.
syncInfoReserved Reserved for future use.
syncOffsetIndicator E-UTRAN should ensure *syncOffsetIndicator* is set to the same value as *syncOffsetIndicator1* or *syncOffsetIndicator2* in *preconfigSync* within *SL-Preconfiguration*, if configured.
syncTxThreshIC Indicates the threshold used while in coverage. In case the RSRP measurement of the cell chosen for transmission of sidelink communication/ discovery announcements, is below the level indicated by this field, the UE may transmit SLSS (i.e. become synchronisation reference) when performing the corresponding sidelink transmission..
txParameters Includes parameters relevant only for transmission. E-UTRAN includes the field in one entry per list, as included in *commSyncConfig* or *discSyncConfig*.

– *SL-TF-ResourceConfig*

The IE *SL-TF-ResourceConfig* specifies a set of time/ frequency resources used for sidelink.

SL-TF-ResourceConfig information element

```
-- ASN1START

SL-TF-ResourceConfig-r12 ::=        SEQUENCE    {
    prb-Num-r12                         INTEGER (1..100),
    prb-Start-r12                       INTEGER (0..99),
    prb-End-r12                         INTEGER (0..99),
    offsetIndicator-r12                 SL-OffsetIndicator-r12,
    subframeBitmap-r12                  SubframeBitmapSL-r12
}

SubframeBitmapSL-r12 ::=        CHOICE {
    bs4-r12                                 BIT STRING (SIZE (4)),
    bs8-r12                                 BIT STRING (SIZE (8)),
    bs12-r12                                BIT STRING (SIZE (12)),
    bs16-r12                                BIT STRING (SIZE (16)),
    bs30-r12                                BIT STRING (SIZE (30)),
    bs40-r12                                BIT STRING (SIZE (40)),
    bs42-r12                                BIT STRING (SIZE (42))
}

-- ASN1STOP
```

SL-TF-ResourceConfig field descriptions
prb-Start, prb-End, prb-Num Sidelink transmissions on a sub-frame can occur on PRB with index greater than or equal to *prb-Start* and less than *prb-Start* + *prb-Num*, and on PRB with index greater than *prb-End* - *prb-Num* and less than or equal to *prb-End*. Even for neighbouring cells, *prb-Start* and prb-End , are relative to PRB #0 of the cell from which it was obtained. See TS36.213 [23, 14.1.3, 14.2.3, 14.3.3].
subframeBitmap Indicates the subframe bitmap indicating resources used for sidelink. E-UTRAN configures value *bs40* for FDD and the following values for TDD: value *bs42* for configuration0, value *bs16* for configuration1, value bs8 for configuration2, value *bs12* for configuration3, value *bs8* for configuration4, value *bs4* for configuration5 and value *bs30* for configuration6.

– *SL-TxParameters*

The IE *SL-TxParameters* identifies a set of parameters configured for sidelink transmission, used for communication, discovery and synchronisation.

***SL-TxParameters* information element**

```
-- ASN1START

SL-TxParameters-r12 ::=             SEQUENCE    {
    alpha-r12                               Alpha-r12,
    p0-r12                                  P0-SL-r12
}

P0-SL-r12 ::=                           INTEGER (-126..31)

-- ASN1STOP
```

***SL-TxParameters* field descriptions**
alpha
Parameter(s): $\alpha_{PSSCH,1}$, $\alpha_{PSSCH,2}$, $\alpha_{PSCCH,1}$, $\alpha_{PSCCH,2}$, $\alpha_{PSDCH,1}$, α_{PSSS} See TS 36.213 [23, 14.1.1.5, 14.2.1.2, 14.3.1, 14.4] where al0 corresponds to 0, al04 corresponds to value 0.4, al05 to 0.5, al06 to 0.6, al07 to 0.7, al08 to 0.8, al09 to 0.9 and al1 corresponds to 1. This field applies for sidelink power control.
p0
Parameter: $P_{O\_PSSCH,1}$, $P_{O\_PSSCH,2}$, $P_{O\_PSCCH,1}$, $P_{O\_PSCCH,2}$, $P_{O\_PSDCH,1}$, P_{O_PSSS} see TS 36.213 [23, 14.1.1.5, 14.2.1.2, 14.3.1, 14.4], unit dBm.

– *SL-TxPoolIdentity*

The IE *SL-TxPoolIdentity* identifies an individual pool entry configured for sidelink transmission, used for communication and discovery.

***SL-TxPoolIdentity* information element**

```
-- ASN1START

SL-TxPoolIdentity-r12 ::=           INTEGER (1.. maxSL-TxPool-r12)

-- ASN1STOP
```

– *SL-TxPoolToReleaseList*

The IE *SL-TxPoolToReleaseList* is used to release one or more individual pool entries used for sidelink transmission, for communication and discovery.

***SL-TxPoolToReleaseList* information element**

```
-- ASN1START

SL-TxPoolToReleaseList-r12 ::=  SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-TxPoolIdentity-r12

-- ASN1STOP
```

6.4 RRC multiplicity and type constraint values

– Multiplicity and type constraint definitions

```
-- ASN1START

maxBandComb-r10             INTEGER ::= 128 -- Maximum number of band combinations.
```

```
maxBandComb-r11             INTEGER ::= 256 -- Maximum number of additional band combinations.
maxBands                    INTEGER ::= 64  -- Maximum number of bands listed in EUTRA UE caps
maxBandwidthClass-r10       INTEGER ::= 16  -- Maximum number of supported CA BW classes per band
maxBandwidthCombSet-r10     INTEGER ::= 32  -- Maximum number of bandwidth combination sets per
                                            -- supported band combination
maxCDMA-BandClass           INTEGER ::= 32  -- Maximum value of the CDMA band classes
maxCellBlack                INTEGER ::= 16  -- Maximum number of blacklisted physical cell identity
                                            -- ranges listed in SIB type 4 and 5
maxCellHistory-r12          INTEGER ::= 16  -- Maximum number of visited EUTRA cells reported
maxCellInfoGERAN-r9         INTEGER ::= 32  -- Maximum number of GERAN cells for which system in-
                                            -- formation can be provided as redirection assistance
maxCellInfoUTRA-r9          INTEGER ::= 16  -- Maximum number of UTRA cells for which system
                                            -- information can be provided as redirection
                                            -- assistance
maxCombIDC-r11              INTEGER ::= 128 -- Maximum number of reported UL CA combinations
maxCSI-IM-r11               INTEGER ::= 3   -- Maximum number of CSI-IM configurations
                                            -- (per carrier frequency)
maxCSI-IM-r12               INTEGER ::= 4   -- Maximum number of CSI-IM configurations
                                            -- (per carrier frequency)
maxCSI-Proc-r11             INTEGER ::= 4   -- Maximum number of CSI processes (per carrier
                                            --  frequency)
maxCSI-RS-NZP-r11           INTEGER ::= 3   -- Maximum number of CSI RS resource
                                            --  configurations using non-zero Tx power
                                            --  (per carrier frequency)
maxCSI-RS-ZP-r11            INTEGER ::= 4   -- Maximum number of CSI RS resource
                                            --  configurations using zero Tx power(per carrier
                                            --  frequency)
maxCQI-ProcExt-r11          INTEGER ::= 3   -- Maximum number of additional periodic CQI
                                            -- configurations (per carrier frequency)
maxFreqUTRA-TDD-r10         INTEGER ::= 6   -- Maximum number of UTRA TDD carrier frequencies for
                                            -- which system information can be provided as
                                            -- redirection assistance
maxCellInter                INTEGER ::= 16  -- Maximum number of neighbouring inter-frequency
                                            -- cells listed in SIB type 5
maxCellIntra                INTEGER ::= 16  -- Maximum number of neighbouring intra-frequency
                                            -- cells listed in SIB type 4
maxCellListGERAN            INTEGER ::= 3   -- Maximum number of lists of GERAN cells
maxCellMeas                 INTEGER ::= 32  -- Maximum number of entries in each of the
                                            -- cell lists in a measurement object
maxCellReport               INTEGER ::= 8   -- Maximum number of reported cells/CSI-RS resources
maxCSI-RS-Meas-r12          INTEGER ::= 96  -- Maximum number of entries in the CSI-RS list
                                            -- in a measurement object
maxDRB                      INTEGER ::= 11  -- Maximum number of Data Radio Bearers
maxDS-Duration-r12          INTEGER ::= 5   -- Maximum number of subframes in a discovery signals
                                            -- occasion
maxDS-ZTP-CSI-RS-r12        INTEGER ::= 5   -- Maximum number of zero transmission power CSI-RS for
                                            -- a serving cell concerning discovery signals
maxEARFCN                   INTEGER ::= 65535   -- Maximum value of EUTRA carrier frequency
maxEARFCN-Plus1             INTEGER ::= 65536   -- Lowest value extended EARFCN range
maxEARFCN2                  INTEGER ::= 262143  -- Highest value extended EARFCN range
maxEPDCCH-Set-r11           INTEGER ::= 2   -- Maximum number of EPDCCH sets
maxFBI                      INTEGER ::= 64  -- Maximum value of fequency band indicator
maxFBI-Plus1                    INTEGER ::= 65  -- Lowest value extended FBI range
maxFBI2                     INTEGER ::= 256 -- Highest value extended FBI range
maxFreq                     INTEGER ::= 8   -- Maximum number of carrier frequencies
maxFreqIDC-r11              INTEGER ::= 32  -- Maximum number of carrier frequencies that are
                                            -- affected by the IDC problems
maxFreqMBMS-r11             INTEGER ::= 5   -- Maximum number of carrier frequencies for which an
                                            -- MBMS capable UE may indicate an interest
maxGERAN-SI                 INTEGER ::= 10  -- Maximum number of GERAN SI blocks that can be
                                            -- provided as part of NACC information
maxGNFG                     INTEGER ::= 16  -- Maximum number of GERAN neighbour freq groups
maxLogMeasReport-r10        INTEGER ::= 520 -- Maximum number of logged measurement entries
                                            --  that can be reported by the UE in one message
maxMBSFN-Allocations        INTEGER ::= 8   -- Maximum number of MBSFN frame allocations with
                                            -- different offset
maxMBSFN-Area               INTEGER ::= 8
maxMBSFN-Area-1             INTEGER ::= 7
maxMeasId                   INTEGER ::= 32
maxMeasId-Plus1             INTEGER ::= 33
maxMeasId-r12               INTEGER ::= 64
maxMultiBands               INTEGER ::= 8   -- Maximum number of additional frequency bands
                                            -- that a cell belongs to
maxNS-Pmax-r10              INTEGER ::= 8   -- Maximum number of NS and P-Max values per band
maxNAICS-Entries-r12            INTEGER ::= 8   -- Maximum number of supported NAICS combination(s)
maxNeighCell-r12                INTEGER ::= 8   -- Maximum number of neighbouring cells in NAICS
                                            -- configuration (per carrier frequency)
maxObjectId                 INTEGER ::= 32
```

```
maxP-a-PerNeighCell-r12     INTEGER ::= 3   -- Maximum number of power offsets for a neighbour cell
                                            -- in NAICS configuration
maxPageRec                  INTEGER ::= 16  --
maxPhysCellIdRange-r9       INTEGER ::= 4   -- Maximum number of physical cell identity ranges
maxPLMN-r11                 INTEGER ::= 6   -- Maximum number of PLMNs
maxPNOffset                 INTEGER ::= 511 -- Maximum number of CDMA2000 PNOffsets
maxPMCH-PerMBSFN            INTEGER ::= 15
maxRAT-Capabilities         INTEGER ::= 8   -- Maximum number of interworking RATs (incl EUTRA)
maxRE-MapQCL-r11            INTEGER ::= 4   -- Maximum number of PDSCH RE Mapping configurations
                                            --  (per carrier frequency)
maxReportConfigId           INTEGER ::= 32
maxRSTD-Freq-r10            INTEGER ::= 3   -- Maximum number of frequency layers for RSTD
                                            -- measurement
maxSAI-MBMS-r11             INTEGER ::= 64  -- Maximum number of MBMS service area identities
                                            -- broadcast per carrier frequency
maxSCell-r10                INTEGER ::= 4   -- Maximum number of SCells
maxSL-Dest-r12          INTEGER ::= 16  -- Maximum number of sidelink destinations
maxSL-DiscPowerClass-r12    INTEGER ::= 3   -- Maximum number of sidelink power classes
maxSL-RxPool-r12            INTEGER ::= 16  -- Maximum number of individual sidelink Rx resource
pools
maxSL-SyncConfig-r12        INTEGER ::= 16  -- Maximum number of sidelink Sync configurations
maxSL-TF-IndexPair-r12  INTEGER ::= 64  -- Maximum number of sidelink Time Freq resource index
                                            --  pairs
maxSL-TxPool-r12            INTEGER ::= 4   -- Maximum number of individual sidelink Tx resource
pools
maxSTAG-r11                 INTEGER ::= 3   -- Maximum number of STAGs
maxServCell-r10             INTEGER ::= 5   -- Maximum number of Serving cells
maxServiceCount             INTEGER ::= 16  -- Maximum number of MBMS services that can be included
                                            --  in an MBMS counting request and response
maxServiceCount-1           INTEGER ::= 15
maxSessionPerPMCH           INTEGER ::= 29
maxSessionPerPMCH-1         INTEGER ::= 28
maxSIB                      INTEGER ::= 32  -- Maximum number of SIBs
maxSIB-1                    INTEGER ::= 31
maxSI-Message               INTEGER ::= 32  -- Maximum number of SI messages
maxSimultaneousBands-r10    INTEGER ::= 64  -- Maximum number of simultaneously aggregated bands
maxSubframePatternIDC-r11   INTEGER ::= 8   -- Maximum number of subframe reservation patterns
                                            -- that the UE can simultaneously recommend to the
                                            -- E-UTRAN for use.
maxUTRA-FDD-Carrier         INTEGER ::= 16  -- Maximum number of UTRA FDD carrier frequencies
maxUTRA-TDD-Carrier         INTEGER ::= 16  -- Maximum number of UTRA TDD carrier frequencies
maxWLAN-Id-r12              INTEGER ::= 16  -- Maximum number of WLAN identifiers

-- ASN1STOP
```

NOTE: The value of maxDRB aligns with SA2.

– End of EUTRA-RRC-Definitions

```
-- ASN1START

END

-- ASN1STOP
```

6.5 PC5 RRC messages

NOTE: The messages included in this section reflect the current status of the discussions. Additional messages may be included at a later stage.

6.5.1 General message structure

– *PC5-RRC-Definitions*

This ASN.1 segment is the start of the PC5 RRC PDU definitions.

```
-- ASN1START

PC5-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN
```

```
IMPORTS
    TDD-ConfigSL-r12
FROM EUTRA-RRC-Definitions;

-- ASN1STOP
```

– *SBCCH-SL-BCH-Message*

The *SBCCH-SL-BCH-Message* class is the set of RRC messages that may be sent from the UE to the UE via SL-BCH on the SBCCH logical channel.

```
-- ASN1START

SBCCH-SL-BCH-Message ::= SEQUENCE {
    message                SBCCH-SL-BCH-MessageType
}

SBCCH-SL-BCH-MessageType ::=                      MasterInformationBlock-SL

-- ASN1STOP
```

6.5.2 Message definitions

– *MasterInformationBlock-SL*

The *MasterInformationBlock-SL* includes the information transmitted by a UE transmitting SLSS, i.e. acting as synchronisation reference, via SL-BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: SBCCH

Direction: UE to UE

MasterInformationBlock-SL

```
-- ASN1START

MasterInformationBlock-SL ::=       SEQUENCE {
    sl-Bandwidth-r12                    ENUMERATED {
                                            n6, n15, n25, n50, n75, n100},
    tdd-ConfigSL-r12                    TDD-ConfigSL-r12,
    directFrameNumber-r12               BIT STRING (SIZE (10)),
    directSubframeNumber-r12            INTEGER (0..9),
    inCoverage-r12                      BOOLEAN,
    reserved-r12                        BIT STRING (SIZE (19))
}


-- ASN1STOP
```

***MasterInformationBlock-SL* field descriptions**
directFrameNumber Indicates the frame number in which SLSS and SL-BCH are transmitted. The subframe in the frame corresponding to *directFrameNumber* is indicated by *directSubframeNumber*.
inCoverage Value *TRUE* indicates that the UE transmitting the *MasterInformationBlock-SL* is in E-UTRAN coverage.
sl-Bandwidth Parameter: transmission bandwidth configuration. n6 corresponds to 6 resource blocks, n15 to 15 resource blocks and so on.

– End of *PC5-RRC-Definitions*

```
-- ASN1START

END

-- ASN1STOP
```

7 Variables and constants

7.1 UE variables

NOTE: To facilitate the specification of the UE behavioural requirements, UE variables are represented using ASN.1. Unless explicitly specified otherwise, it is however up to UE implementation how to store the variables. The optionality of the IEs in ASN.1 is used only to indicate that the values may not always be available.

– *EUTRA-UE-Variables*

This ASN.1 segment is the start of the E-UTRA UE variable definitions.

```
-- ASN1START

EUTRA-UE-Variables DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    AbsoluteTimeInfo-r10,
    AreaConfiguration-r10,
    AreaConfiguration-v1130,
    CarrierFreqGERAN,
    CellIdentity,
    ConnEstFailReport-r11,
    SpeedStateScaleFactors,
    C-RNTI,
    LoggingDuration-r10,
    LoggingInterval-r10,
    LogMeasInfo-r10,
    MeasCSI-RS-Id-r12,
    MeasId,
    MeasId-v1250,
    MeasIdToAddModList,
    MeasIdToAddModListExt-r12,
    MeasObjectToAddModList,
    MeasObjectToAddModList-v9e0,
    MeasScaleFactor-r12,
    MobilityStateParameters,
    NeighCellConfig,
    PhysCellId,
    PhysCellIdCDMA2000,
    PhysCellIdGERAN,
    PhysCellIdUTRA-FDD,
    PhysCellIdUTRA-TDD,
    PLMN-Identity,
    PLMN-IdentityList3-r11,
    QuantityConfig,
    ReportConfigToAddModList,
    RLF-Report-r9,
    TargetMBSFN-AreaList-r12,
    TraceReference-r10,
    VisitedCellInfoList-r12,
    maxCellMeas,
    maxCSI-RS-Meas-r12,
    maxMeasId,
    maxMeasId-r12
FROM EUTRA-RRC-Definitions;

-- ASN1STOP
```

– *VarConnEstFailReport*

The UE variable *VarConnEstFailReport* includes the connection establishment failure information.

***VarConnEstFailReport* UE variable**

```
-- ASN1START

VarConnEstFailReport-r11 ::=        SEQUENCE {
    connEstFailReport-r11               ConnEstFailReport-r11,
    plmn-Identity-r11                   PLMN-Identity
}

-- ASN1STOP
```

– *VarLogMeasConfig*

The UE variable *VarLogMeasConfig* includes the configuration of the logging of measurements to be performed by the UE while in RRC_IDLE, covering intra-frequency, inter-frequency, inter-RAT mobility and MBSFN related measurements. If MBSFN logging is configured, the UE performs logging of measurements while in both RRC_IDLE and RRC_CONNECTED. Otherwise, the UE performs logging of measurements only while in RRC_IDLE.

***VarLogMeasConfig* UE variable**

```
-- ASN1START

VarLogMeasConfig-r10 ::=                SEQUENCE {
    areaConfiguration-r10           AreaConfiguration-r10       OPTIONAL,
    loggingDuration-r10             LoggingDuration-r10,
    loggingInterval-r10             LoggingInterval-r10
}

VarLogMeasConfig-r11 ::=        SEQUENCE {
    areaConfiguration-r10           AreaConfiguration-r10       OPTIONAL,
    areaConfiguration-v1130         AreaConfiguration-v1130     OPTIONAL,
    loggingDuration-r10             LoggingDuration-r10,
    loggingInterval-r10             LoggingInterval-r10
}

VarLogMeasConfig-r12 ::=        SEQUENCE {
    areaConfiguration-r10           AreaConfiguration-r10       OPTIONAL,
    areaConfiguration-v1130         AreaConfiguration-v1130     OPTIONAL,
    loggingDuration-r10             LoggingDuration-r10,
    loggingInterval-r10             LoggingInterval-r10,
    targetMBSFN-AreaList-r12        TargetMBSFN-AreaList-r12    OPTIONAL
}

-- ASN1STOP
```

– *VarLogMeasReport*

The UE variable *VarLogMeasReport* includes the logged measurements information.

***VarLogMeasReport* UE variable**

```
-- ASN1START

VarLogMeasReport-r10 ::=                SEQUENCE {
    traceReference-r10                  TraceReference-r10,
    traceRecordingSessionRef-r10            OCTET STRING (SIZE (2)),
    tce-Id-r10                          OCTET STRING (SIZE (1)),
    plmn-Identity-r10                   PLMN-Identity,
    absoluteTimeInfo-r10                AbsoluteTimeInfo-r10,
    logMeasInfoList-r10                 LogMeasInfoList2-r10
}

VarLogMeasReport-r11 ::=            SEQUENCE {
    traceReference-r10                  TraceReference-r10,
    traceRecordingSessionRef-r10        OCTET STRING (SIZE (2)),
    tce-Id-r10                          OCTET STRING (SIZE (1)),
```

```
    plmn-IdentityList-r11               PLMN-IdentityList3-r11,
    absoluteTimeInfo-r10                AbsoluteTimeInfo-r10,
    logMeasInfoList-r10                 LogMeasInfoList2-r10
}

LogMeasInfoList2-r10 ::=                SEQUENCE (SIZE (1..maxLogMeas-r10)) OF LogMeasInfo-r10

-- ASN1STOP
```

– *VarMeasConfig*

The UE variable *VarMeasConfig* includes the accumulated configuration of the measurements to be performed by the UE, covering intra-frequency, inter-frequency and inter-RAT mobility related measurements.

NOTE: The amount of measurement configuration information, which a UE is required to store, is specified in subclause 11.1. If the number of frequencies configured for a particular RAT exceeds the minimum performance requirements specified in [16], it is up to UE implementation which frequencies of that RAT are measured. If the total number of frequencies for all RATs provided to the UE in the measurement configuration exceeds the minimum performance requirements specified in [16], it is up to UE implementation which frequencies/RATs are measured.

VarMeasConfig UE variable

```
-- ASN1START

VarMeasConfig ::=                   SEQUENCE {
    -- Measurement identities
    measIdList                          MeasIdToAddModList                  OPTIONAL,
    measIdListExt-r12                   MeasIdToAddModListExt-r12           OPTIONAL,
    -- Measurement objects
    measObjectList                      MeasObjectToAddModList              OPTIONAL,
    measObjectList-v9i0                 MeasObjectToAddModList-v9e0         OPTIONAL,
    -- Reporting configurations
    reportConfigList                    ReportConfigToAddModList            OPTIONAL,
    -- Other parameters
    quantityConfig                      QuantityConfig                      OPTIONAL,
    measScaleFactor-r12                 MeasScaleFactor-r12                 OPTIONAL,
    s-Measure                           INTEGER (-140..-44)                 OPTIONAL,
    speedStatePars                      CHOICE {
        release                             NULL,
        setup                               SEQUENCE {
            mobilityStateParameters             MobilityStateParameters,
            timeToTrigger-SF                    SpeedStateScaleFactors
        }
    }                                                                       OPTIONAL,
    allowInterruptions-r11          BOOLEAN                             OPTIONAL
}

-- ASN1STOP
```

– *VarMeasReportList*

The UE variable *VarMeasReportList* includes information about the measurements for which the triggering conditions have been met.

***VarMeasReportList* UE variable**

```
-- ASN1START

VarMeasReportList ::=               SEQUENCE (SIZE (1..maxMeasId)) OF VarMeasReport
VarMeasReportList-r12 ::=           SEQUENCE (SIZE (1..maxMeasId-r12)) OF VarMeasReport

VarMeasReport ::=                   SEQUENCE {
    -- List of measurement that have been triggered
    measId                              MeasId,
    measId-v1250                        MeasId-v1250                    OPTIONAL,
    cellsTriggeredList                  CellsTriggeredList              OPTIONAL,
    csi-RS-TriggeredList-r12            CSI-RS-TriggeredList-r12        OPTIONAL,
    numberOfReportsSent                 INTEGER
}
```

```
CellsTriggeredList ::=              SEQUENCE (SIZE (1..maxCellMeas)) OF CHOICE {
    physCellIdEUTRA                         PhysCellId,
    physCellIdUTRA                          CHOICE {
        fdd                                     PhysCellIdUTRA-FDD,
        tdd                                     PhysCellIdUTRA-TDD
    },
    physCellIdGERAN                         SEQUENCE {
        carrierFreq                             CarrierFreqGERAN,
        physCellId                              PhysCellIdGERAN
    },
    physCellIdCDMA2000                      PhysCellIdCDMA2000
}

CSI-RS-TriggeredList-r12 ::=        SEQUENCE (SIZE (1..maxCSI-RS-Meas-r12)) OF MeasCSI-RS-Id-r12

-- ASN1STOP
```

– *VarMobilityHistoryReport*

The UE variable *VarMobilityHistoryReport* includes the mobility history information.

```
-- ASN1START
VarMobilityHistoryReport-r12 ::=    VisitedCellInfoList-r12

-- ASN1STOP
```

– *VarRLF-Report*

The UE variable *VarRLF-Report* includes the radio link failure information or handover failure information.

***VarRLF-Report* UE variable**

```
-- ASN1START

VarRLF-Report-r10 ::=               SEQUENCE {
    rlf-Report-r10                          RLF-Report-r9,
    plmn-Identity-r10                       PLMN-Identity
}

VarRLF-Report-r11 ::=               SEQUENCE {
    rlf-Report-r10                      RLF-Report-r9,
    plmn-IdentityList-r11               PLMN-IdentityList3-r11
}

-- ASN1STOP
```

– *VarShortMAC-Input*

The UE variable *VarShortMAC-Input* specifies the input used to generate the shortMAC-I.

***VarShortMAC-Input* UE variable**

```
-- ASN1START

VarShortMAC-Input ::=                   SEQUENCE {
    cellIdentity                            CellIdentity,
    physCellId                              PhysCellId,
    c-RNTI                                  C-RNTI
}
-- ASN1STOP
```

VarShortMAC-Input field descriptions
cellIdentity Set to CellIdentity of the current cell.
c-RNTI Set to C-RNTI that the UE had in the PCell it was connected to prior to the failure.
physCellId Set to the physical cell identity of the PCell the UE was connected to prior to the failure.

– Multiplicity and type constraint definitions

This section includes multiplicity and type constraints applicable (only) for UE variables.

```
-- ASN1START

maxLogMeas-r10              INTEGER ::= 4060-- Maximum number of logged measurement entries
                                        --  that can be stored by the UE

-- ASN1STOP
```

– End of *EUTRA-UE-Variables*

```
-- ASN1START

END

-- ASN1STOP
```

7.2 Counters

Counter	Reset	Incremented	When reaching max value

7.3 Timers (Informative)

Timer	Start	Stop	At expiry
T300	Transmission of *RRCConnectionRequest*	Reception of *RRCConnectionSetup* or *RRCConnectionReject* message, cell re-selection and upon abortion of connection establishment by upper layers	Perform the actions as specified in 5.3.3.6
T301	Transmission of *RRCConnectionReestablishmentRequest*	Reception of *RRCConnectionReestablishment* or *RRCConnectionReestablishmentReject* message as well as when the selected cell becomes unsuitable	Go to RRC_IDLE
T302	Reception of *RRCConnectionReject* while performing RRC connection establishment	Upon entering RRC_CONNECTED and upon cell re-selection	Inform upper layers about barring alleviation as specified in 5.3.3.7
T303	Access barred while performing RRC connection establishment for mobile originating calls	Upon entering RRC_CONNECTED and upon cell re-selection	Inform upper layers about barring alleviation as specified in 5.3.3.7
T304	Reception of *RRCConnectionReconfiguration* message including the *MobilityControl Info* or reception of *MobilityFromEUTRACommand* message including *CellChangeOrder*	Criterion for successful completion of handover within E-UTRA, handover to E-UTRA or cell change order is met (the criterion is specified in the target RAT in case of inter-RAT)	In case of cell change order from E-UTRA or intra E-UTRA handover, initiate the RRC connection re-establishment procedure; In case of handover to E-UTRA, perform the actions defined in the specifications applicable for the source RAT.
T305	Access barred while performing RRC connection establishment for mobile originating signalling	Upon entering RRC_CONNECTED and upon cell re-selection	Inform upper layers about barring alleviation as specified in 5.3.3.7
T306	Access barred while performing RRC connection establishment for mobile originating CS fallback.	Upon entering RRC_CONNECTED and upon cell re-selection	Inform upper layers about barring alleviation as specified in 5.3.3.7
T307	Reception of *RRCConnectionReconfiguration* message including *MobilityControlInfoSCG*	Successful completion of random access on the PSCell, upon initiating re-establishment and upon SCG release	Inform E-UTRAN about the SCG change failure by initiating the SCG failure information procedure as specified in 5.6.13.
T310	Upon detecting physical layer problems for the PCell i.e. upon receiving N310 consecutive out-of-sync indications from lower layers	Upon receiving N311 consecutive in-sync indications from lower layers for the PCell, upon triggering the handover procedure and upon initiating the connection re-establishment procedure	If security is not activated: go to RRC_IDLE else: initiate the connection re-establishment procedure
T311	Upon initiating the RRC connection re-establishment procedure	Selection of a suitable E-UTRA cell or a cell using another RAT.	Enter RRC_IDLE
T312	Upon triggering a measurement report for a measurement identity for which T312 has been configured, while T310 is running	Upon receiving N311 consecutive in-sync indications from lower layers, upon triggering the handover procedure, upon initiating the connection re-establishment procedure, and upon the expiry of T310	If security is not activated: go to RRC_IDLE else: initiate the connection re-establishment procedure

Timer	Start	Stop	At expiry
T313	Upon detecting physical layer problems for the PSCell i.e. upon receiving N313 consecutive out-of-sync indications from lower layers	Upon receiving N314 consecutive in-sync indications from lower layers for the PSCell, upon initiating the connection re-establishment procedure, upon SCG release and upon receiving *RRCConnectionReconfiguration* including *MobilityControlInfoSCG*	Inform E-UTRAN about the SCG radio link failure by initiating the SCG failure information procedure as specified in 5.6.13.
T320	Upon receiving *t320* or upon cell (re)selection to E-UTRA from another RAT with validity time configured for dedicated priorities (in which case the remaining validity time is applied).	Upon entering RRC_CONNECTED, when PLMN selection is performed on request by NAS, or upon cell (re)selection to another RAT (in which case the timer is carried on to the other RAT).	Discard the cell reselection priority information provided by dedicated signalling.
T321	Upon receiving *measConfig* including a *reportConfig* with the *purpose* set to *reportCGI*	Upon acquiring the information needed to set all fields of *cellGlobalId* for the requested cell, upon receiving *measConfig* that includes removal of the *reportConfig* with the *purpose* set to *reportCGI*	Initiate the measurement reporting procedure, stop performing the related measurements and remove the corresponding *measId*
T325	Timer (re)started upon receiving *RRCConnectionReject* message with *deprioritisationTimer*.		Stop deprioritisation of all frequencies or E-UTRA signalled by *RRCConnectionReject.*
T330	Upon receiving *LoggedMeasurementConfiguration* message	Upon log volume exceeding the suitable UE memory, upon initiating the release of *LoggedMeasurementConfiguration* procedure	Perform the actions specified in 5.6.6.4
T340	Upon transmitting *UEAssistanceInformation* message with *powerPrefIndication* set to *normal*	Upon initiating the connection re-establishment procedure	No action.
T350	Upon entering RRC_IDLE if *t350* has been received in wlan-OffloadInfo.	Upon entering RRC_CONNECTED, or upon cell reselection.	Perform the actions specified in 5.6.12.4.

7.4 Constants

Constant	Usage
N310	Maximum number of consecutive "out-of-sync" indications for the PCell received from lower layers
N311	Maximum number of consecutive "in-sync" indications for the PCell received from lower layers
N313	Maximum number of consecutive "out-of-sync" indications for the PSCell received from lower layers
N314	Maximum number of consecutive "in-sync" indications for the PSCell received from lower layers

8 Protocol data unit abstract syntax

8.1 General

The RRC PDU contents in clause 6 and clause 10 are described using abstract syntax notation one (ASN.1) as specified in ITU-T Rec. X.680 [13] and X.681 [14]. Transfer syntax for RRC PDUs is derived from their ASN.1 definitions by use of Packed Encoding Rules, unaligned as specified in ITU-T Rec. X.691 [15].

The following encoding rules apply in addition to what has been specified in X.691:

- When a bit string value is placed in a bit-field as specified in 15.6 to 15.11 in X.691, the leading bit of the bit string value shall be placed in the leading bit of the bit-field, and the trailing bit of the bit string value shall be placed in the trailing bit of the bit-field.

NOTE: The terms 'leading bit' and 'trailing bit' are defined in ITU-T Rec. X.680. When using the 'bstring' notation, the leading bit of the bit string value is on the left, and the trailing bit of the bit string value is on the right.

- When decoding types constrained with the ASN.1 Contents Constraint ("CONTAINING"), automatic decoding of the contained type should not be performed because errors in the decoding of the contained type should not cause the decoding of the entire RRC message PDU to fail. It is recommended that the decoder first decodes the outer PDU type that contains the OCTET STRING or BIT STRING with the Contents Constraint, and then decodes the contained type that is nested within the OCTET STRING or BIT STRING as a separate step.

- When decoding a) RRC message PDUs, b) BIT STRING constrained with a Contents Constraint, or c) OCTET STRING constrained with a Contents Constraint, PER decoders are required to never report an error if there are extraneous zero or non-zero bits at the end of the encoded RRC message PDU, BIT STRING or OCTET STRING.

8.2 Structure of encoded RRC messages

An RRC PDU, which is the bit string that is exchanged between peer entities/ across the radio interface contains the basic production as defined in X.691.

RRC PDUs shall be mapped to and from PDCP SDUs (in case of DCCH) or RLC SDUs (in case of PCCH, BCCH, CCCH or MCCH) upon transmission and reception as follows:

- when delivering an RRC PDU as an PDCP SDU to the PDCP layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the PDCP SDU and onwards; and

- when delivering an RRC PDU as an RLC SDU to the RLC layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the RLC SDU and onwards; and

- upon reception of an PDCP SDU from the PDCP layer, the first bit of the PDCP SDU shall represent the first bit of the RRC PDU and onwards; and

- upon reception of an RLC SDU from the RLC layer, the first bit of the RLC SDU shall represent the first bit of the RRC PDU and onwards.

8.3 Basic production

The 'basic production' is obtained by applying UNALIGNED PER to the abstract syntax value (the ASN.1 description) as specified in X.691. It always contains a multiple of 8 bits.

8.4 Extension

The following rules apply with respect to the use of protocol extensions:

- A transmitter compliant with this version of the specification shall, unless explicitly indicated otherwise on a PDU type basis, set the extension part empty. Transmitters compliant with a later version may send non-empty extensions;
- A transmitter compliant with this version of the specification shall set spare bits to zero;

8.5 Padding

If the encoded RRC message does not fill a transport block, the RRC layer shall add padding bits. This applies to PCCH and BCCH.

Padding bits shall be set to 0 and the number of padding bits is a multiple of 8.

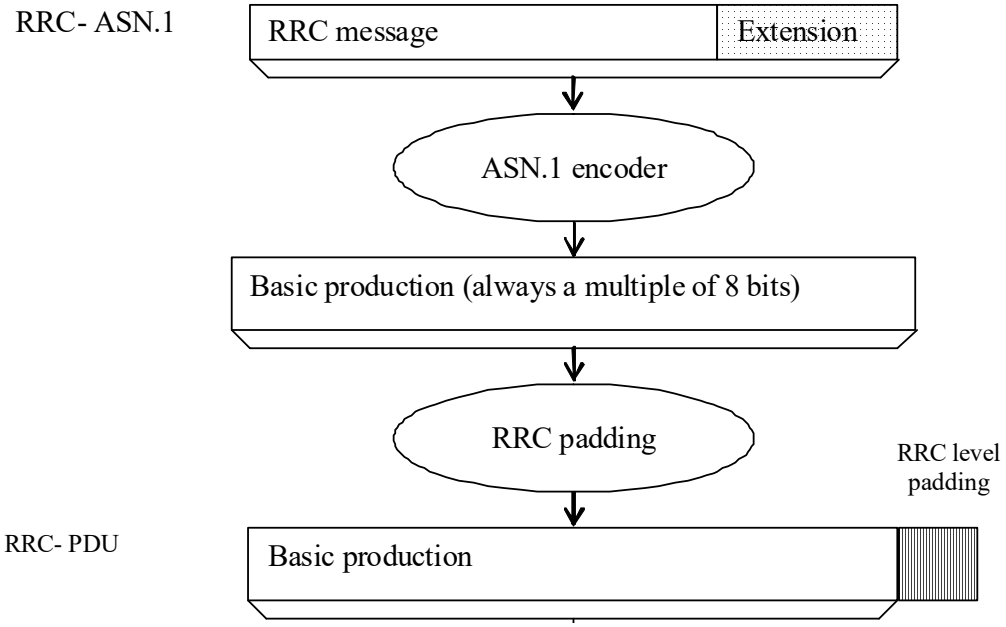


Figure 8.5-1: RRC level padding

9 Specified and default radio configurations

Specified and default configurations are configurations of which the details are specified in the standard. Specified configurations are fixed while default configurations can be modified using dedicated signalling.

9.1 Specified configurations

9.1.1 Logical channel configurations

9.1.1.1 BCCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration	N/A		
RLC configuration	TM		
MAC configuration	TM		

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

9.1.1.2 CCCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration	N/A		
RLC configuration	TM		
MAC configuration		Normal MAC headers are used	
Logical channel configuration			
priority	1	Highest priority	
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		
logicalChannelSR-Mask-r9	release		v920

9.1.1.3 PCCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration	N/A		
RLC configuration	TM		
MAC configuration	TM		

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

9.1.1.4 MCCH and MTCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration	N/A		
RLC configuration	UM		
Sn-FieldLength	size5		
t-Reordering	0		

9.1.1.5 SBCCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration	N/A		
RLC configuration	TM		
MAC configuration	TM		

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

9.1.1.6 STCH configuration

Parameters

Name	Value	Semantics description	Ver
PDCP configuration			
discardTimer	Undefined	Up to UE implementation	
pdcp-SN-Size	16		
maxCID	15		
profiles			
RLC configuration		Uni-directional UM RLC UM window size is set to 0	

Name	Value	Semantics description	Ver
sn-FieldLength	5		
logicalChannelIdentity	Undefined	Selected by the transmitting UE, up to UE implementation	
Logical channel configuration			
priority	Undefined	Selected by the transmitting UE, up to UE implementation	
prioritisedBitRate	Undefined	Selected by the transmitting UE, up to UE implementation	
bucketSizeDuration	Undefined	Selected by the transmitting UE, up to UE implementation	
logicalChannelGroup	3		
MAC configuration			
maxHARQ-Tx	4		

9.1.2 SRB configurations

9.1.2.1 SRB1

Parameters

Name	Value	Semantics description	Ver
RLC configuration			
logicalChannelIdentity	1		

9.1.2.2 SRB2

Parameters

Name	Value	Semantics description	Ver
RLC configuration			
logicalChannelIdentity	2		

9.2 Default radio configurations

The following sections only list default values for REL-8 parameters included in protocol version v8.5.0. For all fields introduced in a later protocol version, the default value is "released" unless explicitly specified otherwise. If UE is to apply default configuration while it is configured with some critically extended fields, the UE shall apply the original version with only default values. For the following fields, introduced in a protocol version later than v8.5.0, the default corresponds with "value not applicable":

- *codeBookSubsetRestriction-v920*;
- *pmi-RI-Report*;

NOTE 1: Value "N/A" indicates that the UE does not apply a specific value (i.e. upon switching to a default configuration, E-UTRAN can not assume the UE keeps the previously configured value). This implies that E-UTRAN needs to configure a value before invoking the related functionality.

NOTE 2: In general, the signalling should preferably support a "release" option for fields introduced after v8.5.0. The "value not applicable" should be used restrictively, mainly limited to for fields which value is relevant only if another field is set to a value other than its default.

9.2.1 SRB configurations

9.2.1.1 SRB1

Parameters

Name	Value	Semantics description	Ver
RLC configuration CHOICE	am		
ul-RLC-Config *>t-PollRetransmit* *>pollPDU* *>pollByte* *>maxRetxThreshold*	 ms45 infinity infinity t4		
dl-RLC-Config *>t-Reordering* *>t-StatusProhibit*	 ms35 ms0		
Logical channel configuration			
priority	1	Highest priority	
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		

9.2.1.2 SRB2

Parameters

Name	Value	Semantics description	Ver
RLC configuration CHOICE	am		
ul-RLC-Config *>t-PollRetransmit* *>pollPDU* *>pollByte* *>maxRetxThreshold*	 ms45 infinity infinity t4		
dl-RLC-Config *>t-Reordering* *>t-StatusProhibit*	 ms35 ms0		
Logical channel configuration			
priority	3		
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		

9.2.2 Default MAC main configuration

Parameters

Name	Value	Semantics description	Ver
MAC main configuration			
maxHARQ-tx	n5		
periodicBSR-Timer	infinity		
retxBSR-Timer	sf2560		
ttiBundling	FALSE		
drx-Config	release		
phr-Config	release		

9.2.3 Default semi-persistent scheduling configuration

SPS-Config *>sps-ConfigDL* *>sps-ConfigUL*	 release release		

9.2.4 Default physical channel configuration

Parameters

Name	Value	Semantics description	Ver
PDSCH-ConfigDedicated *>p-a*	 dB0		
PUCCH-ConfigDedicated *> tdd-AckNackFeedbackMode* *>ackNackRepetition*	 bundling release	 Only valid for TDD mode	
PUSCH-ConfigDedicated *>betaOffset-ACK-Index* *>betaOffset-RI-Index* *>betaOffset-CQI-Index*	 10 12 15		
UplinkPowerControlDedicated *>p0-UE-PUSCH* *>deltaMCS-Enabled* *>accumulationEnabled* *>p0-UE-PUCCH* *>pSRS-Offset* *> filterCoefficient*	 0 en0 (disabled) TRUE 0 7 fc4		
tpc-pdcch-ConfigPUCCH	release		
tpc-pdcch-ConfigPUSCH	release		
CQI-ReportConfig *> CQI-ReportPeriodic* *> cqi-ReportModeAperiodic* *> nomPDSCH-RS-EPRE-Offset*	 release N/A N/A		
SoundingRS-UL-ConfigDedicated	release		
AntennaInfoDedicated *>transmissionMode* *>codebookSubsetRestriction* *>ue-TransmitAntennaSelection*	 tm1, tm2 N/A release	 If the number of PBCH antenna ports is one, tm1 is used as default; otherwise tm2 is used as default	
SchedulingRequestConfig	release		

9.2.5 Default values timers and constants

Parameters

Name	Value	Semantics description	Ver
t310	ms1000		
n310	n1		
t311	ms1000		
n311	n1		

9.3 Sidelink pre-configured parameters

9.3.1 Specified parameters

This section only list parameters which value is specified in the standard.

Parameters

Name	Value	Semantics description	Ver
preconfigSync *>syncTxParameters* *>>alpha*		 0	
preconfigComm *>sc-TxParameters* *>>alpha* *>dataTxParameters* *>>alpha*		 0 0	

9.3.2 Pre-configurable parameters

This ASN.1 segment is the start of the E-UTRA definitions of pre-configured sidelink parameters.

NOTE 1: Upper layers are assumed to provide a set of pre-configured parameters that are valid at the current UE location if any, see TS 24.334 [69, 10.2].

```
-- ASN1START

EUTRA-Sidelink-Preconf DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    AdditionalSpectrumEmission,
    ARFCN-ValueEUTRA-r9,
    FilterCoefficient,
    maxSL-TxPool-r12,
    P-Max,
    SL-CP-Len-r12,
    SL-HoppingConfigComm-r12,
    SL-OffsetIndicatorSync-r12,
    SL-PeriodComm-r12,
    RSRP-RangeSL3-r12,
    SL-TF-ResourceConfig-r12,
    SL-TRPT-Subset-r12,
    P0-SL-r12,
    TDD-ConfigSL-r12
FROM EUTRA-RRC-Definitions;

-- ASN1STOP
```

– *SL-Preconfiguration*

The IE *SL-Preconfiguration* includes the sidelink pre-configured parameters.

SL-Preconfiguration information elements

```
-- ASN1START

SL-Preconfiguration-r12 ::=     SEQUENCE {
    preconfigGeneral-r12                SL-PreconfigGeneral-r12,
    preconfigSync-r12                   SL-PreconfigSync-r12,
    preconfigComm-r12                   SL-PreconfigCommPoolList4-r12,
    ...
}

SL-PreconfigGeneral-r12 ::=     SEQUENCE {
    -- PDCP configuration
    rohc-Profiles-r12                   SEQUENCE {
        profile0x0001-r12                       BOOLEAN,
        profile0x0002-r12                       BOOLEAN,
        profile0x0004-r12                       BOOLEAN,
        profile0x0006-r12                       BOOLEAN,
        profile0x0101-r12                       BOOLEAN,
        profile0x0102-r12                       BOOLEAN,
        profile0x0104-r12                       BOOLEAN
    },
    -- Physical configuration
    carrierFreq-r12                     ARFCN-ValueEUTRA-r9,
    maxTxPower-r12                      P-Max,
    additionalSpectrumEmission-r12      AdditionalSpectrumEmission,
    sl-bandwidth-r12                    ENUMERATED {n6, n15, n25, n50, n75, n100},
    tdd-ConfigSL-r12                    TDD-ConfigSL-r12,
    reserved-r12                        BIT STRING (SIZE (19)),
    ...
}

SL-PreconfigSync-r12 ::=    SEQUENCE {
    syncCP-Len-r12                      SL-CP-Len-r12,
    syncOffsetIndicator1-r12            SL-OffsetIndicatorSync-r12,
    syncOffsetIndicator2-r12            SL-OffsetIndicatorSync-r12,
```

```
    syncTxParameters-r12                P0-SL-r12,
    syncTxThreshOoC-r12                 RSRP-RangeSL3-r12,
    filterCoefficient-r12               FilterCoefficient,
    syncRefMinHyst-r12                  ENUMERATED {dB0, dB3, dB6, dB9, dB12},
    syncRefDiffHyst-r12                 ENUMERATED {dB0, dB3, dB6, dB9, dB12, dBinf},
    ...
}

SL-PreconfigCommPoolList4-r12 ::=   SEQUENCE (SIZE (1..maxSL-TxPool-r12)) OF SL-PreconfigCommPool-
r12

SL-PreconfigCommPool-r12 ::=        SEQUENCE {
-- This IE is same as SL-CommResourcePool with rxParametersNCell absent
    sc-CP-Len-r12                       SL-CP-Len-r12,
    sc-Period-r12                       SL-PeriodComm-r12,
    sc-TF-ResourceConfig-r12            SL-TF-ResourceConfig-r12,
    sc-TxParameters-r12                 P0-SL-r12,
    data-CP-Len-r12                     SL-CP-Len-r12,
    data-TF-ResourceConfig-r12          SL-TF-ResourceConfig-r12,
    dataHoppingConfig-r12               SL-HoppingConfigComm-r12,
    dataTxParameters-r12                P0-SL-r12,
    trpt-Subset-r12                     SL-TRPT-Subset-r12,
    ...
}

END

-- ASN1STOP
```

***SL-Preconfiguration* field descriptions**
carrierFreq Indicates the carrier frequency for sidelink operation. In case of FDD it is uplink carrier frequency and the corresponding downlink frequency can be determined from the default TX-RX frequency separation defined in TS 36.101 [42, table 5.7.3-1].
preconfigComm Indicates a list of resource pools. The first resource pool in the list is used for both reception and transmission of sidelink communication. The other resource pools, if present, are only used for reception of sidelink communication.
syncRefDiffHyst Hysteresis when evaluating a SyncRef UE using relative comparison. Value *dB0* corresponds to 0 dB, *dB3* to 3 dB and so on, value *dBinf* corresponds to infinite dB.
syncRefMinHyst Hysteresis when evaluating a SyncRef UE using absolute comparison. Value *dB0* corresponds to 0 dB, *dB3* to 3 dB and so on.

NOTE 1: The network may configure one or more of the reception only resource pools in *preconfigComm* to cover reception from in coverage UEs using scheduled resource allocation. For such a resource pool the network should set all bits of *subframeBitmap* to 1 and *offsetIndicator* to indicate the subframe immediately following the sidelink control information.

NOTE 2: The network should ensure that the resources defined by the first entry in *preconfigComm* (used for transmission by an out of coverage UE) do not overlap with those of the pool(s) covering scheduled transmissions by in coverage UEs. Furthermore, the network should ensure that for none of the entries in *preconfigComm* the resources defined by *sc-TF-ResourceConfig* overlap.

10 Radio information related interactions between network nodes

10.1 General

This section specifies RRC messages that are transferred between network nodes. These RRC messages may be transferred to or from the UE via another Radio Access Technology. Consequently, these messages have similar characteristics as the RRC messages that are transferred across the E-UTRA radio interface, i.e. the same transfer syntax and protocol extension mechanisms apply.

10.2 Inter-node RRC messages

10.2.1 General

This section specifies RRC messages that are sent either across the X2- or the S1-interface, either to or from the eNB, i.e. a single 'logical channel' is used for all RRC messages transferred across network nodes. The information could originate from or be destined for another RAT.

– *EUTRA-InterNodeDefinitions*

This ASN.1 segment is the start of the E-UTRA inter-node PDU definitions.

```
-- ASN1START

EUTRA-InterNodeDefinitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    AntennaInfoCommon,
    AntennaInfoDedicated-v10i0,
    ARFCN-ValueEUTRA,
    ARFCN-ValueEUTRA-v9e0,
    ARFCN-ValueEUTRA-r9,
    CellIdentity,
    C-RNTI,
    DL-DCCH-Message,
    DRB-Identity,
    DRB-ToReleaseList,
    InDeviceCoexIndication-r11,
    MasterInformationBlock,
    maxFreq,
    maxDRB,
    maxSCell-r10,
    maxServCell-r10,
    MBMSInterestIndication-r11,
    MeasConfig,
    MeasGapConfig,
    OtherConfig-r9,
    PhysCellId,
    P-Max,
    PowerCoordinationInfo-r12,
    SidelinkUEInformation-r12,
    SL-CommConfig-r12,
    SL-DiscConfig-r12,
    RadioResourceConfigDedicated,
    RSRP-Range,
    RSRQ-Range,
    RSRQ-Range-v1250,
    SCellToAddModList-r10,
    SCG-ConfigPartSCG-r12,
    SecurityAlgorithmConfig,
    SCellIndex-r10,
    SCellToReleaseList-r10,
    ServCellIndex-r10,
    ShortMAC-I,
    SystemInformationBlockType1,
    SystemInformationBlockType1-v890-IEs,
    SystemInformationBlockType2,
    UEAssistanceInformation-r11,
    UECapabilityInformation,
    UE-CapabilityRAT-ContainerList,
    UE-RadioPagingInfo-r12,
    WLAN-OffloadConfig-r12
FROM EUTRA-RRC-Definitions;

-- ASN1STOP
```

10.2.2 Message definitions

– *HandoverCommand*

This message is used to transfer the handover command generated by the target eNB.

Direction: target eNB to source eNB/ source RAN

***HandoverCommand* message**

```
-- ASN1START

HandoverCommand ::=                 SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            handoverCommand-r8                  HandoverCommand-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

HandoverCommand-r8-IEs ::=          SEQUENCE {
    handoverCommandMessage              OCTET STRING (CONTAINING DL-DCCH-Message),
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

***HandoverCommand* field descriptions**
handoverCommandMessage
Contains the entire DL-DCCH-Message including the *RRCConnectionReconfiguration* message used to perform handover within E-UTRAN or handover to E-UTRAN, generated (entirely) by the target eNB.

NOTE: The source BSC, in case of inter-RAT handover from GERAN to E-UTRAN, expects that the HandoverCommand message includes DL-DCCH-Message only. Thus, criticalExtensionsFuture, spare1-spare7 and nonCriticalExtension should not be used regardless whether the source RAT is E-UTRAN, UTRAN or GERAN.

– *HandoverPreparationInformation*

This message is used to transfer the E-UTRA RRC information used by the target eNB during handover preparation, including UE capability information.

Direction: source eNB/ source RAN to target eNB

***HandoverPreparationInformation* message**

```
-- ASN1START

HandoverPreparationInformation ::=  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            handoverPreparationInformation-r8   HandoverPreparationInformation-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

HandoverPreparationInformation-r8-IEs ::= SEQUENCE {
    ue-RadioAccessCapabilityInfo        UE-CapabilityRAT-ContainerList,
    as-Config                           AS-Config                   OPTIONAL,       -- Cond HO
```

```
    rrm-Config                          RRM-Config                OPTIONAL,
    as-Context                          AS-Context             OPTIONAL,       -- Cond HO
    nonCriticalExtension                HandoverPreparationInformation-v920-IEs     OPTIONAL
}

HandoverPreparationInformation-v920-IEs ::= SEQUENCE {
    ue-ConfigRelease-r9                 ENUMERATED {
                                        rel9, rel10, rel11, rel12, v10j0, v11e0,
                                        v1280, spare1, ...}             OPTIONAL,   -- Cond HO2
    nonCriticalExtension                HandoverPreparationInformation-v9d0-IEs     OPTIONAL
}

HandoverPreparationInformation-v9d0-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING (CONTAINING HandoverPreparationInformation-
v9j0-IEs)   OPTIONAL,
    nonCriticalExtension                HandoverPreparationInformation-v9e0-IEs         OPTIONAL
}

-- Late non-critical extensions:
HandoverPreparationInformation-v9j0-IEs ::= SEQUENCE {
    -- Following field is only for pre REL-10 late non-critical extensions
    lateNonCriticalExtension            OCTET STRING                    OPTIONAL,
    nonCriticalExtension                HandoverPreparationInformation-v10j0-IEs        OPTIONAL
}

HandoverPreparationInformation-v10j0-IEs ::= SEQUENCE {
    as-Config-v10j0                     AS-Config-v10j0         OPTIONAL,
    -- Following field is only for late non-critical extensions from REL-10
    nonCriticalExtension                SEQUENCE {}             OPTIONAL
}

-- Regular non-critical extensions:
HandoverPreparationInformation-v9e0-IEs ::= SEQUENCE {
    as-Config-v9e0                      AS-Config-v9e0                  OPTIONAL,   -- Cond HO2
    nonCriticalExtension                HandoverPreparationInformation-v1130-IEs        OPTIONAL
}

HandoverPreparationInformation-v1130-IEs    ::= SEQUENCE {
    as-Context-v1130                    AS-Context-v1130                OPTIONAL,   -- Cond HO2
    nonCriticalExtension                HandoverPreparationInformation-v1250-IEs
    OPTIONAL
}

HandoverPreparationInformation-v1250-IEs ::= SEQUENCE {
    ue-SupportedEARFCN-r12              ARFCN-ValueEUTRA-r9             OPTIONAL,   -- Cond HO3
    as-Config-v1250                AS-Config-v1250             OPTIONAL,   -- Cond HO2
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

***HandoverPreparationInformation* field descriptions**
as-Config The radio resource configuration. Applicable in case of intra-E-UTRA handover. If the target receives an incomplete *MeasConfig* and *RadioResourceConfigDedicated* in the *as-Config*, the target eNB may decide to apply the full configuration option based on the *ue-ConfigRelease*.
as-Context Local E-UTRAN context required by the target eNB.
rrm-Config Local E-UTRAN context used depending on the target node's implementation, which is mainly used for the RRM purpose.
ue-ConfigRelease Indicates the RRC protocol release or version applicable for the current UE configuration. This could be used by target eNB to decide if the full configuration approach should be used. If this field is not present, the target assumes that the current UE configuration is based on the release 8 version of RRC protocol. NOTE 1.
ue-RadioAccessCapabilityInfo NOTE 2
ue-SupportedEARFCN Includes UE supported EARFCN of the handover target E-UTRA cell if the target E-UTRA cell belongs to multiple frequency bands.

NOTE 1: The source typically sets the *ue-ConfigRelease* to the release corresponding with the current dedicated radio configuration. The source may however also consider the common radio resource configuration e.g. in case interoperability problems would appear if the UE temporary continues extensions of this part of the configuration in a target PCell not supporting them.

NOTE 2: The following table indicates per source RAT whether RAT capabilities are included or not.

Source RAT	E-UTRA capabilites	UTRA capabilities	GERAN capabilities
UTRAN	Included	May be included, ignored by eNB if received	May be included
GERAN CS	Excluded	May be included, ignored by eNB if received	Included
GERAN PS	Excluded	May be included, ignored by eNB if received	Included
E-UTRAN	Included	May be included	May be included

Conditional presence	Explanation
HO	The field is mandatory present in case of handover within E-UTRA; otherwise the field is not present.
HO2	The field is optional present in case of handover within E-UTRA; otherwise the field is not present.
HO3	The field is optional present in case of handover from GERAN to E-UTRA, otherwise the field is not present.

– *SCG-Config*

This message is used to transfer the SCG radio configuration generated by the SeNB.

Direction: Secondary eNB to master eNB

SCG-Config message

```
-- ASN1START

SCG-Config-r12 ::=                  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            scg-Config-r12                  SCG-Config-r12-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SCG-Config-r12-IEs ::=              SEQUENCE {
    scg-RadioConfig-r12                 SCG-ConfigPartSCG-r12               OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

SCG-Config field descriptions
scg-RadioConfig-r12
Includes the change of the dedicated SCG configuration and, upon addition of an SCG cell, the common SCG configuration.
The SeNB only includes a new SCG cell in response to a request from MeNB, but may include release of an SCG cell release or release of the SCG part of an SCG/Split DRB without prior request from MeNB. The SeNB does not use this field to initiate release of the SCG.

– *SCG-ConfigInfo*

This message is used by MeNB to request the SeNB to perform certain actions e.g. to establish, modify or release an SCG, and it may include additional information e.g. to assist the SeNB with assigning the SCG configuration.

Direction: Master eNB to secondary eNB

SCG-ConfigInfo message

```
-- ASN1START

SCG-ConfigInfo-r12 ::=                  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            scg-ConfigInfo-r12                  SCG-ConfigInfo-r12-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SCG-ConfigInfo-r12-IEs ::=          SEQUENCE {
    radioResourceConfigDedMCG-r12   RadioResourceConfigDedicated        OPTIONAL,
    sCellToAddModListMCG-r12        SCellToAddModList-r10               OPTIONAL,
    measGapConfig-r12               MeasGapConfig                       OPTIONAL,
    powerCoordinationInfo-r12       PowerCoordinationInfo-r12           OPTIONAL,
    scg-RadioConfig-r12             SCG-ConfigPartSCG-r12               OPTIONAL,
    eutra-CapabilityInfo-r12        OCTET STRING (CONTAINING UECapabilityInformation)   OPTIONAL,
    scg-ConfigRestrictInfo-r12      SCG-ConfigRestrictInfo-r12          OPTIONAL,
    mbmsInterestIndication-r12      OCTET STRING (CONTAINING
                                        MBMSInterestIndication-r11)     OPTIONAL,
    measResultServCellListSCG-r12   MeasResultServCellListSCG-r12       OPTIONAL,
    drb-ToAddModListSCG-r12         DRB-InfoListSCG-r12                 OPTIONAL,
    drb-ToReleaseListSCG-r12        DRB-ToReleaseList                   OPTIONAL,
    sCellToAddModListSCG-r12        SCellToAddModListSCG-r12            OPTIONAL,
    sCellToReleaseListSCG-r12       SCellToReleaseList-r10              OPTIONAL,
    p-Max-r12                           P-Max                               OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

DRB-InfoListSCG-r12 ::=             SEQUENCE (SIZE (1..maxDRB)) OF DRB-InfoSCG-r12

DRB-InfoSCG-r12 ::=             SEQUENCE {
    eps-BearerIdentity-r12          INTEGER (0..15)             OPTIONAL,   -- Cond DRB-Setup
    drb-Identity-r12                DRB-Identity,
    drb-Type-r12                    ENUMERATED {split, scg}     OPTIONAL,   -- Cond DRB-Setup
    ...
}

SCellToAddModListSCG-r12 ::=    SEQUENCE (SIZE (1..maxSCell-r10)) OF Cell-ToAddMod-r12

Cell-ToAddMod-r12 ::=               SEQUENCE {
    sCellIndex-r12                      SCellIndex-r10,
    cellIdentification-r12              SEQUENCE {
        physCellId-r12                      PhysCellId,
        dl-CarrierFreq-r12                  ARFCN-ValueEUTRA-r9
    }                                                               OPTIONAL,   -- Cond SCellAdd
    measResultCellToAdd-r12             SEQUENCE {
        rsrpResult-r12                      RSRP-Range,
        rsrqResult-r12                      RSRQ-Range
    }                                                               OPTIONAL,   -- Cond SCellAdd2
    ...
}

MeasResultServCellListSCG-r12 ::=   SEQUENCE (SIZE (1..maxServCell-r10)) OF MeasResultServCellSCG-
r12

MeasResultServCellSCG-r12 ::=           SEQUENCE {
    servCellId-r12                      ServCellIndex-r10,
    measResultSCell-r12                 SEQUENCE {
        rsrpResultSCell-r12                 RSRP-Range,
        rsrqResultSCell-r12                 RSRQ-Range
    },
    ...
```

```
}

SCG-ConfigRestrictInfo-r12 ::=      SEQUENCE {
    maxSCH-TB-BitsDL-r12                INTEGER (1..100),
    maxSCH-TB-BitsUL-r12                INTEGER (1..100)
}

-- ASN1STOP
```

***SCG-ConfigInfo* field descriptions**
drb-ToAddModListSCG Includes DRBs the SeNB is requested to establish or modify (DRB type change).
drb-ToReleaseListSCG Includes DRBs the SeNB is requested to release.
maxSCH-TB-BitsXL Indicates the maximum DL-SCH/UL-SCH TB bits that may be scheduled in a TTI. Specified as a percentage of the value defined for the applicable UE category.
measGapConfig Includes the current measurement gap configuration.
measResultServCellListSCG Includes measurement results of SCG (serving) cells.
radioResourceConfigDedMCG Includes the current dedicated MCG radio resource configuration.
sCellToAddModListMCG Includes the current MCG SCell configuration.
sCellToAddModListSCG Includes SCG cells the SeNB is requested to establish. Measurement results may be provided for these cells.
sCellToReleaseListSCG Includes SCG cells the SeNB is requested to release.
scg-RadioConfig Includes the current dedicated SCG configuration.
scg-ConfigRestrictInfo Includes fields for which MeNB explictly indicates the restriction to be observed by SeNB.
p-Max Cell specific value i.e. as broadcast by PCell.

Conditional presence	Explanation
DRB-Setup	The field is mandatory present in case DRB establishment is requested; otherwise the field is not present.
SCellAdd	The field is mandatory present in case SCG cell establishment is requested; otherwise the field is not present.
SCellAdd2	The field is optional present in case SCG cell establishment is requested; otherwise the field is not present.

– *UERadioAccessCapabilityInformation*

This message is used to transfer UE radio access capability information, covering both upload to and download from the EPC.

Direction: eNB to/ from EPC

***UERadioAccessCapabilityInformation* message**

```
-- ASN1START

UERadioAccessCapabilityInformation ::= SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            ueRadioAccessCapabilityInformation-r8
                                                UERadioAccessCapabilityInformation-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
```

```
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UERadioAccessCapabilityInformation-r8-IEs ::= SEQUENCE {
    ue-RadioAccessCapabilityInfo        OCTET STRING (CONTAINING UECapabilityInformation),
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

***UERadioAccessCapabilityInformation* field descriptions**
ue-RadioAccessCapabilityInfo Including E-UTRA, GERAN, and CDMA2000-1xRTT Bandclass radio access capabilities (separated). UTRA radio access capabilities are not included.

– *UERadioPagingInformation*

This message is used to transfer radio paging information required for a category 0 UE, covering both upload to and download from the EPC.

Direction: eNB to/ from EPC

***UERadioPagingInformation* message**

```
-- ASN1START

UERadioPagingInformation ::= SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            ueRadioPagingInformation-r12            UERadioPagingInformation-r12-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UERadioPagingInformation-r12-IEs ::= SEQUENCE {
    ue-RadioPagingInfo-r12              OCTET STRING (CONTAINING UE-RadioPagingInfo-r12),
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- ASN1STOP
```

10.3 Inter-node RRC information element definitions

– *AS-Config*

The *AS-Config* IE contains information about RRC configuration information in the source eNB which can be utilized by target eNB to determine the need to change the RRC configuration during the handover preparation phase. The information can also be used after the handover is successfully performed or during the RRC connection re-establishment.

***AS-Config* information element**

```
-- ASN1START

AS-Config ::=               SEQUENCE {
    sourceMeasConfig                    MeasConfig,
    sourceRadioResourceConfig           RadioResourceConfigDedicated,
    sourceSecurityAlgorithmConfig       SecurityAlgorithmConfig,
    sourceUE-Identity                   C-RNTI,
    sourceMasterInformationBlock        MasterInformationBlock,
    sourceSystemInformationBlockType1   SystemInformationBlockType1(WITH COMPONENTS
```

```
                                        {..., nonCriticalExtension ABSENT}),
    sourceSystemInformationBlockType2   SystemInformationBlockType2,
    antennaInfoCommon                   AntennaInfoCommon,
    sourceDl-CarrierFreq                ARFCN-ValueEUTRA,
    ...,
    [[  sourceSystemInformationBlockType1Ext    OCTET STRING (CONTAINING
                                                SystemInformationBlockType1-v890-IEs)   OPTIONAL,
        sourceOtherConfig-r9                OtherConfig-r9
    -- sourceOtherConfig-r9 should have been optional. A target eNB compliant with this transfer
    -- syntax should support receiving an AS-Config not including this extension addition group
    -- e.g. from a legacy source eNB
    ]],
    [[  sourceSCellConfigList-r10           SCellToAddModList-r10           OPTIONAL
    ]],
    [[  sourceConfigSCG-r12                 SCG-Config-r12      OPTIONAL
    ]]
}

AS-Config-v9e0 ::=              SEQUENCE {
    sourceDl-CarrierFreq-v9e0       ARFCN-ValueEUTRA-v9e0
}

AS-Config-v10j0 ::=             SEQUENCE {
    antennaInfoDedicatedPCell-v10i0     AntennaInfoDedicated-v10i0          OPTIONAL
}

AS-Config-v1250 ::=             SEQUENCE {
    sourceWlan-OffloadConfig-r12        WLAN-OffloadConfig-r12              OPTIONAL,
    sourceSL-CommConfig-r12             SL-CommConfig-r12                   OPTIONAL,
    sourceSL-DiscConfig-r12             SL-DiscConfig-r12                   OPTIONAL
}

-- ASN1STOP
```

NOTE: The *AS-Config* re-uses information elements primarily created to cover the radio interface signalling requirements. Consequently, the information elements may include some parameters that are not relevant for the target eNB e.g. the SFN as included in the *MasterInformationBlock*.

***AS-Config* field descriptions**
antennaInfoCommon This field provides information about the number of antenna ports in the source PCell.
sourceDL-CarrierFreq Provides the parameter Downlink EARFCN in the source PCell, see TS 36.101 [42]. If the source eNB provides *AS-Config-v9e0*, it sets *sourceDl-CarrierFreq* (i.e. without suffix) to *maxEARFCN*.
sourceOtherConfig Provides other configuration in the source PCell.
sourceMasterInformationBlock *MasterInformationBlock* transmitted in the source PCell.
sourceMeasConfig Measurement configuration in the source cell. The measurement configuration for all measurements existing in the source eNB when handover is triggered shall be included. See 10.5.
sourceSL-CommConfig This field covers the sidelink communication configuration.
sourceSL-DiscConfig This field covers the sidelink discovery configuration.
sourceRadioResourceConfig Radio configuration in the source PCell. The radio resource configuration for all radio bearers existing in the source PCell when handover is triggered shall be included. See 10.5.
sourceSCellConfigList Radio resource configuration (common and dedicated) of the SCells configured in the source eNB.
sourceSecurityAlgorithmConfig This field provides the AS integrity protection (SRBs) and AS ciphering (SRBs and DRBs) algorithm configuration used in the source PCell.
sourceSystemInformationBlockType1 *SystemInformationBlockType1* transmitted in the source PCell.
sourceSystemInformationBlockType2 *SystemInformationBlockType2* transmitted in the source PCell.

– *AS-Context*

The IE *AS-Context* is used to transfer local E-UTRAN context required by the target eNB.

AS-Context information element

```
-- ASN1START

AS-Context ::=                          SEQUENCE {
    reestablishmentInfo                     ReestablishmentInfo         OPTIONAL    -- Cond HO
}

AS-Context-v1130 ::=                    SEQUENCE {
    idc-Indication-r11                      OCTET STRING (CONTAINING
                                            InDeviceCoexIndication-r11) OPTIONAL,   -- Cond HO2
    mbmsInterestIndication-r11              OCTET STRING (CONTAINING
                                            MBMSInterestIndication-r11) OPTIONAL,   -- Cond HO2
    powerPrefIndication-r11                 OCTET STRING (CONTAINING
                                            UEAssistanceInformation-r11)    OPTIONAL,   -- Cond HO2
    ...,
    [[  sidelinkUEInformation-r12               OCTET STRING (CONTAINING
                                                SidelinkUEInformation-r12)  OPTIONAL    -- Cond HO2
    ]]
}

-- ASN1STOP
```

***AS-Context* field descriptions**
idc-Indication Including information used for handling the IDC problems.
reestablishmentInfo Including information needed for the RRC connection re-establishment.

Conditional presence	Explanation
HO	The field is mandatory present in case of handover within E-UTRA; otherwise the field is not present.
HO2	The field is optional present in case of handover within E-UTRA; otherwise the field is not present.

– *ReestablishmentInfo*

The *ReestablishmentInfo* IE contains information needed for the RRC connection re-establishment.

ReestablishmentInfo information element

```
-- ASN1START

ReestablishmentInfo ::=             SEQUENCE {
    sourcePhysCellId                    PhysCellId,
    targetCellShortMAC-I                ShortMAC-I,
    additionalReestabInfoList           AdditionalReestabInfoList               OPTIONAL,
    ...
}

AdditionalReestabInfoList ::=       SEQUENCE ( SIZE (1..maxReestabInfo) ) OF AdditionalReestabInfo

AdditionalReestabInfo ::=   SEQUENCE{
    cellIdentity                        CellIdentity,
    key-eNodeB-Star                     Key-eNodeB-Star,
    shortMAC-I                          ShortMAC-I
}

Key-eNodeB-Star ::=                 BIT STRING (SIZE (256))

-- ASN1STOP
```

ReestablishmentInfo field descriptions
additionalReestabInfoList Contains a list of shortMAC-I and KeNB* for cells under control of the target eNB, required for potential re-establishment by the UE in these cells to succeed.
Key-eNodeB-Star Parameter KeNB*: See TS 33.401 [32, 7.2.8.4]. If the cell identified by *cellIdentity* belongs to multiple frequency bands, the source eNB selects the DL-EARFCN for the KeNB* calculation using the same logic as UE uses when selecting the DL-EARFCN in IDLE as defined in section 6.2.2. This parameter is only used for X2 handover, and for S1 handover, it shall be ignored by target eNB.
sourcePhyCellId The physical cell identity of the source PCell, used to determine the UE context in the target eNB at re-establishment.
targetCellShortMAC-I The ShortMAC-I for the handover target PCell, in order for potential re-establishment to succeed.

– *RRM-Config*

The *RRM-Config* IE contains information about UE specific RRM information before the handover which can be utilized by target eNB.

RRM-Config information element

```
-- ASN1START

RRM-Config ::=              SEQUENCE {
    ue-InactiveTime             ENUMERATED {
                                    s1, s2, s3, s5, s7, s10, s15, s20,
                                    s25, s30, s40, s50, min1, min1s20c, min1s40,
                                    min2, min2s30, min3, min3s30, min4, min5, min6,
                                    min7, min8, min9, min10, min12, min14, min17, min20,
                                    min24, min28, min33, min38, min44, min50, hr1,
                                    hr1min30, hr2, hr2min30, hr3, hr3min30, hr4, hr5, hr6,
                                    hr8, hr10, hr13, hr16, hr20, day1, day1hr12, day2,
                                    day2hr12, day3, day4, day5, day7, day10, day14, day19,
                                    day24, day30, dayMoreThan30}        OPTIONAL,
    ...,
    [[  candidateCellInfoList-r10   CandidateCellInfoList-r10       OPTIONAL
    ]]
}

CandidateCellInfoList-r10 ::=   SEQUENCE (SIZE (1..maxFreq)) OF CandidateCellInfo-r10

CandidateCellInfo-r10 ::=       SEQUENCE {
    -- cellIdentification
    physCellId-r10                  PhysCellId,
    dl-CarrierFreq-r10              ARFCN-ValueEUTRA,
    -- available measurement results
    rsrpResult-r10                  RSRP-Range          OPTIONAL,
    rsrqResult-r10                  RSRQ-Range          OPTIONAL,
    ...,
    [[  dl-CarrierFreq-v1090            ARFCN-ValueEUTRA-v9e0       OPTIONAL
    ]],
    [[  rsrqResult-v1250                RSRQ-Range-v1250            OPTIONAL
    ]]
}

-- ASN1STOP
```

RRM-Config field descriptions
candidateCellInfoList A list of the best cells on each frequency for which measurement information was available, in order of decreasing RSRP.
dl-CarrierFreq The source includes *dl-CarrierFreq-v1090* if and only if *dl-CarrierFreq-r10* is set to *maxEARFCN*.
ue-InactiveTime Duration while UE has not received or transmitted any user data. Thus the timer is still running in case e.g., UE measures the neighbour cells for the HO purpose. Value s1 corresponds to 1 second, s2 corresponds to 2 seconds and so on. Value min1 corresponds to 1 minute, value min1s20 corresponds to 1 minute and 20 seconds, value min1s40 corresponds to 1 minute and 40 seconds and so on. Value hr1 corresponds to 1 hour, hr1min30 corresponds to 1 hour and 30 minutes and so on.

10.4 Inter-node RRC multiplicity and type constraint values

– Multiplicity and type constraints definitions

```
-- ASN1START

maxReestabInfo              INTEGER ::= 32  -- Maximum number of KeNB* and shortMAC-I forwarded
                                            -- at handover for re-establishment preparation

-- ASN1STOP
```

– End of *EUTRA-InterNodeDefinitions*

```
-- ASN1START

END

-- ASN1STOP
```

10.5 Mandatory information in *AS-Config*

The *AS-Config* transferred between source eNB and target-eNB shall include all IEs necessary to describe the AS context. The conditional presence in section 6 is only applicable for eNB to UE communication.

The "need" or "cond" statements are not applied in case of sending the IEs from source eNB to target eNB. Some information elements shall be included regardless of the "need" or "cond" e.g. *discardTimer*. The *AS-Config* re-uses information elements primarily created to cover the radio interface signalling requirements. The information elements may include some parameters that are not relevant for the target eNB e.g. the SFN as included in the *MasterInformationBlock*.

All the fields in the *AS-Config* as defined in 10.3 that are introduced after v9.2.0 and that are optional for eNB to UE communication shall be included, if the functionality is configured. The fields in the *AS-Config* that are defined before and including v9.2.0 shall be included as specified in the following.

Within the *sourceRadioResourceConfig, sourceMeasConfig* and *sourceOtherConfig*, the source eNB shall include fields that are optional for eNB to UE communication, if the functionality is configured unless explicitly specified otherwise in the following:

- in accordance with a condition that is explicitly stated to be applicable; or
- a default value is defined for the concerned field; and the configured value is the same as the default value that is defined; or
- the need of the field is OP and the current UE configuration corresponds with the behaviour defined for absence of the field;

The following fields, if the functionality is configured, are not mandatory for the source eNB to include in the *AS-Config* since delta signalling by the target eNB for these fields is not supported:

- *semiPersistSchedC-RNTI*
- *measGapConfig*

For the measurement configuration, a corresponding operation as 5.5.6.1 and 5.5.2.2a is executed by target eNB.

11 UE capability related constraints and performance requirements

11.1 UE capability related constraints

The following table lists constraints regarding the UE capabilities that E-UTRAN is assumed to take into account.

Parameter	Description	Value
#DRBs	The number of DRBs that a UE shall support	8
#RLC-AM	The number of RLC AM entities that a UE shall support	10
#minCellperMeasObjectEUTRA	The minimum number of neighbour cells (excluding black list cells) that a UE shall be able to store within a MeasObjectEUTRA. NOTE.	32
#minBlackCellRangesperMeasObjectEUTRA	The minimum number of blacklist cell PCI ranges that a UE shall be able to store within a MeasObjectEUTRA	32
#minCellperMeasObjectUTRA	The minimum number of neighbour cells that a UE shall be able to store within a MeasObjectUTRA. NOTE.	32
#minCellperMeasObjectGERAN	The minimum number of neighbour cells that a UE shall be able to store within a measObjectGERAN. NOTE.	32
#minCellperMeasObjectCDMA2000	The minimum number of neighbour cells that a UE shall be able to store within a measObjectCDMA2000. NOTE.	32
#minCellTotal	The minimum number of neighbour cells (excluding black list cells) that UE shall be able to store in total in all measurement objects configured	256
NOTE: In case of CGI reporting, the limit regarding the cells E-UTRAN can configure includes the cell for which the UE is requested to report CGI i.e. the amount of neighbour cells that can be included is at most (# minCellperMeasObjectRAT - 1), where RAT represents EUTRA/UTRA/GERAN/CDMA2000 respectively.		

11.2 Processing delay requirements for RRC procedures

The UE performance requirements for RRC procedures are specified in the following table, by means of a value N:

N = the number of 1ms subframes from the end of reception of the E-UTRAN -> UE message on the UE physical layer up to when the UE shall be ready for the reception of uplink grant for the UE -> E-UTRAN response message with no access delay other than the TTI-alignment (e.g. excluding delays caused by scheduling, the random access procedure or physical layer synchronisation).

NOTE: No processing delay requirements are specified for RN-specific procedures.

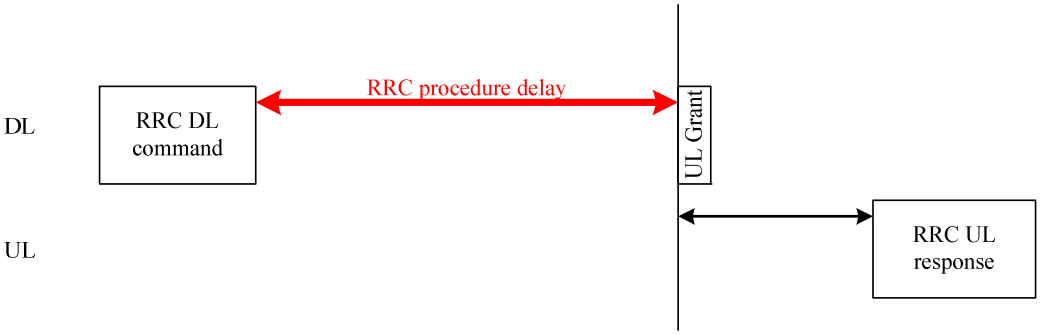


Figure 11.2-1: Illustration of RRC procedure delay

Procedure title:	E-UTRAN -> UE	UE -> E-UTRAN	N	Notes

Procedure title:	E-UTRAN -> UE	UE -> E-UTRAN	N	Notes
RRC Connection Control Procedures				
RRC connection establishment	*RRCConnectionSetup*	*RRCConnectionSetupComplete*	15	
RRC connection release	*RRCConnectionRelease*		NA	
RRC connection re-configuration (radio resource configuration)	*RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	15	
RRC connection re-configuration (measurement configuration)	*RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	15	
RRC connection re-configuration (intra-LTE mobility)	*RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	15	
RRC connection reconfiguration (SCell addition/release)	*RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	20	
RRC connection reconfiguration (SCG establishment/ release, SCG cell addition/ release)	*RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	20	
RRC connection re-establishment	*RRCConnectionReestablishment*	*RRCConnectionReestablishmentComplete*	15	
Initial security activation	*SecurityModeCommand*	*SecurityModeCommandComplete/SecurityModeCommandFailure*	10	
Initial security activation + RRC connection re-configuration (RB establishment)	*SecurityModeCommand, RRCConnectionReconfiguration*	*RRCConnectionReconfigurationComplete*	20	The two DL messages are transmitted in the same TTI
Paging	*Paging*		NA	
Inter RAT mobility				
Handover to E-UTRA	*RRCConnectionReconfiguration (sent by other RAT)*	*RRCConnectionReconfigurationComplete*	NA	The performance of this procedure is specified in [50] in case of handover from GSM and [29], [30] in case of handover from UTRA.
Handover from E-UTRA	*MobilityFromEUTRACommand*		NA	The performance of this procedure is specified in [16]
Handover from E-UTRA to CDMA2000	*HandoverFromEUTRAPreparationRequest (CDMA2000)*		NA	Used to trigger the handover preparation procedure with a CDMA2000 RAT. The performance of this procedure is specified in [16]
Measurement procedures				
Measurement Reporting		*MeasurementReport*	NA	
Other procedures				
UE capability transfer	*UECapabilityEnquiry*	*UECapabilityInformation*	10	
Counter check	*CounterCheck*	*CounterCheckResponse*	10	
Proximity indication		*ProximityIndication*	NA	

Procedure title:	E-UTRAN -> UE	UE -> E-UTRAN	N	Notes
UE information	*UEInformationRequest*	*UEInformationResponse*	15	
MBMS counting	*MBMSCountingRequest*	*MBMSCountingResponse*	NA	
MBMS interest indication		*MBMSInterestIndication*	NA	
In-device coexistence indication		*InDeviceCoexIndication*	NA	
UE assistance information		*UEAssistanceInformation*	NA	
SCG failure information		*SCGFailureInformation*	NA	
Sidelink UE information		*SidelinkUEInformation*	NA	

11.3 Void

Annex A (informative): Guidelines, mainly on use of ASN.1

Editor's note No agreements have been reached concerning the extension of RRC PDUs so far. Any statements in this section about the protocol extension mechanism should be considered as FFS.

A.1 Introduction

The following clauses contain guidelines for the specification of RRC protocol data units (PDUs) with ASN.1.

A.2 Procedural specification

A.2.1 General principles

The procedural specification provides an overall high level description regarding the UE behaviour in a particular scenario.

It should be noted that most of the UE behaviour associated with the reception of a particular field is covered by the applicable parts of the PDU specification. The procedural specification may also include specific details of the UE behaviour upon reception of a field, but typically this should be done only for cases that are not easy to capture in the PDU section e.g. general actions, more complicated actions depending on the value of multiple fields.

Likewise, the procedural specification need not specify the UE requirements regarding the setting of fields within the messages that are send to E-UTRAN i.e. this may also be covered by the PDU specification.

A.2.2 More detailed aspects

The following more detailed conventions should be used:

- Bullets:
  - Capitals should be used in the same manner as in other parts of the procedural text i.e. in most cases no capital applies since the bullets are part of the sentence starting with 'The UE shall:'
  - All bullets, including the last one in a sub-clause, should end with a semi-colon i.e. an ';'

- Conditions

  - Whenever multiple conditions apply, a semi-colon should be used at the end of each conditions with the exception of the last one, i.e. as in 'if cond1; or cond2:

A.3 PDU specification

A.3.1 General principles

A.3.1.1 ASN.1 sections

The RRC PDU contents are formally and completely described using abstract syntax notation (ASN.1), see X.680 [13], X.681 (02/2002) [14].

The complete ASN.1 code is divided into a number of ASN.1 sections in the specifications. In order to facilitate the extraction of the complete ASN.1 code from the specification, each ASN.1 section begins with a text paragraph consisting entirely of an *ASN.1 start tag*, which consists of a double hyphen followed by a single space and the text string "ASN1START" (in all upper case letters). Each ASN.1 section ends with a text paragraph consisting entirely of an *ASN.1 stop tag*, which consists of a double hyphen followed by a single space and the text "ASN1STOP" (in all upper case letters):

```
-- ASN1START

-- ASN1STOP
```

The text paragraphs containing the ASN.1 start and stop tags should not contain any ASN.1 code significant for the complete description of the RRC PDU contents. The complete ASN.1 code may be extracted by copying all the text paragraphs between an ASN.1 start tag and the following ASN.1 stop tag in the order they appear, throughout the specification.

NOTE: A typical procedure for extraction of the complete ASN.1 code consists of a first step where the entire RRC PDU contents description (ultimately the entire specification) is saved into a plain text (ASCII) file format, followed by a second step where the actual extraction takes place, based on the occurrence of the ASN.1 start and stop tags.

A.3.1.2 ASN.1 identifier naming conventions

The naming of identifiers (i.e., the ASN.1 field and type identifiers) should be based on the following guidelines:

- Message (PDU) identifiers should be ordinary mixed case without hyphenation. These identifiers, *e.g.*, the *RRCConnectionModificationCommand*, should be used for reference in the procedure text. Abbreviated forms of these identifiers should not be used.

- Type identifiers other than PDU identifiers should be ordinary mixed case, with hyphenation used to set off acronyms only where an adjacent letter is a capital, *e.g.*, *EstablishmentCause, SelectedPLMN* (not *Selected-PLMN*, since the "d" in "Selected" is lowercase)*, InitialUE-Identity* and *MeasSFN-SFN-TimeDifference*.

- Field identifiers shall start with a lowercase letter and use mixed case thereafter, *e.g.*, *establishmentCause*. If a field identifier begins with an acronym (which would normally be in upper case), the entire acronym is lowercase (*plmn-Identity*, not *pLMN-Identity*). The acronym is set off with a hyphen (*ue-Identity*, not *ueIdentity*), in order to facilitate a consistent search pattern with corresponding type identifiers.

- Identifiers that are likely to be keywords of some language, especially widely used languages, such as C++ or Java, should be avoided to the extent possible.

- Identifiers, other than PDU identifiers, longer than 25 characters should be avoided where possible. It is recommended to use abbreviations, which should be done in a consistent manner i.e. use 'Meas' instead of 'Measurement' for all occurrences. Examples of typical abbreviations are given in table A.3.1.2.1-1 below.

- *For future extension:* When an extension is introduced a suffix is added to the identifier of the concerned ASN.1 field and/ or type. A suffix of the form "-rX" is used, with X indicating the release, for ASN.1 fields or types

introduced in a later release (i.e. a release later than the original/ first release of the protocol) as well as for ASN.1 fields or types for which a revision is introduced in a later release replacing a previous version, *e.g.*, *Foo-r9* for the Rel-9 version of the ASN.1 type *Foo*. A suffix of the form "-rXb" is used for the first revision of a field that it appears in the same release (X) as the original version of the field, "-rXc" for a second intra-release revision and so on. A suffix of the form "-vXYZ" is used for ASN.1 fields or types that only are an extension of a corresponding earlier field or type (see sub-clause A.4), e.g., *AnElement-v10b0* for the extension of the ASN.1 type *AnElement* introduced in version 10.11.0 of the specification. A number *0...9, 10, 11, etc.* is used to represent the first part of the version number, indicating the release of the protocol. Lower case letters *a, b, c, etc.* are used to represent the second (and third) part of the version number if they are greater than 9. In the procedural specification, in field descriptions as well as in headings suffices are not used, unless there is a clear need to distinguish the extension from the original field.

- More generally, in case there is a need to distinguish different variants of an ASN.1 field or IE, a suffix should be added at the end of the identifiers e.g. *MeasObjectUTRA*, *ConfigCommon*. When there is no particular need to distinguish the fields (e.g. because the field is included in different IEs), a common field identifier name may be used. This may be attractive e.g. in case the procedural specification is the same for the different variants.

Table A.3.1.2-1: Examples of typical abbreviations used in ASN.1 identifiers

Abbreviation	Abbreviated word
Comm	Communication
Conf	Confirmation
Config	Configuration
Disc	Discovery
DL	Downlink
Ext	Extension
Freq	Frequency
Id	Identity
Ind	Indication
Info	Information
Meas	Measurement
Neigh	Neighbour(ing)
Param(s)	Parameter(s)
Persist	Persistent
Phys	Physical
Proc	Process
Reestab	Reestablishment
Req	Request
Rx	Reception
Sched	Scheduling
Sync	Synchronisation
Thresh	Threshold
Tx/ Transm	Transmission
UL	Uplink

NOTE: The table A.3.1.2.1-1 is not exhaustive. Additional abbreviations may be used in ASN.1 identifiers when needed.

A.3.1.3 Text references using ASN.1 identifiers

A text reference into the RRC PDU contents description from other parts of the specification is made using the ASN.1 field or type identifier of the referenced element. The ASN.1 field and type identifiers used in text references should be in the *italic font style*. The "do not check spelling and grammar" attribute in Word should be set. Quotation marks (i.e., " ") should not be used around the ASN.1 field or type identifier.

A reference to an RRC PDU type should be made using the corresponding ASN.1 type identifier followed by the word "message", e.g., a reference to the *RRCConnectionRelease* message.

A reference to a specific part of an RRC PDU, or to a specific part of any other ASN.1 type, should be made using the corresponding ASN.1 field identifier followed by the word "field", e.g., a reference to the *prioritisedBitRate* field in the example below.

```
-- /example/ ASN1START
```

```
LogicalChannelConfig ::=            SEQUENCE {
    ul-SpecificParameters               SEQUENCE {
        priority                            Priority,
        prioritisedBitRate                  PrioritisedBitRate,
        bucketSizeDuration                  BucketSizeDuration,
        logicalChannelGroup                 INTEGER (0..3)
    }       OPTIONAL
}

-- ASN1STOP
```

NOTE: All the ASN.1 start tags in the ASN.1 sections, used as examples in this annex to the specification, are deliberately distorted, in order not to include them when the ASN.1 description of the RRC PDU contents is extracted from the specification.

A reference to a specific type of information element should be made using the corresponding ASN.1 type identifier preceded by the acronym "IE", e.g., a reference to the IE *LogicalChannelConfig* in the example above.

References to a specific type of information element should only be used when those are generic, i.e., without regard to the particular context wherein the specific type of information element is used. If the reference is related to a particular context, e.g., an RRC PDU type (message) wherein the information element is used, the corresponding field identifier in that context should be used in the text reference.

A reference to a specific value of an ASN.1 field should be made using the corresponding ASN.1 value without using quotation marks around the ASN.1 value, e.g., 'if the *status* field is set to value *true*'.

A.3.2 High-level message structure

Within each logical channel type, the associated RRC PDU (message) types are alternatives within a CHOICE, as shown in the example below.

```
-- /example/ ASN1START

DL-DCCH-Message ::= SEQUENCE {
    message                 DL-DCCH-MessageType
}

DL-DCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        dlInformationTransfer                   DLInformationTransfer,
        handoverFromEUTRAPreparationRequest     HandoverFromEUTRAPreparationRequest,
        mobilityFromEUTRACommand                MobilityFromEUTRACommand,
        rrcConnectionReconfiguration            RRCConnectionReconfiguration,
        rrcConnectionRelease                    RRCConnectionRelease,
        securityModeCommand                     SecurityModeCommand,
        ueCapabilityEnquiry                     UECapabilityEnquiry,
        spare1 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- ASN1STOP
```

A nested two-level CHOICE structure is used, where the alternative PDU types are alternatives within the inner level *c1* CHOICE.

Spare alternatives (i.e., *spare1* in this case) may be included within the *c1* CHOICE to facilitate future extension. The number of such spare alternatives should not extend the total number of alternatives beyond an integer-power-of-two number of alternatives (i.e., eight in this case).

Further extension of the number of alternative PDU types is facilitated using the *messageClassExtension* alternative in the outer level CHOICE.

A.3.3 Message definition

Each PDU (message) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START

RRCConnectionReconfiguration ::=    SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcConnectionReconfiguration-r8     RRCConnectionReconfiguration-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {
    -- Enter the IEs here.
    ...
}

-- ASN1STOP
```

Hooks for *critical* and *non-critical* extension should normally be included in the PDU type specification. How these hooks are used is further described in sub-clause A.4.

Critical extensions are characterised by a redefinition of the PDU contents and need to be governed by a mechanism for protocol version agreement between the encoder and the decoder of the PDU, such that the encoder is prevented from sending a critically extended version of the PDU type, which is not comprehended by the decoder.

Critical extension of a PDU type is facilitated by a two-level CHOICE structure, where the alternative PDU contents are alternatives within the inner level *c1* CHOICE. Spare alternatives (i.e., *spare3* down to *spare1* in this case) may be included within the *c1* CHOICE. The number of spare alternatives to be included in the original PDU specification should be decided case by case, based on the expected rate of critical extension in the future releases of the protocol.

Further critical extension, when the spare alternatives from the original specifications are used up, is facilitated using the *criticalExtensionsFuture* in the outer level CHOICE.

In PDU types where critical extension is not expected in the future releases of the protocol, the inner level *c1* CHOICE and the spare alternatives may be excluded, as shown in the example below.

```
-- /example/ ASN1START

RRCConnectionReconfigurationComplete ::= SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        rrcConnectionReconfigurationComplete-r8
                                            RRCConnectionReconfigurationComplete-r8-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCConnectionReconfigurationComplete-r8-IEs ::= SEQUENCE {
    -- Enter the IEs here. --                                                   -- Cond condTag
    ...
}

-- ASN1STOP
```

Non-critical extensions are characterised by the addition of new information to the original specification of the PDU type. If not comprehended, a non-critical extension may be skipped by the decoder, whilst the decoder is still able to complete the decoding of the comprehended parts of the PDU contents.

Non-critical extensions at locations other than the end of the message or other than at the end of a field contained in a BIT or OCTET STRING are facilitated by use of the ASN.1 extension marker "...". The original specification of a PDU type should normally include the extension marker at the end of the sequence of information elements contained.

Non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING are facilitated by use of an empty sequence that is marked OPTIONAL e.g. as shown in the following example:

```
-- /example/ ASN1START

RRCMessage-r8-IEs ::=                   SEQUENCE {
    field1                                  InformationElement1,
    field2                                  InformationElement2,
```

```
    nonCriticalExtension                SEQUENCE {}                 OPTIONAL
}

-- ASN1STOP
```

The ASN.1 section specifying the contents of a PDU type may be followed by a *field description* table where a further description of, e.g., the semantic properties of the fields may be included. The general format of this table is shown in the example below. The field description table is absent in case there are no fields for which further description needs to be provided e.g. because the PDU does not include any fields, or because an IE is defined for each field while there is nothing specific regarding the use of this IE that needs to be specified.

***%PDU-TypeIdentifier%* field descriptions**
%field identifier% Field description.
%field identifier% Field description.

The field description table has one column. The header row shall contain the ASN.1 type identifier of the PDU type.

The following rows are used to provide field descriptions. Each row shall include a first paragraph with a *field identifier* (in ***bold and italic*** font style) referring to the part of the PDU to which it applies. The following paragraphs at the same row may include (in regular font style), e.g., semantic description, references to other specifications and/ or specification of value units, which are relevant for the particular part of the PDU.

The parts of the PDU contents that do not require a field description shall be omitted from the field description table.

A.3.4 Information elements

Each IE (information element) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START

PRACH-ConfigSIB ::=                 SEQUENCE {
    rootSequenceIndex                   INTEGER (0..1023),
    prach-ConfigInfo                    PRACH-ConfigInfo
}

PRACH-Config ::=                    SEQUENCE {
    rootSequenceIndex                   INTEGER (0..1023),
    prach-ConfigInfo                    PRACH-ConfigInfo                    OPTIONAL    -- Need ON
}

PRACH-ConfigInfo ::=                SEQUENCE {
    prach-ConfigIndex                   ENUMERATED {ffs},
    highSpeedFlag                       ENUMERATED {ffs},
    zeroCorrelationZoneConfig           ENUMERATED {ffs}
}

-- ASN1STOP
```

IEs should be introduced whenever there are multiple fields for which the same set of values apply. IEs may also be defined for other reasons e.g. to break down a ASN.1 definition in to smaller pieces.

A group of closely related IE type definitions, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in this example, are preferably placed together in a common ASN.1 section. The IE type identifiers should in this case have a common base, defined as the *generic type identifier*. It may be complemented by a suffix to distinguish the different variants. The "*PRACH-Config*" is the generic type identifier in this example, and the "*SIB*" suffix is added to distinguish the variant. The sub-clause heading and generic references to a group of closely related IEs defined in this way should use the generic type identifier.

The same principle should apply if a new version, or an extension version, of an existing IE is created for *critical* or *non-critical* extension of the protocol (see sub-clause A.4). The new version, or the extension version, of the IE is included in the same ASN.1 section defining the original. A suffix is added to the type identifier, using the naming conventions defined in sub-clause A.3.1.2, indicating the release or version of the where the new version, or extension version, was introduced.

Local IE type definitions, like the IE *PRACH-ConfigInfo* in the example above, may be included in the ASN.1 section and be referenced in the other IE types defined in the same ASN.1 section. The use of locally defined IE types should be encouraged, as a tool to break up large and complex IE type definitions. It can improve the readability of the code. There may also be a benefit for the software implementation of the protocol end-points, as these IE types are typically provided by the ASN.1 compiler as independent data elements, to be used in the software implementation.

An IE type defined in a local context, like the IE *PRACH-ConfigInfo*, should not be referenced directly from other ASN.1 sections in the RRC specification. An IE type which is referenced in more than one ASN.1 section should be defined in a separate sub-clause, with a separate heading and a separate ASN.1 section (possibly as one in a set of closely related IE types, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in the example above). Such IE types are also referred to as 'global IEs'.

NOTE: Referring to an IE type, that is defined as a local IE type in the context of another ASN.1 section, does not generate an ASN.1 compilation error. Nevertheless, using a locally defined IE type in that way makes the IE type definition difficult to find, as it would not be visible at an outline level of the specification. It should be avoided.

The ASN.1 section specifying the contents of one or more IE types, like in the example above, may be followed by a *field description* table, where a further description of, e.g., the semantic properties of the fields of the information elements may be included. This table may be absent, similar as indicated in sub-clause A.3.3 for the specification of the PDU type. The general format of the *field description* table is the same as shown in sub-clause A.3.3 for the specification of the PDU type.

A.3.5 Fields with optional presence

A field with optional presence may be declared with the keyword DEFAULT. It identifies a default value to be assumed, if the sender does not include a value for that field in the encoding:

```
-- /example/ ASN1START

PreambleInfo ::=                    SEQUENCE {
    numberOfRA-Preambles                INTEGER (1..64)                     DEFAULT 1,
    ...
}

-- ASN1STOP
```

Alternatively, a field with optional presence may be declared with the keyword OPTIONAL. It identifies a field for which a value can be omitted. The omission carries semantics, which is different from any normal value of the field:

```
-- /example/ ASN1START

PRACH-Config ::=                SEQUENCE {
    rootSequenceIndex                   INTEGER (0..1023),
    prach-ConfigInfo                    PRACH-ConfigInfo                    OPTIONAL    -- Need ON
}

-- ASN1STOP
```

The semantics of an optionally present field, in the case it is omitted, should be indicated at the end of the paragraph including the keyword OPTIONAL, using a short comment text with a need statement. The need statement includes the keyword "Need", followed by one of the predefined semantics tags (OP, ON or OR) defined in sub-clause 6.1. If the semantics tag OP is used, the semantics of the absent field are further specified either in the field description table following the ASN.1 section, or in procedure text.

A.3.6 Fields with conditional presence

A field with conditional presence is declared with the keyword OPTIONAL. In addition, a short comment text shall be included at the end of the paragraph including the keyword OPTIONAL. The comment text includes the keyword "Cond", followed by a condition tag associated with the field ("UL" in this example):

```
-- /example/ ASN1START

LogicalChannelConfig ::=            SEQUENCE {
    ul-SpecificParameters               SEQUENCE {
```

```
        priority                            INTEGER (0),
        ...
    }       OPTIONAL                                                                    -- Cond UL
}

-- ASN1STOP
```

When conditionally present fields are included in an ASN.1 section, the field description table after the ASN.1 section shall be followed by a *conditional presence* table. The conditional presence table specifies the conditions for including the fields with conditional presence in the particular ASN.1 section.

Conditional presence	Explanation
UL	**Specification of the conditions for including the field associated with the condition tag = "UL". Semantics in case of optional presence under certain conditions may also be specified.**

The conditional presence table has two columns. The first column (heading: "Conditional presence") contains the condition tag (in *italic* font style), which links the fields with a condition tag in the ASN.1 section to an entry in the table. The second column (heading: "Explanation") contains a text specification of the conditions and requirements for the presence of the field. The second column may also include semantics, in case of an optional presence of the field, under certain conditions i.e. using the same predefined tags as defined for optional fields in A.3.5.

Conditional presence should primarily be used when presence of a field despends on the presence and/ or value of other fields within the same message. If the presence of a field depends on whether another feature/ function has been configured, while this function can be configured indepedently e.g. by another message and/ or at another point in time, the relation is best reflected by means of a statement in the field description table.

If the ASN.1 section does not include any fields with conditional presence, the conditional presence table shall not be included.

Whenever a field is only applicable in specific cases e.g. TDD, use of conditional presence should be considered.

A.3.7 Guidelines on use of lists with elements of SEQUENCE type

Where an information element has the form of a list (the SEQUENCE OF construct in ASN.1) with the type of the list elements being a SEQUENCE data type, an information element shall be defined for the list elements even if it would not otherwise be needed.

For example, a list of PLMN identities with reservation flags is defined as in the following example:

```
-- /example/ ASN1START

PLMN-IdentityInfoList ::=               SEQUENCE (SIZE (1..6)) OF PLMN-IdentityInfo

PLMN-IdentityInfo ::=               SEQUENCE {
    plmn-Identity                       PLMN-Identity,
    cellReservedForOperatorUse          ENUMERATED {reserved, notReserved}
}

-- ASN1STOP
```

rather than as in the following (bad) example, which may cause generated code to contain types with unpredictable names:

```
-- /bad example/ ASN1START

PLMN-IdentityList ::=                   SEQUENCE (SIZE (1..6)) OF SEQUENCE {
    plmn-Identity                           PLMN-Identity,
    cellReservedForOperatorUse              ENUMERATED {reserved, notReserved}
}

-- ASN1STOP
```

A.4 Extension of the PDU specifications

A.4.1 General principles to ensure compatibility

It is essential that extension of the protocol does not affect interoperability i.e. it is essential that implementations based on different versions of the RRC protocol are able to interoperate. In particular, this requirement applies for the following kind of protocol extensions:

- Introduction of new PDU types (i.e. these should not cause unexpected behaviour or damage).
- Introduction of additional fields in an extensible PDUs (i.e. it should be possible to ignore uncomprehended extensions without affecting the handling of the other parts of the message).
- Introduction of additional values of an extensible field of PDUs. If used, the behaviour upon reception of an uncomprehended value should be defined.

It should be noted that the PDU extension mechanism may depend on the logical channel used to transfer the message e.g. for some PDUs an implementation may be aware of the protocol version of the peer in which case selective ignoring of extensions may not be required.

The non-critical extension mechanism is the primary mechanism for introducing protocol extensions i.e. the critical extension mechanism is used merely when there is a need to introduce a 'clean' message version. Such a need appears when the last message version includes a large number of non-critical extensions, which results in issues like readability, overhead associated with the extension markers. The critical extension mechanism may also be considered when it is complicated to accommodate the extensions by means of non-critical extension mechanisms.

A.4.2 Critical extension of messages and fields

The mechanisms to critically extend a message are defined in A.3.3. There are both "outer branch" and "inner branch" mechanisms available. The "outer branch" consists of a CHOICE having the name *criticalExtensions*, with two values, *c1* and *criticalExtensionsFuture*. The *criticalExtensionsFuture* branch consists of an empty SEQUENCE, while the c1 branch contains the "inner branch" mechanism.

The "inner branch" structure is a CHOICE with values of the form "*MessageName-rX-IEs*" (e.g., "*RRCConnectionReconfiguration-r8-IEs*") or "*spareX*", with the spare values having type NULL. The "-rX-IEs" structures contain the *complete* structure of the message IEs for the appropriate release; i.e., the critical extension branch for the Rel-10 version of a message includes all Rel-8 and Rel-9 fields (that are not obviated in the later version), rather than containing only the additional Rel-10 fields.

The following guidelines may be used when deciding which mechanism to introduce for a particular message, i.e. only an 'outer branch', or an 'outer branch' in combination with an 'inner branch' including a certain number of spares:

- For certain messages, e.g. initial uplink messages, messages transmitted on a broadcast channel, critical extension may not be applicable.
- An outer branch may be sufficient for messages not including any fields.
- The number of spares within inner branch should reflect the likelihood that the message will be critically extended in future releases (since each release with a critical extension for the message consumes one of the spare values). The estimation of the critical extension likelyhood may be based on the number, size and changeability of the fields included in the message.
- In messages where an inner branch extension mechanism is available, all spare values of the inner branch should be used before any critical extensions are added using the outer branch.

The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release

```
-- /example/ ASN1START                  -- Original release

RRCMessage ::=                          SEQUENCE {
    rrc-TransactionIdentifier               RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
```

```
            rrcMessage-r8                       RRCMessage-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

-- ASN1STOP
```

```
-- /example/ ASN1START                  -- Later release

RRCMessage ::=                          SEQUENCE {
    rrc-TransactionIdentifier               RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcMessage-r8                       RRCMessage-r8-IEs,
            rrcMessage-r10                      RRCMessage-r10-IEs,
            rrcMessage-r11                      RRCMessage-r11-IEs,
            rrcMessage-r14                      RRCMessage-r14-IEs
        },
        later                           CHOICE {
            c2                                  CHOICE{
                rrcMessage-r16                      RRCMessage-r16-IEs,
                spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,
                spare3 NULL, spare2 NULL, spare1 NULL
            },
            criticalExtensionsFuture                SEQUENCE {}
        }
    }
}

-- ASN1STOP
```

It is important to note that critical extensions may also be used at the level of individual fields i.e. a field may be replaced by a critically extended version. When sending the extended version, the original version may also be included (e.g. original field is mandatory, EUTRAN is unaware if UE supports the extended version). In such cases, a UE supporting both versions may be required to ignore the original field. The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release

```
-- /example/ ASN1START                  -- Original release

RRCMessage ::=                          SEQUENCE {
    rrc-TransactionIdentifier               RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            rrcMessage-r8                       RRCMessage-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCMessage-rN-IEs ::= SEQUENCE {
    field1-rN                           ENUMERATED {
                                            value1, value2, value3, value4} OPTIONAL,   -- Need ON
    field2-rN                           InformationElement2-rN              OPTIONAL,   -- Need ON
    nonCriticalExtension                RRCConnectionReconfiguration-vMxy-IEs   OPTIONAL
}

RRCConnectionReconfiguration-vMxy-IEs ::= SEQUENCE {
    field2-rM                           InformationElement2-rM          OPTIONAL, -- Cond NoField2rN
    nonCriticalExtension                SEQUENCE {}                     OPTIONAL
}

-- ASN1STOP
```

Conditional presence	Explanation
NoField2rN	The field is optionally present, need ON, if *field2-rN* is absent. Otherwise the field is not present

Finally, it is noted that a critical extension may be introduced in the same release as the one in which the original field was introduced e.g. to correct an essential ASN.1 error. In such cases a UE capability may be introduced, to assist E-UTRAN in deciding whether or not to use the critically extension.

A.4.3 Non-critical extension of messages

A.4.3.1 General principles

The mechanisms to extend a message in a non-critical manner are defined in A.3.3. W.r.t. the use of extension markers, the following additional guidelines apply:

- When further non-critical extensions are added to a message that has been critically extended, the inclusion of these non-critical extensions in earlier critical branches of the message should be avoided when possible.
- The extension marker ("…") is the primary non-critical extension mechanism that is used unless a length determinant is not required. Examples of cases where a length determinant is not required:
  - at the end of a message,
  - at the end of a structure contained in a BIT STRING or OCTET STRING
- When an extension marker is available, non-critical extensions are preferably placed at the location (e.g. the IE) where the concerned parameter belongs from a logical/ functional perspective (referred to as the '*default extension location*')
- It is desirable to aggregate extensions of the same release or version of the specification into a group, which should be placed at the lowest possible level.
- In specific cases it may be preferrable to place extensions elsewhere (referred to as the '*actual extension location*') e.g. when it is possible to aggregate several extensions in a group. In such a case, the group should be placed at the lowest suitable level in the message. <TBD: ref to seperate example>
- In case placement at the default extension location affects earlier critical branches of the message, locating the extension at a following higher level in the message should be considered.
- In case an extension is not placed at the default extension location, an IE should be defined. The IE's ASN.1 definition should be placed in the same ASN.1 section as the default extension location. In case there are intermediate levels in-between the actual and the default extension location, an IE may be defined for each level. Intermediate levels are primarily introduced for readability and overview. Hence intermediate levels need not allways be introduced e.g. they may not be needed when the default and the actual extension location are within the same ASN.1 section. <TBD: ref to seperate example>

A.4.3.2 Further guidelines

Further to the general principles defined in the previous section, the following additional guidelines apply regarding the use of extension markers:

- Extension markers within SEQUENCE
  - Extension markers are primarily, but not exclusively, introduced at the higher nesting levels
  - Extension markers are introduced for a SEQUENCE comprising several fields as well as for information elements whose extension would result in complex structures without it (e.g. re-introducing another list)
  - Extension markers are introduced to make it possible to maintain important information structures e.g. parameters relevant for one particular RAT
  - Extension markers are also used for size critical messages (i.e. messages on BCCH, PCCH and CCCH), although introduced somewhat more carefully
  - The extension fields introduced (or frozen) in a specific version of the specification are grouped together using double brackets.
- Extension markers within ENUMERATED

  - Spare values are used until the number of values reaches the next power of 2, while the extension marker caters for extension beyond that limit

  - A suffix of the form "vXYZ" is used for the identifier of each new value, e.g. "value-vXYZ".

- Extension markers within CHOICE:

  - Extension markers are introduced when extension is foreseen and when comprehension is not required by the receiver i.e. behaviour is defined for the case where the receiver cannot comprehend the extended value (e.g. ignoring an optional CHOICE field). It should be noted that defining the behaviour of a receiver upon receiving a not comprehended choice value is not required if the sender is aware whether or not the receiver supports the extended value.

  - A suffix of the form "vXYZ" is used for the identifier of each new choice value, e.g. "choice-vXYZ".

Non-critical extensions at the end of a message/ of a field contained in an OCTET or BIT STRING:

- When a nonCriticalExtension is actually used, a "Need" statement should not be provided for the field, which always is a group including at least one extension and a field facilitating further possible extensions. For simplicity, it is recommended not to provide a "Need" statement when the field is not actually used either.

Further, more general, guidelines:

- In case a need statement is not provided for a group, a "Need" statement is provided for all individual extension fields within the group i.e. including for fields that are not marked as OPTIONAL. The latter is to clarify the action upon absence of the whole group.

A.4.3.3 Typical example of evolution of IE with local extensions

The following example illustrates the use of the extension marker for a number of elementary cases (sequence, enumerated, choice). The example also illustrates how the IE may be revised in case the critical extension mechanism is used.

NOTE In case there is a need to support further extensions of release n while the ASN.1 of release (n+1) has been frozen, without requiring the release n receiver to support decoding of release (n+1) extensions, more advanced mechanisms are needed e.g. including multiple extension markers.

```
-- /example/ ASN1START

InformationElement1 ::=             SEQUENCE {
    field1                              ENUMERATED {
                                            value1, value2, value3, value4-v880,
                                            ..., value5-v960 },
    field2                              CHOICE {
        field2a                             BOOLEAN,
        field2b                             InformationElement2b,
        ...,
        field2c-v960                        InformationElement2c-r9
    },
    ...,
    [[  field3-r9                           InformationElement3-r9      OPTIONAL        -- Need OR
    ]],
    [[  field3-v9a0                         InformationElement3-v9a0    OPTIONAL,       -- Need OR
        field4-r9                           InformationElement4         OPTIONAL        -- Need OR
    ]]
}

InformationElement1-r10 ::=         SEQUENCE {
    field1                              ENUMERATED {
                                            value1, value2, value3, value4-v880,
                                            value5-v960, value6-v1170, spare2, spare1, ... },
    field2                              CHOICE {
        field2a                             BOOLEAN,
        field2b                             InformationElement2b,
        field2c-v960                        InformationElement2c-r9,
        ...,
        field2d-v12b0                       INTEGER (0..63)
    },
    field3-r9                           InformationElement3-r10         OPTIONAL,   -- Need OR
    field4-r9                           InformationElement4             OPTIONAL,   -- Need OR
    field5-r10                          BOOLEAN,
```

```
    field6-r10                          InformationElement6-r10         OPTIONAL,   -- Need OR
    ...,
    [[  field3-v1170                        InformationElement3-v1170       OPTIONAL    -- Need OR
    ]]
}

-- ASN1STOP
```

Some remarks regarding the extensions of *InformationElement1* as shown in the above example:

- The *InformationElement1* is initially extended with a number of non-critical extensions. In release 10 however, a critical extension is introduced for the message using this IE. Consequently, a new version of the IE *InformationElement1* (i.e. *InformationElement1-r10*) is defined in which the earlier non-critical extensions are incorporated by means of a revision of the original field.
- The *value4-v880* is replacing a spare value defined in the original protocol version for *field1*. Likewise *value6-v1170* replaces *spare3* that was originally defined in the r10 version of *field1*
- Within the critically extended release 10 version of *InformationElement1*, the names of the original fields/ IEs are not changed, unless there is a real need to distinguish them from other fields/ IEs. E.g. the *field1* and *InformationElement4* were defined in the original protocol version (release 8) and hence not tagged. Moreover, the *field3-r9* is introduced in release 9 and not re-tagged; although, the *InformationElement3* is also critically extended and therefore tagged *InformationElement3-r10* in the release 10 version of InformationElement1.

A.4.3.4 Typical examples of non critical extension at the end of a message

The following example illustrates the use of non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING i.e. when an empty sequence is used.

```
-- /example/ ASN1START

RRCMessage-r8-IEs ::=           SEQUENCE {
    field1                          InformationElement1,
    field2                          InformationElement2,
    field3                          InformationElement3                 OPTIONAL,   -- Need ON
    nonCriticalExtension            RRCMessage-v860-IEs                 OPTIONAL
}

RRCMessage-v860-IEs ::=         SEQUENCE {
    field4-v860                     InformationElement4                 OPTIONAL,   -- Need OP
    field5-v860                     BOOLEAN                             OPTIONAL,   -- Cond C54
    nonCriticalExtension            RRCMessage-v940-IEs                 OPTIONAL
}

RRCMessage-v940-IEs ::=         SEQUENCE {
    field6-v940                     InformationElement6-r9                  OPTIONAL,   -- Need OR
    nonCriticalExtensions           SEQUENCE {}                             OPTIONAL
}

-- ASN1STOP
```

Some remarks regarding the extensions shown in the above example:

- The *InformationElement4* is introduced in the original version of the protocol (release 8) and hence no suffix is used.

A.4.3.5 Examples of non-critical extensions not placed at the default extension location

The following example illustrates the use of non-critical extensions in case an extension is not placed at the default extension location.

– *ParentIE-WithEM*

The IE *ParentIE-WithEM* is an example of a high level IE including the extension marker (EM). The root encoding of this IE includes two lower level IEs *ChildIE1-WithoutEM* and *ChildIE2-WithoutEM* which not include the extension marker. Consequently, non-critical extensions of the Child-IEs have to be included at the level of the Parent-IE.

The example illustrates how the two extension IEs *ChildIE1-WithoutEM-vNx0* and *ChildIE2-WithoutEM-vNx0* (both in release N) are used to connect non-critical extensions with a default extension location in the lower level IEs to the actual extension location in this IE.

ParentIE-WithEM information element

```
-- /example/ ASN1START

ParentIE-WithEM ::=                 SEQUENCE {
    -- Root encoding, including:
    childIE1-WithoutEM                  ChildIE1-WithoutEM              OPTIONAL,       -- Need ON
    childIE2-WithoutEM                  ChildIE2-WithoutEM              OPTIONAL,       -- Need ON
    ...,
    [[  childIE1-WithoutEM-vNx0             ChildIE1-WithoutEM-vNx0     OPTIONAL,       -- Need ON
        childIE2-WithoutEM-vNx0             ChildIE2-WithoutEM-vNx0     OPTIONAL        -- Need ON
    ]]
}

-- ASN1STOP
```

Some remarks regarding the extensions shown in the above example:

- The fields *childIEx-WithoutEM-vNx0* may not really need to be optional (depends on what is defined at the next lower level).
- In general, especially when there are several nesting levels, fields should be marked as optional only when there is a clear reason.

– *ChildIE1-WithoutEM*

The IE *ChildIE1-WithoutEM* is an example of a lower level IE, used to control certain radio configurations including a configurable feature which can be setup or released using the local IE *ChIE1-ConfigurableFeature*. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature. The example is based on the following assumptions:

- when initially configuring as well as when modifying the new field, the original fields of the configurable feature have to be provided also i.e. as if the extended ones were present within the setup branch of this feature.
- when the configurable feature is released, the new field should be released also.
- when omitting the original fields of the configurable feature the UE continues using the existing values (which is used to optimise the signalling for features that typically continue unchanged upon handover).
- when omitting the new field of the configurable feature the UE releases the existing values and discontinues the associated functionality (which may be used to support release of unsupported functionality upon handover to an eNB supporting an earlier protocol version).

The above assumptions, which affect the use of conditions and need codes, may not always apply. Hence, the example should not be re-used blindly.

ChildIE1-WithoutEM information elements

```
-- /example/ ASN1START

ChildIE1-WithoutEM ::=              SEQUENCE {
    -- Root encoding, including:
    chIE1-ConfigurableFeature           ChIE1-ConfigurableFeature       OPTIONAL        -- Need ON
}
```

```
ChildIE1-WithoutEM-vNx0 ::=     SEQUENCE {
    chIE1-ConfigurableFeature-vNx0      ChIE1-ConfigurableFeature-vNx0  OPTIONAL    -- Cond ConfigF
}

ChIE1-ConfigurableFeature ::=       CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        -- Root encoding
    }
}

ChIE1-ConfigurableFeature-vNx0 ::=  SEQUENCE {
    chIE1-NewField-rN                   INTEGER (0..31)
}

-- ASN1STOP
```

Conditional presence	Explanation
ConfigF	The field is optional present, need OR, in case of *chIE1-ConfigurableFeature* is included and set to "setup"; otherwise the field is not present and the UE shall delete any existing value for this field.

– *ChildIE2-WithoutEM*

The IE *ChildIE2-WithoutEM* is an example of a lower level IE, typically used to control certain radio configurations. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature.

***ChildIE2-WithoutEM* information element**

```
-- /example/ ASN1START

ChildIE2-WithoutEM ::=              CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        -- Root encoding
    }
}

ChildIE2-WithoutEM-vNx0 ::=         SEQUENCE {
    chIE2-NewField-rN                   INTEGER (0..31)                 OPTIONAL    -- Cond ConfigF
}

-- ASN1STOP
```

Conditional presence	Explanation
ConfigF	The field is optional present, need OR, in case of *chIE2-ConfigurableFeature* is included and set to "setup"; otherwise the field is not present and the UE shall delete any existing value for this field.

A.5 Guidelines regarding inclusion of transaction identifiers in RRC messages

The following rules provide guidance on which messages should include a Transaction identifier

1: DL messages on CCCH that move UE to RRC-Idle should not include the RRC transaction identifier.

2: All network initiated DL messages by default should include the RRC transaction identifier.

3: All UL messages that are direct response to a DL message with an RRC Transaction identifier should include the RRC Transaction identifier.

4: All UL messages that require a direct DL response message should include an RRC transaction identifier.

5: All UL messages that are not in response to a DL message nor require a corresponding response from the network should not include the RRC Transaction identifier.

A.6 Protection of RRC messages (informative)

The following list provides information which messages can be sent (unprotected) prior to security activation and which messages can be sent unprotected after security activation. Those messages indicated "-" in "P" column should never be sent unprotected by eNB or UE. Further requirements are defined in the procedural text.

P…Messages that can be sent (unprotected) prior to security activation

A - I…Messages that can be sent without integrity protection after security activation

A - C…Messages that can be sent unciphered after security activation

NA… Message can never be sent after security activation

Message	P	A-I	A-C	Comment
CSFBParametersRequestCDMA2000	+	-	-	
CSFBParametersResponseCDMA2000	+	-	-	
CounterCheck	-	-	-	
CounterCheckResponse	-	-	-	
DLInformationTransfer	+	-	-	
HandoverFromEUTRAPreparationRequest (CDMA2000)	-	-	-	
InDeviceCoexIndication	-	-	-	
InterFreqRSTDMeasurementIndication	-	-	-	
LoggedMeasurementsConfiguration	-	-	-	
MasterInformationBlock	+	+	+	
MBMSCountingRequest	+	+	+	
MBMSCountingResponse	-	-	-	
MBMSInterestIndication	+	-	-	
MBSFNAreaConfiguration	+	+	+	
MeasurementReport	-	-	-	RAN2 agreed that measurement configuration may be sent prior to security activation. But: In order to protect privacy of UEs MEASUREMENT REPORT is only be sent from the UE after successful security activation.
MobilityFromEUTRACommand	-	-	-	
Paging	+	+	+	
SidelinkUEInformation	+	-	-	
ProximityIndication	-	-	-	
RNReconfiguration	-	-	-	
RNReconfigurationComplete	-	-	-	
RRCConnectionReconfiguration	+	-	-	The message shall not be sent unprotected before security activation if it is used to perform handover or to establish SRB2 and DRBs
RRCConnectionReconfigurationComplete	+	-	-	Unprotected, if sent as response to RRCConnectionReconfiguration which was sent before security activation
RRCConnectionReestablishment	-	+	+	This message is not protected by PDCP operation.
RRCConnectionReestablishmentComplete	-	-	-	
RRCConnectionReestablishmentReject	-	+	+	One reason to send this may be that the security context has been lost, therefore sent as unprotected.
RRCConnectionReestablishmentRequest	-	-	+	This message is not protected by PDCP operation. However a short MAC-I is included.
RRCConnectionReject	+	NA	NA	
RRCConnectionRelease	+	-	-	Justification for P: If the RRC connection only for signalling not requiring DRBs or ciphered messages, or the signalling connection has to be released prematurely, this message is sent as unprotected.
RRCConnectionRequest	+	NA	NA	
RRCConnectionSetup	+	NA	NA	
RRCConnectionSetupComplete	+	NA	NA	
SecurityModeCommand	+	NA	NA	Integrity protection applied, but no ciphering (integrity verification done after the message received by RRC)
SecurityModeComplete	-	NA	NA	Integrity protection applied, but no ciphering. Ciphering is applied after completing the procedure.
SecurityModeFailure	+	NA	NA	Neither integrity protection nor ciphering applied.
SystemInformation	+	+	+	

Message	P	A-I	A-C	Comment
SystemInformationBlockType1	+	+	+	
UEAssistanceInformation	-	-	-	
UECapabilityEnquiry	+	-	-	
UECapabilityInformation	+	-	-	
SCGFailureInformation	-	-	-	
UEInformationRequest	-	-	-	
UEInformationResponse	-	-	-	In order to protect privacy of UEs UEInformationResponse is only be sent from the UE after successful security activation
ULHandoverPreparationTransfer (CDMA2000)	-	-	-	This message should follow HandoverFromEUTRAPreparationRequest
ULInformationTransfer	+	-	-	

A.7 Miscellaneous

The following miscellaneous conventions should be used:

- References: Whenever another specification is referenced, the specification number and optionally the relevant subclause, table or figure, should be indicated in addition to the pointer to the References section e.g. as follows: 'see TS 36.212 [22, 5.3.3.1.6]'.

- UE capabilities: TS 36.306 [6] specifies that E-UTRAN should in general respect the UE's capabilities. Hence there is no need to include statement clarifying that E-UTRAN, when setting the value of a certain configuration field, shall respect the related UE capabilities unless there is a particular need e.g. particularly complicated cases.

Annex B (normative): Release 8 and 9 AS feature handling

B.1 Feature group indicators

This annex contains the definitions of the bits in fields *featureGroupIndicators* (in Table B.1-1) and *featureGroupIndRel9Add* (in Table B.1-1a).

In this release of the protocol, the UE shall include the fields *featureGroupIndicators* in the IE *UE-EUTRA-Capability* and *featureGroupIndRel9Add* in the IE *UE-EUTRA-Capability-v9a0*. All the functionalities defined within the field *featureGroupIndicators* defined in Table B.1-1 or Table B.1-1a are mandatory for the UE, if the related capability (frequency band, RAT, SR-VCC or Inter-RAT ANR) is also supported. For a specific indicator, if all functionalities for a feature group listed in Table B.1-1 have been implemented and tested, the UE shall set the indicator as one (1), else (i.e. if any one of the functionalities in a feature group listed in Table B.1-1 or Table B.1-1a, which have not been implemented or tested), the UE shall set the indicator as zero (0).

The UE shall set all indicators that correspond to RATs not supported by the UE as zero (0).

The UE shall set all indicators, which do not have a definition in Table B.1-1 or Table B.1-1a, as zero (0).

If the optional fields *featureGroupIndicators* or *featureGroupIndRel9Add* are not included by a UE of a future release, the network may assume that all features pertaining to the RATs supported by the UE, respectively listed in Table B.1-1 or Table B.1-1a and deployed in the network, have been implemented and tested by the UE.

In Table B.1-1, a 'VoLTE capable UE' corresponds to a UE which is IMS voice capable.

The indexing in Table B.1-1a starts from index 33, which is the leftmost bit in the field *featureGroupIndRel9Add*.

Table B.1-1: Definitions of feature group indicators

Index of indicator (bit number)	**Definition** (description of the supported functionality, if indicator set to one)	**Notes**	**If indicated "Yes" the feature shall be implemented and successfully tested for this version of the specification**	***FDD/ TDD diff***
1 (leftmost bit)	- Intra-subframe frequency hopping for PUSCH scheduled by UL grant - DCI format 3a (TPC commands for PUCCH and PUSCH with single bit power adjustments) - Aperiodic CQI/PMI/RI reporting on PUSCH: Mode 2-0 – UE selected subband CQI without PMI - Aperiodic CQI/PMI/RI reporting on PUSCH: Mode 2-2 – UE selected subband CQI with multiple PMI			Yes
2	- Simultaneous CQI and ACK/NACK on PUCCH, i.e. PUCCH format 2a and 2b - Absolute TPC command for PUSCH - Resource allocation type 1 for PDSCH - Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-0 – UE selected subband CQI without PMI - Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-1 – UE selected subband CQI with single PMI			Yes
3	- 5bit RLC UM SN - 7bit PDCP SN	- can only be set to 1 if the UE has set bit number 7 to 1.	Yes, if UE supports VoLTE. Yes, if UE supports SRVCC to EUTRAN from GERAN.	No
4	- Short DRX cycle	- can only be set to 1 if the UE has set bit number 5 to 1.		Yes

5	- Long DRX cycle - DRX command MAC control element		Yes	No
6	- Prioritised bit rate		Yes	No
7	- RLC UM	- can only be set to 0 if the UE does not support VoLTE	Yes, if UE supports VoLTE. Yes, if UE supports SRVCC to EUTRAN from GERAN.	No
8	- EUTRA RRC_CONNECTED to UTRA FDD or UTRA TDD CELL_DCH PS handover, if the UE supports either only UTRAN FDD or only UTRAN TDD - EUTRA RRC_CONNECTED to UTRA FDD CELL_DCH PS handover, if the UE supports both UTRAN FDD and UTRAN TDD	- can only be set to 1 if the UE has set bit number 22 to 1	Yes for FDD, if UE supports UTRA FDD	Yes
9	- EUTRA RRC_CONNECTED to GERAN GSM_Dedicated handover	- related to SR-VCC - can only be set to 1 if the UE has set bit number 23 to 1	Yes, if UE supports SRVCC to EUTRAN from GERAN.	Yes
10	- EUTRA RRC_CONNECTED to GERAN (Packet_) Idle by Cell Change Order - EUTRA RRC_CONNECTED to GERAN (Packet_) Idle by Cell Change Order with NACC (Network Assisted Cell Change)			Yes
11	- EUTRA RRC_CONNECTED to CDMA2000 1xRTT CS Active handover	- related to SR-VCC - can only be set to 1 if the UE has sets bit number 24 to 1		Yes
12	- EUTRA RRC_CONNECTED to CDMA2000 HRPD Active handover	- can only be set to 1 if the UE has set bit number 26 to 1		Yes
13	- Inter-frequency handover (within FDD or TDD)	- can only be set to 1 if the UE has set bit number 25 to 1	Yes, unless UE only supports band 13	No
14	- Measurement reporting event: Event A4 – Neighbour > threshold - Measurement reporting event: Event A5 – Serving < threshold1 & Neighbour > threshold2		Yes	No
15	- Measurement reporting event: Event B1 – Neighbour > threshold for UTRAN FDD or UTRAN TDD, if the UE supports either only UTRAN FDD or only UTRAN TDD and has set bit number 22 to 1 - Measurement reporting event: Event B1 – Neighbour > threshold for UTRAN FDD or UTRAN TDD, if the UE supports both UTRAN FDD and UTRAN TDD and has set bit number 22 or 39 to 1, respectively - Measurement reporting event: Event B1 – Neighbour > threshold for GERAN, 1xRTT or HRPD, if the UE has set bit number 23, 24 or 26 to 1, respectively	- can only be set to 1 if the UE has set at least one of the bit number 22, 23, 24, 26 or 39 to 1. - even if the UE sets bits 41, it shall still set bit 15 to 1 if measurement reporting event B1 is tested for all RATs supported by UE	Yes for FDD, if UE supports only UTRAN FDD and does not support UTRAN TDD or GERAN or 1xRTT or HRPD	Yes
16	- Intra-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* - Inter-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells*, if the UE has set bit number 25 to 1		Yes	No

	- Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* for UTRAN FDD or UTRAN TDD, if the UE supports either only UTRAN FDD or only UTRAN TDD and has set bit number 22 to 1 - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* for UTRAN FDD or UTRAN TDD, if the UE supports both UTRAN FDD and UTRAN TDD and has set bit number 22 or 39 to 1, respectively - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* for GERAN, 1xRTT or HRPD, if the UE has set bit number 23, 24 or 26 to 1, respectively. NOTE: Event triggered periodical reporting (i.e., with *triggerType* set to *event* and with *reportAmount* > 1) is a mandatory functionality of event triggered reporting and therefore not the subject of this bit.			
17	Intra-frequency ANR features including: - Intra-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* - Intra-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 to 1.	Yes	No
18	Inter-frequency ANR features including: - Inter-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* - Inter-frequency periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and bit number 25 to 1.	Yes, unless UE only supports band 13	No
19	Inter-RAT ANR features including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* for GERAN, if the UE has set bit number 23 to 1 - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* for UTRAN FDD or UTRAN TDD, if the UE supports either only UTRAN FDD or only UTRAN TDD and has set bit number 22 to 1 - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* for UTRAN FDD or UTRAN TDD, if the UE supports both UTRAN FDD and UTRAN TDD and has set bit number 22 or 39 to 1, respectively	- can only be set to 1 if the UE has set bit number 5 to 1 and the UE has set at least one of the bit number 22, 23, 24 or 26 to 1. - even if the UE sets bits 33 to 37, it shall still set bit 19 to 1 if inter-RAT ANR features are tested for all RATs for which inter-RAT measurement reporting is indicated as tested		Yes

	- Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* for 1xRTT or HRPD, if the UE has set bit number 24 or 26 to 1, respectively - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI* for UTRAN FDD or UTRAN TDD, if the UE supports either only UTRAN FDD or only UTRANTDD and has set bit number 22 to 1 - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI* for UTRAN FDD or UTRAN TDD, if the UE supports both UTRAN FDD and UTRAN TDD and has set bit number 22 or 39 to 1, respectively - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI* for GERAN, 1xRTT or HRPD, if the UE has set bit number 23, 24 or 26 to 1, respectively			
20	If bit number 7 is set to 0: - SRB1 and SRB2 for DCCH + 8x AM DRB If bit number 7 is set to 1: - SRB1 and SRB2 for DCCH + 8x AM DRB - SRB1 and SRB2 for DCCH + 5x AM DRB + 3x UM DRB NOTE: UE which indicate support for a DRB combination also support all subsets of the DRB combination. Therefore, release of DRB(s) never results in an unsupported DRB combination.	- Regardless of what bit number 7 and bit number 20 is set to, UE shall support at least SRB1 and SRB2 for DCCH + 4x AM DRB - Regardless of what bit number 20 is set to, if bit number 7 is set to 1, UE shall support at least SRB1 and SRB2 for DCCH + 4x AM DRB + 1x UM DRB	Yes	No
21	- Predefined intra- and inter-subframe frequency hopping for PUSCH with N_sb > 1 - Predefined inter-subframe frequency hopping for PUSCH with N_sb > 1			No
22	- UTRAN FDD or UTRAN TDD measurements, reporting and measurement reporting event B2 in E-UTRA connected mode, if the UE supports either only UTRAN FDD or only UTRAN TDD - UTRAN FDD measurements, reporting and measurement reporting event B2 in E-UTRA connected mode, if the UE supports both UTRAN FDD and UTRAN TDD		Yes for FDD, if UE supports UTRA FDD	Yes
23	- GERAN measurements, reporting and measurement reporting event B2 in E-UTRA connected mode			Yes
24	- 1xRTT measurements, reporting and measurement reporting event B2 in E-UTRA connected mode		Yes for FDD, if UE supports enhanced 1xRTT CSFB for FDD Yes for TDD, if UE supports enhanced	Yes

			1xRTT CSFB for TDD	
25	- Inter-frequency measurements and reporting in E-UTRA connected mode NOTE: The UE setting this bit to 1 and indicating support for FDD and TDD frequency bands in the UE capability signalling implements and is tested for FDD measurements while the UE is in TDD, and for TDD measurements while the UE is in FDD.		Yes, unless UE only supports band 13	No
26	- HRPD measurements, reporting and measurement reporting event B2 in E-UTRA connected mode		Yes for FDD, if UE supports HRPD	Yes
27	- EUTRA RRC_CONNECTED to UTRA FDD or UTRA TDD CELL_DCH CS handover, if the UE supports either only UTRAN FDD or only UTRAN TDD - EUTRA RRC_CONNECTED to UTRA FDD CELL_DCH CS handover, if the UE supports both UTRAN FDD and UTRAN TDD	- related to SR-VCC - can only be set to 1 if the UE has set bit number 8 to 1 and supports SR-VCC from EUTRA defined in TS 24.008 [49]	Yes for FDD, if UE supports VoLTE and UTRA FDD	Yes
28	- TTI bundling		Yes for FDD	Yes
29	- Semi-Persistent Scheduling			Yes
30	- Handover between FDD and TDD	- can only be set to 1 if the UE has set bit number 13 to 1		No
31	- Indicates whether the UE supports the mechanisms defined for cells broadcasting multi band information i.e. comprehending *multiBandInfoList*, disregarding in RRC_CONNECTED the related system information fields and understanding the EARFCN signalling for all bands, that overlap with the bands supported by the UE, and that are defined in the earliest version of TS 36.101 [42] that includes all UE supported bands.		Yes	No
32	Undefined			

NOTE: The column FDD/ TDD diff indicates if the UE is allowed to signal different values for FDD and TDD.

Table B.1-1a: Definitions of feature group indicators

Index of indicator (bit number)	**Definition** (description of the supported functionality, if indicator set to one)	**Notes**	**If indicated "Yes" the feature shall be implemented and successfully tested for this version of the specification**	***FDD/ TDD diff***
33 (leftmost bit)	Inter-RAT ANR features for UTRAN FDD including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and bit number 22 to 1.		Yes
34	Inter-RAT ANR features for GERAN including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCells* - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and bit number 23 to 1.		Yes
35	Inter-RAT ANR features for 1xRTT including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and bit number 24 to 1.		Yes
36	Inter-RAT ANR features for HRPD including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and bit number 26 to 1.		Yes
37	Inter-RAT ANR features for UTRAN TDD including: - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportStrongestCellsForSON* - Inter-RAT periodical measurement reporting where *triggerType* is set to *periodical* and *purpose* is set to *reportCGI*	- can only be set to 1 if the UE has set bit number 5 and at least one of the bit number 22 (for UEs supporting only UTRA TDD) or the bit number 39 to 1.		Yes
38	- EUTRA RRC_CONNECTED to UTRA TDD CELL_DCH PS handover, if the UE supports both UTRAN FDD and UTRAN TDD	- can only be set to 1 if the UE has set bit number 39 to 1		Yes
39	- UTRAN TDD measurements, reporting and measurement reporting event B2 in E-UTRA connected mode, if the UE supports both UTRAN FDD and UTRAN TDD			Yes
40	- EUTRA RRC_CONNECTED to UTRA	- related to SR-VCC		Yes

	TDD CELL_DCH CS handover, if the UE supports both UTRAN FDD and UTRAN TDD	- can only be set to 1 if the UE has set bit number 38 to 1		
41	Measurement reporting event: Event B1 – Neighbour > threshold for UTRAN FDD, if the UE supports UTRAN FDD and has set bit number 22 to 1		Yes for FDD, unless UE has set bit number 15 to 1	Yes
42	Undefined			
43	Undefined			
44	Undefined			
45	Undefined			
46	Undefined			
47	Undefined			
48	Undefined			
49	Undefined			
50	Undefined			
51	Undefined			
52	Undefined			
53	Undefined			
54	Undefined			
55	Undefined			
56	Undefined			
57	Undefined			
58	Undefined			
59	Undefined			
60	Undefined			
61	Undefined			
62	Undefined			
63	Undefined			
64	Undefined			

NOTE: The column FDD/ TDD diff indicates if the UE is allowed to signal different values for FDD and TDD. Annex E specifies for which TDD and FDD serving cells a UE supporting TDD/FDD CA shall support a feature for which it indicates support within the FGI signalling.

Clarification for mobility from EUTRAN and inter-frequency handover within EUTRAN

There are several feature groups related to mobility from E-UTRAN and inter-frequency handover within EUTRAN. The description of these features is based on the assumption that we have 5 main "functions" related to mobility from E-UTRAN:

A. Support of measurements and cell reselection procedure in idle mode

B. Support of RRC release with redirection procedure in connected mode

C. Support of Network Assisted Cell Change in connected mode

D. Support of measurements and reporting in connected mode

E. Support of handover procedure in connected mode

All functions can be applied for mobility to Inter-frequency to EUTRAN, GERAN, UTRAN, CDMA2000 HRPD and CDMA2000 1xRTT except for function C) which is only applicable for mobility to GERAN. Table B.1-2 below summarises the mobility functions that are supported based on the UE capability signaling (band support) and the setting of the feature group support indicators.

Table B.1-2: Mobility from E-UTRAN

Feature	GERAN	UTRAN	HRPD	1xRTT	EUTRAN
A. Measurements and cell reselection procedure in E-UTRA idle mode	Supported if GERAN band support is indicated	Supported if UTRAN band support is indicated	Supported if CDMA2000 HRPD band support is indicated	Supported if CDMA2000 1xRTT band support is indicated	Supported for supported bands
B. RRC release with blind redirection procedure in E-UTRA connected mode	Supported if GERAN band support is indicated	Supported if UTRAN band support is indicated	Supported if CDMA2000 HRPD band support is indicated	Supported if CDMA2000 1xRTT band support is indicated	Supported for supported bands
C. Cell Change Order (with or without) Network Assisted Cell Change) in E-UTRA connected mode	Group 10	N.A.	N.A	N.A	N.A.
D. Inter-frequency/RAT measurements, reporting and measurement reporting event B2 (for inter-RAT) in E-UTRA connected mode	Group 23	Group 22/39	Group 26	Group 24	Group 25
E. Inter-frequency/RAT handover procedure in E-UTRA connected mode	Group 9 (GSM_connected handover) Separate UE capability bit defined in TS 36.306 for PS handover	Group 8/38 (PS handover) or Group 27/40 (SRVCC handover)	Group 12	Group 11	Group 13 (within FDD or TDD) Group 30 (between FDD and TDD)

In case measurements and reporting function is not supported by UE, the network may still issue the mobility procedures redirection (B) and CCO (C) in a blind fashion.

B.2 CSG support

In this release of the protocol, it is mandatory for the UE to support a minimum set of CSG functionality consisting of:

- Identifying whether a cell is CSG or not;
- Ignoring CSG cells in cell selection/reselection.

Additional CSG functionality in AS, i.e. the requirement to detect and camp on CSG cells when the "CSG whitelist" is available or when manual CSG selection is triggered by the user, are related to the corresponding NAS features. This additional AS functionality consists of:

- Manual CSG selection;
- Autonomous CSG search;
- Implicit priority handling for cell reselection with CSG cells.

It is possible that this additional CSG functionality in AS is not supported or tested in early UE implementations.

Note that since the above AS features relate to idle mode operations, the capability support is not signalled to the network. For these reasons, no "feature group indicator" is assigned to this feature to indicate early support in Rel-8.

Annex C (normative): Release 10 AS feature handling

C.1 Feature group indicators

This annex contains the definitions of the bits in field *featureGroupIndRel10*.

In this release of the protocol, the UE shall include the field *featureGroupIndRel10* in the IE *UE-EUTRA-Capability-v1020-IEs*. All the functionalities defined within the field *featureGroupIndRel10* defined in Table C.1-1 are mandatory for the UE, if the related capability (spatial multiplexing in UL, PDSCH transmission mode 9, carrier aggregation, handover to EUTRA, or RAT) is also supported. For a specific indicator, if all functionalities for a feature group listed in Table C.1-1 have been implemented and tested, the UE shall set the indicator as one (1), else (i.e. if any one of the functionalities in a feature group listed in Table C.1-1 have not been implemented or tested), the UE shall set the indicator as zero (0).

The UE shall set all indicators that correspond to RATs not supported by the UE as zero (0).

The UE shall set all indicators, which do not have a definition in Table C.1-1, as zero (0).

If the optional field *featureGroupIndRel10* is not included by a UE of a future release, the network may assume that all features, listed in Table C.1-1 and deployed in the network, have been implemented and tested by the UE.

The indexing in Table C.1-1 starts from index 101, which is the leftmost bit in the field *featureGroupIndRel10*.

Table C.1-1: Definitions of feature group indicators

Index of indicator	Definition (description of the supported functionality, if indicator set to one)	Notes	If indicated "Yes" the feature shall be implemented and successfully tested for this version of the specification	FDD/ TDD diff
101 (leftmost bit)	- DMRS with OCC (orthogonal cover code) and SGH (sequence group hopping) disabling	- if the UE supports two or more layers for spatial multiplexing in UL, this bit shall be set to 1. - If a category 0 UE does not support this feature, this bit shall be set to 0.		No
102	- Trigger type 1 SRS (aperiodic SRS) transmission (Up to X ports) NOTE: X = number of supported layers on given band			Yes
103	- PDSCH transmission mode 9 when up to 4 CSI reference signal ports are configured	- for Category 8 UEs, this bit shall be set to 1.		Yes
104	- PDSCH transmission mode 9 for TDD when 8 CSI reference signal ports are configured	- if the UE does not support TDD, this bit is irrelevant (capability signalling exists for FDD for this feature), and this bit shall be set to 0. - for Category 8 UEs, this bit shall be set to 1.		No
105	- Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-0 – UE selected subband CQI without PMI, when PDSCH transmission mode 9 is configured - Periodic CQI/PMI/RI reporting on PUCCH: Mode 2-1 – UE selected subband CQI with single PMI, when PDSCH transmission mode 9 and up to 4 CSI reference signal ports are configured	- this bit can be set to 1 only if indices 2 (Table B.1-1) and 103 are set to 1. - For UEs capable of TDD-FDD CA, this bit can be set to 1 for both FDD and TDD if index 2 is set to 1 for both FDD and TDD, and index 103 is set to 1 either for FDD and TDD.		Yes

106	- Periodic CQI/PMI/RI/PTI reporting on PUCCH: Mode 2-1 – UE selected subband CQI with single PMI, when PDSCH transmission mode 9 and 8 CSI reference signal ports are configured	- this bit can be set to 1 only if the UE supports PDSCH transmission mode 9 with 8 CSI reference signal ports (i.e., for TDD, if index 104 is set to 1, and for FDD, if *tm9-With-8Tx-FDD-r10* is set to 'supported') and if index 2 (Table B.1-1) is set to 1. - For UEs capable of TDD-FDD CA, this bit can be set to 1 for both FDD and TDD if either index 104 is set to 1 or *tm9-With-8Tx-FDD-r10* is set to 'supported', and if index 2 is set to 1 for both FDD and TDD.		Yes
107	- Aperiodic CQI/PMI/RI reporting on PUSCH: Mode 2-0 – UE selected subband CQI without PMI, when PDSCH transmission mode 9 is configured - Aperiodic CQI/PMI/RI reporting on PUSCH: Mode 2-2 – UE selected subband CQI with multiple PMI, when PDSCH transmission mode 9 and up to 4 CSI reference signal ports are configured	- this bit can be set to 1 only if indices 1 (Table B.1-1) and 103 are set to 1.		Yes
108	- Aperiodic CQI/PMI/RI reporting on PUSCH: Mode 2-2 – UE selected subband CQI with multiple PMI, when PDSCH transmission mode 9 and 8 CSI reference signal ports are configured	- this bit can be set to 1 only if the UE supports PDSCH transmission mode 9 with 8 CSI reference signal ports (i.e., for TDD, if index 104 is set to 1, and for FDD, if *tm9-With-8Tx-FDD-r10* is set to 'supported') and if index 1 (Table B.1-1) is set to 1.		Yes
109	- Periodic CQI/PMI/RI reporting on PUCCH Mode 1-1, submode 1	- this bit can be set to 1 only if the UE supports PDSCH transmission mode 9 with 8 CSI reference signal ports (i.e., for TDD, if index 104 is set to 1, and for FDD, if *tm9-With-8Tx-FDD-r10* is set to 'supported'). - For UEs capable of TDD-FDD CA, this bit can be set to 1 for both FDD and TDD if either index 104 is set to 1 or *tm9-With-8Tx-FDD-r10* is set to 'supported'.		Yes
110	- Periodic CQI/PMI/RI reporting on PUCCH Mode 1-1, submode 2	- this bit can be set to 1 only if the UE supports PDSCH transmission mode 9 with 8 CSI reference signal ports (i.e., for TDD, if index 104 is set to 1, and for FDD, if *tm9-With-8Tx-FDD-r10* is set to 'supported'). - For UEs capable of TDD-FDD CA, this bit can be set to 1 for both FDD and TDD if either index 104 is set to 1 or *tm9-With-8Tx-FDD-r10* is set to 'supported'.		Yes
111	- Measurement reporting trigger Event A6	- this bit can be set to 1 only if the UE supports carrier aggregation.		Yes

112	- SCell addition within the Handover to EUTRA procedure	- this bit can be set to 1 only if the UE supports carrier aggregation and the Handover to EUTRA procedure.		Yes
113	- Trigger type 0 SRS (periodic SRS) transmission on X Serving Cells NOTE: X = number of supported component carriers in a given band combination	- this bit can be set to 1 only if the UE supports carrier aggregation in UL.		Yes
114	- Reporting of both UTRA CPICH RSCP and Ec/N0 in a Measurement Report	- this bit can be set to 1 only if index 22 (Table B.1-1) is set to 1.		No
115	- time domain ICIC RLM/RRM measurement subframe restriction for the serving cell - time domain ICIC RRM measurement subframe restriction for neighbour cells - time domain ICIC CSI measurement subframe restriction			Yes
116	- Relative transmit phase continuity for spatial multiplexing in UL	- this bit can be set to 1 only if the UE supports two or more layers for spatial multiplexing in UL.		Yes
117	Undefined			
118	Undefined			
119	Undefined			
120	Undefined			
121	Undefined			
122	Undefined			
123	Undefined			
124	Undefined			
125	Undefined			
126	Undefined			
127	Undefined			
128	Undefined			
129	Undefined			
130	Undefined			
131	Undefined			
132	Undefined			

NOTE: The column FDD/ TDD diff indicates if the UE is allowed to signal different values for FDD and TDD. Annex E specifies for which TDD and FDD serving cells a UE supporting TDD/FDD CA shall support a feature for which it indicates support within the FGI signalling.

Annex D (informative): Descriptive background information

D.1 Signalling of Multiple Frequency Band Indicators (Multiple FBI)

D.1.1 Mapping between frequency band indicator and multiple frequency band indicator

This subclause describes the use of the Multiple Frequency Band Indicator (MFBI) lists and the E-UTRA frequency bands in *SystemInformationBlockType1* by means of an example as shown in Figure D.1.1-1. In this example:

- E-UTRAN cell belongs to band B90 and also bands B6, B7, B91, and B92.
- The *freqBandIndicatorPriority* field is not present in *SystemInformationBlockType1*.
- E-UTRAN uses B64 to indicate the presence of B90 in *freqBandIndicator-v9e0*.
- For the MFBI list of this cell, E-UTRAN uses B64 in *MultiBandInfoList* to indicate the position and priority of the bands in *MultiBandInfoList-v9e0*.
- The UE, after reading *SystemInformationBlockType1*, generates an MFBI list with priority of B91, B6, B92, and B7. If the UE supports the frequency band in the *freqBandIndicator-v9e0* IE it applies that frequency band. Otherwise, the UE applies the first listed band in the MFBI list which it supports.

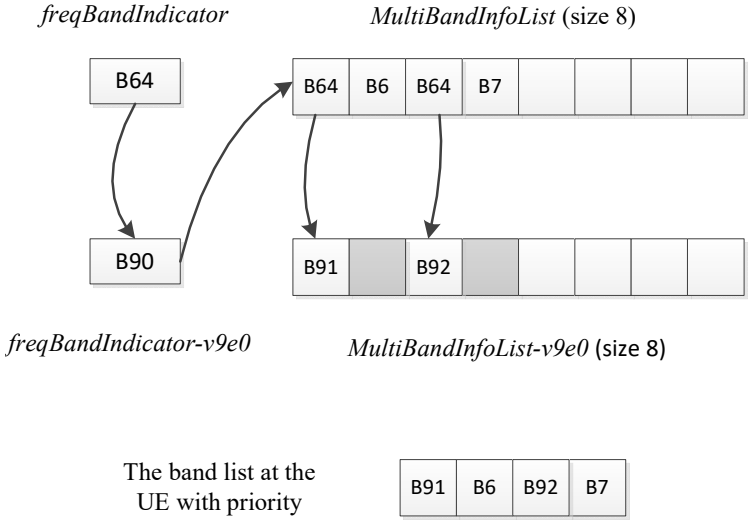


Figure D.1.1-1: Mapping of frequency bands to *MultiBandInfoList/MultiBandInfoList-v9e0*

D.1.2 Mapping between inter-frequency neighbour list and multiple frequency band indicator

This subclause describes the use of the Multiple Frequency Band Indicator (MFBI) lists and the E-UTRA frequencies signalled in *SystemInformationBlockType5* by means of an example as shown in Figure D.1.2-1. In this example:

- E-UTRAN includes 4 frequencies (EARFCNs): the bands associated with f1 and f4 belong to bands lower than 64; the bands associated with f2 and f3 belong to bands larger than 64. The reserved EARFCN value of 65535 is used to indicate the presence of *ARFCN-ValueEUTRA-v9e0*.

- The band associated with f1 has two overlapping bands, B1 and B2 (lower than 64); the band associated with f2 has one overlapping band, B91; the band associated with f3 has four overlapping bands B3, B4, B92, and B93; the band associated with f4 does not have overlapping bands.
- E-UTRAN includes 4 lists in both *interFreqCarrierFreqList-v8h0* and *interFreqCarrierFreqList-v9e0* and ensure the order of the lists is matching. Each list corresponds to one EARFCN and contains up to 8 bands. The first list corresponds to f1, the second list corresponds to f2, and so on. The grey lists mean not including *MultiBandInfoList* or *MultiBandInfoList-v9e0*, i.e. the corresponding EARFCN does not have any overlapping frequency bands in *MultiBandInfoList* or *MultiBandInfoList-v9e0*.

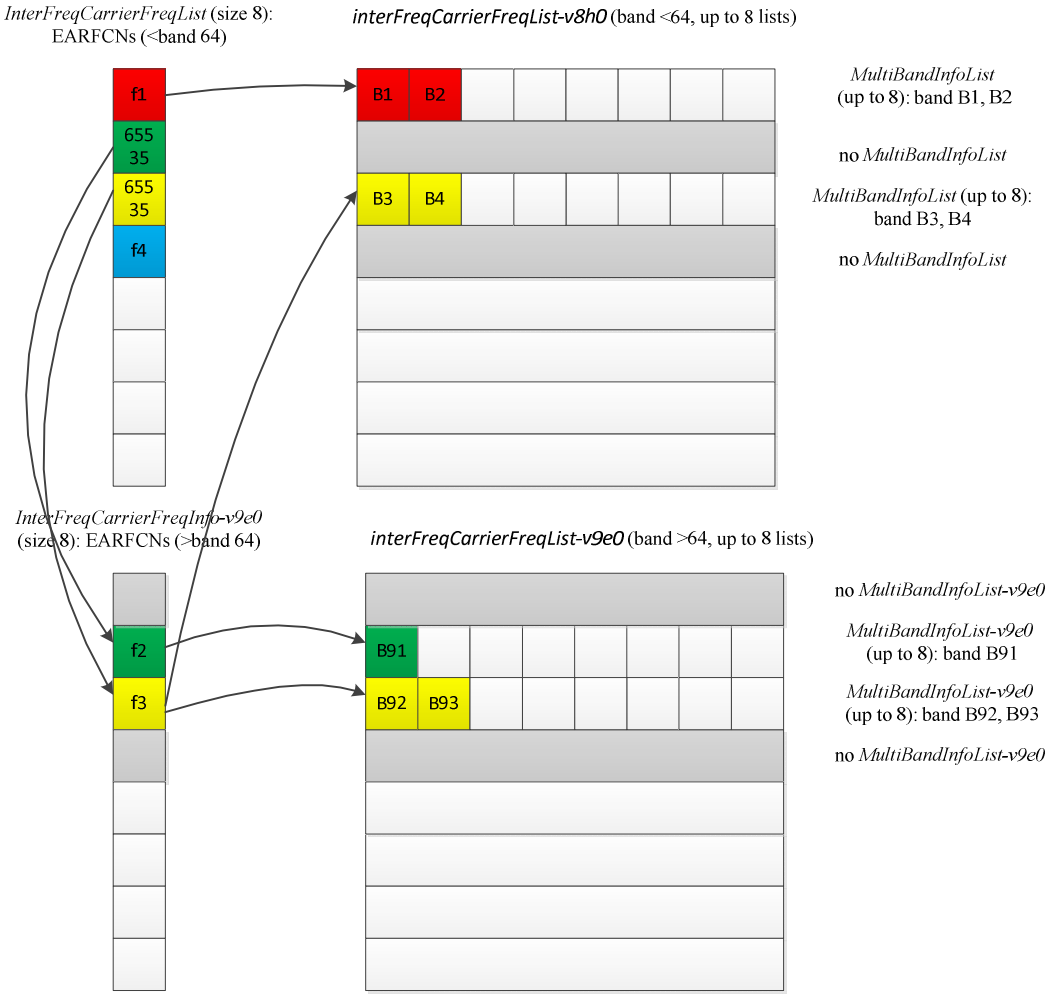


Figure D.1.2-1: Mapping of EARFCNs to *MultiBandInfoList/MultiBandInfoList-v9e0*

D.1.3 Mapping between UTRA FDD frequency list and multiple frequency band indicator

This subclause describes the use of the Multiple Frequency Band Indicator (MFBI) lists and the UTRA FDD frequencies signalled in *SystemInformationBlockType6* by means of an example as shown in Figure D.1.3-1. In this example:

- E-UTRAN includes 4 UTRA FDD frequencies (UARFCNs).
- The bands associated with f1 and f4 have no overlapping bands. The band associated with f2 has two overlapping bands, B1 and B2. The band associated with f3 has one overlapping band, B3.
- E-UTRAN includes 4 lists in *carrierFreqListUTRA-FDD-v8h0* with the first and fourth entry not including *MultiBandInfoList*.

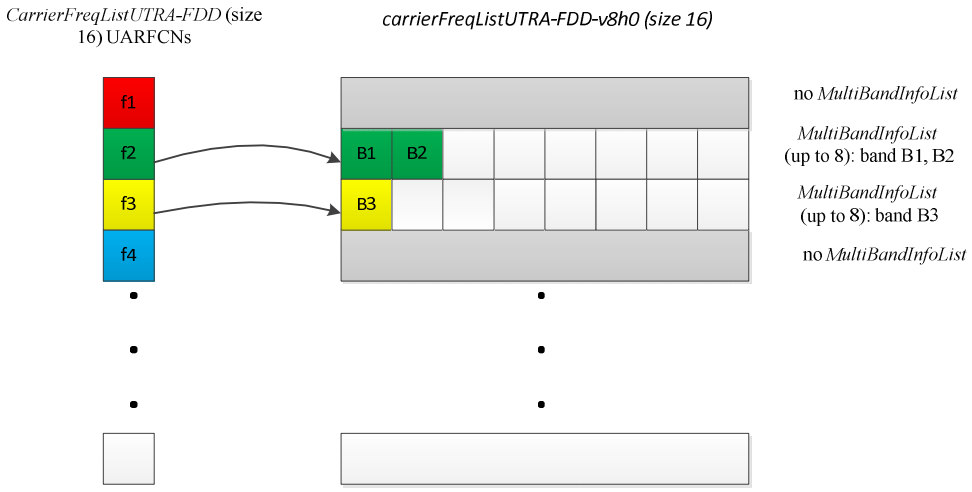


Figure D.1.3-1: Mapping of UARFCNs to *MultiBandInfoList*

Annex E (normative): TDD/FDD differentiation of FGIs/capabilities in TDD-FDD CA

Annex E specifies for which TDD and FDD serving cells a UE supporting TDD/FDD CA shall support a feature/capability for which it indicates support within the FGI/capability signalling.

A UE that indicates support for TDD/ FDD CA:

- For the fields for which the UE is allowed to indicate different support for FDD and TDD, the UE shall support the feature on the PCell and/or SCell(s), as specified in tables E-1, E-2 and E-3 in accordance to the following rules:
  - PCell: the UE shall support the feature for the PCell, if the UE indicates support of the feature for the PCell duplex mode;
  - SCell: the UE shall support the feature for SCell(s), if the UE indicates support of the feature for the SCell duplex mode;
  - Per serving cell: the UE shall support the feature for a serving cell if the UE indicates support of the feature for the serving cell's duplex mode;
  - All serving cells: UE shall support the feature if the UE indicates support of the feature for both TDD and FDD duplex modes;
- For the fields where the UE is not allowed to indicate different support for FDD and TDD, the UE shall support the feature for PCell and SCell(s) if the UE indicates support of the feature via the common FGI/capability bit.

Table E-1: Rel-8/9 FGIs for which FDD/TDD differentiation is allowed (from Annex B)

Index of indicator	Classification
1	Per serving cell
2	All serving cells
4	All serving cells
8	PCell
9	PCell
10	PCell
11	PCell
12	PCell
15	PCell
19	PCell
22	PCell
23	PCell
24	PCell
26	PCell
27	PCell
28	PCell
29	PCell
33	PCell
34	PCell
35	PCell
36	PCell
37	PCell
38	PCell
39	PCell
40	PCell
41	PCell

Table E-2: Rel-10 FGIs for which FDD/TDD differentiation is allowed (from Annex C)

Index of indicator	Classification
102	Per serving cell
103	Per serving cell
105	All serving cells
106	All serving cells
107	All serving cells
108	All serving cells
109	All serving cells
110	All serving cells
111	SCell
112	PCell
113	Per serving cell
115	PCell
116	Per serving cell

Table E-3: Rel-12 UE-EUTRA capabilities for which FDD/TDD differentiation is allowed

UE-EUTRA-Capability	Classification
crossCarrierScheduling	All serving cells
e-CSFB-1XRTT	PCell
e-CSFB-ConcPS-Mob1XRTT	PCell
e-CSFB-dual-1XRTT	PCell
ePDCCH	Per serving cell
e-RedirectionUTRA	PCell
e-RedirectionUTRA-TDD	PCell
inDeviceCoexInd	All serving cells
interFreqRSTD-Measurement	PCell
interFreqSI-AcquisitionForHO	PCell
interRAT-PS-HO-ToGERAN	PCell
intraFreqSI-AcquisitionForHO	PCell
mbms-Scell	SCell
mbms-NonServingCell	SCell
multiACK-CSIreporting	PCell
multiClusterPUSCH-WithinCC	Per serving cell
otdoa-UE-Assisted	PCell
pmi-Disabling	Per serving cell
rsrqMeasWideband	Per serving cell
simultaneousPUCCH-PUSCH	All serving cells
ss-CCH-InterfHandl	PCell
txDiv-PUCCH1b-ChSelect	PCell
ue-TxAntennaSelectionSupported	Per serving cell
utran-SI-AcquisitionForHO	PCell

Annex F (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
12/2007	RP-38	RP-070920	-		Approved at TSG-RAN #38 and placed under Change Control	1.0.0	8.0.0
03/2008	RP-39	RP-080163	0001	4	CR to 36.331 with Miscellaneous corrections	8.0.0	8.1.0
03/2008	RP-39	RP-080164	0002	2	CR to 36.331 to convert RRC to agreed ASN.1 format	8.0.0	8.1.0
05/2008	RP-40	RP-080361	0003	1	CR to 36.331 on Miscellaneous clarifications/ corrections	8.1.0	8.2.0
09/2008	RP-41	RP-080693	0005	-	CR on Miscellaneous corrections and clarifications	8.2.0	8.3.0
12/2008	RP-42	RP-081021	0006	-	Miscellaneous corrections and clarifications	8.3.0	8.4.0
03/2009	RP-43	RP-090131	0007	-	Correction to the Counter Check procedure	8.4.0	8.5.0
	RP-43	RP-090131	0008	-	CR to 36.331-UE Actions on Receiving SIB11	8.4.0	8.5.0
	RP-43	RP-090131	0009	1	Spare usage on BCCH	8.4.0	8.5.0
	RP-43	RP-090131	0010	-	Issues in handling optional IE upon absence in GERAN NCL	8.4.0	8.5.0
	RP-43	RP-090131	0011	-	CR to 36.331 on Removal of useless RLC re-establishment at RB release	8.4.0	8.5.0
	RP-43	RP-090131	0012	1	Clarification to RRC level padding at PCCH and BCCH	8.4.0	8.5.0
	RP-43	RP-090131	0013	-	Removal of Inter-RAT message	8.4.0	8.5.0
	RP-43	RP-090131	0014	-	Padding of the SRB-ID for security input	8.4.0	8.5.0
	RP-43	RP-090131	0015	-	Validity of ETWS SIB	8.4.0	8.5.0
	RP-43	RP-090131	0016	1	Configuration of the Two-Intervals-SPS	8.4.0	8.5.0
	RP-43	RP-090131	0017	-	Corrections on Scaling Factor Values of Qhyst	8.4.0	8.5.0
	RP-43	RP-090131	0018	1	Optionality of srsMaxUppts	8.4.0	8.5.0
	RP-43	RP-090131	0019	-	CR for discussion on field name for common and dedicated IE	8.4.0	8.5.0
	RP-43	RP-090131	0020	-	Corrections to Connected mode mobility	8.4.0	8.5.0
	RP-43	RP-090131	0021	-	Clarification regarding the measurement reporting procedure	8.4.0	8.5.0
	RP-43	RP-090131	0022	1	Corrections on s-Measure	8.4.0	8.5.0
	RP-43	RP-090131	0023	1	R1 of CR0023 (R2-091029) on combination of SPS and TTI bundling for TDD	8.4.0	8.5.0
	RP-43	RP-090131	0024	-	L3 filtering for path loss measurements	8.4.0	8.5.0
	RP-43	RP-090131	0025	1	S-measure handling for reportCGI	8.4.0	8.5.0
	RP-43	RP-090131	0026	1	Measurement configuration clean up	8.4.0	8.5.0
	RP-43	RP-090131	0027	-	Alignment of measurement quantities for UTRA	8.4.0	8.5.0
	RP-43	RP-090131	0028	-	CR to 36.331 on L1 parameters ranges alignment	8.4.0	8.5.0
	RP-43	RP-090131	0029	-	Default configuration for transmissionMode	8.4.0	8.5.0
	RP-43	RP-090131	0030	-	CR to 36.331 on RRC Parameters for MAC, RLC and PDCP	8.4.0	8.5.0
	RP-43	RP-090131	0031	1	CR to 36.331 - Clarification on Configured PRACH Freq Offset	8.4.0	8.5.0
	RP-43	RP-090131	0032	-	Clarification on TTI bundling configuration	8.4.0	8.5.0
	RP-43	RP-090131	0033	1	Update of R2-091039 on Inter-RAT UE Capability	8.4.0	8.5.0
	RP-43	RP-090133	0034	-	Feature Group Support Indicators	8.4.0	8.5.0
	RP-43	RP-090131	0036	-	Corrections to RLF detection	8.4.0	8.5.0
	RP-43	RP-090131	0037	-	Indication of Dedicated Priority	8.4.0	8.5.0
	RP-43	RP-090131	0038	2	Security Clean up	8.4.0	8.5.0
	RP-43	RP-090131	0039	-	Correction of TTT value range	8.4.0	8.5.0
	RP-43	RP-090131	0040	-	Correction on CDMA measurement result IE	8.4.0	8.5.0
	RP-43	RP-090131	0041	1	Clarification of Measurement Reporting	8.4.0	8.5.0
	RP-43	RP-090131	0042	-	Spare values in DL and UL Bandwidth in MIB and SIB2	8.4.0	8.5.0
	RP-43	RP-090131	0044	1	Clarifications to System Information Block Type 8	8.4.0	8.5.0
	RP-43	RP-090131	0045	-	Reception of ETWS secondary notification	8.4.0	8.5.0
	RP-43	RP-090131	0046	1	Validity time for ETWS message Id and Sequence No	8.4.0	8.5.0
	RP-43	RP-090131	0047	-	CR for Timers and constants values used during handover to E-UTRA	8.4.0	8.5.0
	RP-43	RP-090131	0048	-	Inter-RAT Security Clarification	8.4.0	8.5.0
	RP-43	RP-090131	0049	-	CR to 36.331 on consistent naming of 1xRTT identifiers	8.4.0	8.5.0
	RP-43	RP-090131	0050	-	Capturing RRC behavior regarding NAS local release	8.4.0	8.5.0
	RP-43	RP-090131	0051	-	Report CGI before T321 expiry and UE null reporting	8.4.0	8.5.0
	RP-43	RP-090131	0052	-	System Information and 3 hour validity	8.4.0	8.5.0
	RP-43	RP-090131	0053	1	Inter-Node AS Signalling	8.4.0	8.5.0
	RP-43	RP-090131	0054	-	Set of values for the parameter "messagePowerOffsetGroupB"	8.4.0	8.5.0
	RP-43	RP-090131	0055	-	CR to paging reception for ETWS capable UEs in RRC_CONNECTED	8.4.0	8.5.0
	RP-43	RP-090131	0056	1	CR for CSG related items in 36.331	8.4.0	8.5.0
	RP-43	RP-090131	0057	1	SRS common configuration	8.4.0	8.5.0
	RP-43	RP-090131	0058	-	RRC processing delay	8.4.0	8.5.0
	RP-43	RP-090131	0059	-	CR for HNB Name	8.4.0	8.5.0
	RP-43	RP-090131	0060	3	Handover to EUTRA delta configuration	8.4.0	8.5.0
	RP-43	RP-090131	0063	-	Delivery of Message Identifier and Serial Number to upper layers for ETWS	8.4.0	8.5.0
	RP-43	RP-090131	0066	-	Clarification on the maximum size of cell lists	8.4.0	8.5.0
	RP-43	RP-090131	0067	-	Missing RRC messages in 'Protection of RRC messages'	8.4.0	8.5.0
	RP-43	RP-090131	0069	1	Clarification on NAS Security Container	8.4.0	8.5.0
	RP-43	RP-090131	0071	-	Extension of range of CQI/PMI configuration index	8.4.0	8.5.0
	RP-43	RP-090131	0072	1	Access barring alleviation in RRC connection establishment	8.4.0	8.5.0
	RP-43	RP-090367	0077	6	Corrections to feature group support indicators	8.4.0	8.5.0
	RP-43	RP-090131	0078	-	CR from email discussion to capture DRX and TTT handling	8.4.0	8.5.0

	RP-43	RP-090131	0079	1	Need Code handling on BCCH messages	8.4.0	8.5.0
	RP-43	RP-090131	0080	-	Unification of T300 and T301 and removal of miscallaneous FFSs	8.4.0	8.5.0
	RP-43	RP-090131	0084	1	Proposed CR modifying the code-point definitions of neighbourCellConfiguration	8.4.0	8.5.0
	RP-43	RP-090131	0087	2	Remove Redundant Optionality in SIB8	8.4.0	8.5.0
	RP-43	RP-090131	0089	-	Corrections to the generic error handling	8.4.0	8.5.0
	RP-43	RP-090131	0090	-	Configurability of T301	8.4.0	8.5.0
	RP-43	RP-090131	0091	1	Correction related to TTT	8.4.0	8.5.0
	RP-43	RP-090131	0095	-	CR for 36.331 on SPS-config	8.4.0	8.5.0
	RP-43	RP-090131	0096	2	CR for Deactivation of periodical measurement	8.4.0	8.5.0
	RP-43	RP-090131	0099	2	SMC and reconfiguration	8.4.0	8.5.0
	RP-43	RP-090131	0101	-	TDD handover	8.4.0	8.5.0
	RP-43	RP-090131	0102	-	Corrections to system information acquisition	8.4.0	8.5.0
	RP-43	RP-090131	0106	-	Some Corrections and Clarifications to 36.331	8.4.0	8.5.0
	RP-43	RP-090131	0109	-	Clarification on the Maximum number of ROHC context sessions parameter	8.4.0	8.5.0
	RP-43	RP-090131	0110	-	Transmission of rrm-Config at Inter-RAT Handover	8.4.0	8.5.0
	RP-43	RP-090131	0111	1	Use of SameRefSignalsInNeighbor parameter	8.4.0	8.5.0
	RP-43	RP-090131	0112	-	Default serving cell offset for measurement event A3	8.4.0	8.5.0
	RP-43	RP-090131	0114	-	dl-EARFCN missing in HandoverPreparationInformation	8.4.0	8.5.0
	RP-43	RP-090131	0115	-	Cleanup of references to 36.101	8.4.0	8.5.0
	RP-43	RP-090131	0117	-	Correction to the value range of UE-Categories	8.4.0	8.5.0
	RP-43	RP-090131	0122	1	Correction on RRC connection re-establishment	8.4.0	8.5.0
	RP-43	RP-090131	0124	-	Performing Measurements to report CGI for CDMA2000	8.4.0	8.5.0
	RP-43	RP-090131	0125	-	CDMA2000-SystemTimeInfo in VarMeasurementConfiguration	8.4.0	8.5.0
	RP-43	RP-090131	0126	-	UE Capability Information for CDMA2000 1xRTT	8.4.0	8.5.0
	RP-43	RP-090131	0127	-	CDMA2000 related editorial changes	8.4.0	8.5.0
	RP-43	RP-090131	0128	-	Draft CR to 36.331 on State mismatch recovery at re-establishment	8.4.0	8.5.0
	RP-43	RP-090131	0129	1	Draft CR to 36.331 on Renaming of AC barring related IEs	8.4.0	8.5.0
	RP-43	RP-090131	0130	2	Draft CR to 36.331 on Inheriting of dedicated priorities at inter-RAT reselection	8.4.0	8.5.0
	RP-43	RP-090131	0135	-	Proposed CR to 36.331 Description alignment for paging parameter, nB	8.4.0	8.5.0
	RP-43	RP-090131	0139	2	Miscellaneous corrections and clarifications resulting from ASN.1 review	8.4.0	8.5.0
	RP-43	RP-090131	0141	1	Correction regarding Redirection Information fo GERAN	8.4.0	8.5.0
	RP-43	RP-090131	0142	-	Further ASN.1 review related issues	8.4.0	8.5.0
	RP-43	RP-090131	0143	-	Periodic measurements	8.4.0	8.5.0
	RP-43	RP-090131	0144	1	Further analysis on code point "OFF" for ri-ConfigIndex	8.4.0	8.5.0
	RP-43	RP-090131	0145	1	Adding and deleting same measurement or configuration in one message	8.4.0	8.5.0
	RP-43	RP-090131	0147	-	Corrections to IE dataCodingScheme in SIB11	8.4.0	8.5.0
	RP-43	RP-090131	0148	-	Clarification on Mobility from E-UTRA	8.4.0	8.5.0
	RP-43	RP-090131	0149	-	36.331 CR related to “not applicable”	8.4.0	8.5.0
	RP-43	RP-090131	0150	1	UE radio capability transfer	8.4.0	8.5.0
	RP-43	RP-090131	0151	-	CR to 36.331 on value of CDMA band classes	8.4.0	8.5.0
	RP-43	RP-090131	0152	-	Corrections to DRB modification	8.4.0	8.5.0
	RP-43	RP-090131	0153	-	Correction to presence condition for pdcp-config	8.4.0	8.5.0
	RP-43	RP-090131	0155	-	TDD HARQ-ACK feedback mode	8.4.0	8.5.0
	RP-43	RP-090275	0157	-	Corrections regarding use of carrierFreq for CDMA (SIB8) and GERAN (measObject)	8.4.0	8.5.0
	RP-43	RP-090321	0156	1	Sending of GERAN SI/PSI information at Inter-RAT Handover	8.4.0	8.5.0
	RP-43	RP-090339	0158	-	Clarification of CSG support	8.4.0	8.5.0
06/2009	RP-44	RP-090516	0159	-	Octet alignment of VarShortMAC-Input	8.5.0	8.6.0
	RP-44	RP-090516	0160	3	Minor corrections to the feature grouping	8.5.0	8.6.0
	RP-44	RP-090516	0161	-	Security clarification	8.5.0	8.6.0
	RP-44	RP-090516	0162	1	Sending of GERAN SI/PSI information at Inter-RAT Handover	8.5.0	8.6.0
	RP-44	RP-090516	0163	1	Correction of UE measurement model	8.5.0	8.6.0
	RP-44	RP-090516	0164	-	Restricting the reconfiguration of UM RLC SN field size	8.5.0	8.6.0
	RP-44	RP-090516	0165	1	36.331 CR on Clarification on cell change order from GERAN to E-UTRAN	8.5.0	8.6.0
	RP-44	RP-090516	0166	-	36.331 CR - Handling of expired TAT and failed D-SR	8.5.0	8.6.0
	RP-44	RP-090516	0167	1	Proposed CR to 36.331 Clarification on mandatory information in AS-Config	8.5.0	8.6.0
	RP-44	RP-090516	0168	2	Miscellaneous small corrections	8.5.0	8.6.0
	RP-44	RP-090516	0173	-	Clarification on the basis of delta signalling	8.5.0	8.6.0
	RP-44	RP-090516	0177	-	CR on Alignment of CCCH and DCCH handling of missing mandatory field	8.5.0	8.6.0
	RP-44	RP-090516	0180	2	Handling of Measurement Context During HO Preparation	8.5.0	8.6.0
	RP-44	RP-090516	0181	-	Clarification of key-eNodeB-Star in AdditionalReestabInfo	8.5.0	8.6.0
	RP-44	RP-090516	0182	1	UE Capability Transfer	8.5.0	8.6.0
	RP-44	RP-090516	0186	1	Clarification regarding mobility from E-UTRA in-between SMC and SRB2/DRB setup	8.5.0	8.6.0
	RP-44	RP-090516	0188	1	Correction and completion of specification conventions	8.5.0	8.6.0

	RP-44	RP-090516	0195	2	RB combination in feature group indicator	8.5.0	8.6.0
	RP-44	RP-090516	0196	1	CR for need code for fields in mobilityControlInfo	8.5.0	8.6.0
	RP-44	RP-090497	0197	-	Alignment of pusch-HoppingOffset with 36.211	8.5.0	8.6.0
	RP-44	RP-090570	0198	-	Explicit srb-Identity values for SRB1 and SRB2	8.5.0	8.6.0
	RP-44	RP-090516	0199	-	Removing use of *defaultValue* for *mac-MainConfig*	8.5.0	8.6.0
09/2009	RP-45	RP-090906	0200	-	Proposed update of the feature grouping	8.6.0	8.7.0
	RP-45	RP-090906	0201	-	Clarification on measurement object configuration for serving frequency	8.6.0	8.7.0
	RP-45	RP-090906	0202	-	Correction regarding SRVCC	8.6.0	8.7.0
	RP-45	RP-090906	0203	-	Indication of DRB Release during HO	8.6.0	8.7.0
	RP-45	RP-090906	0204	1	Correction regarding application of dedicated resource configuration upon handover	8.6.0	8.7.0
	RP-45	RP-090906	0205	-	REL-9 protocol extensions in RRC	8.6.0	8.7.0
	RP-45	RP-090906	0206	-	In-order delivery of NAS PDUs at RRC connection reconfiguration	8.6.0	8.7.0
	RP-45	RP-090906	0207	-	Correction on Threshold of Measurement Event	8.6.0	8.7.0
	RP-45	RP-090906	0210	-	Clarification on dedicated resource of RA procedure	8.6.0	8.7.0
	RP-45	RP-090906	0213	1	Cell barring when MasterInformationBlock or SystemInformationBlock1 is missing	8.6.0	8.7.0
	RP-45	RP-090915	0218	-	Security threat with duplicate detection for ETWS	8.6.0	8.7.0
	RP-45	RP-090906	0224	-	Clarification on supported handover types in feature grouping	8.6.0	8.7.0
	RP-45	RP-090906	0250	1	Handling of unsupported / non-comprehended frequency band and emission requirement	8.6.0	8.7.0
	RP-45	RP-090906	0251	-	RB combinations in feature group indicator 20	8.6.0	8.7.0
09/2009	RP-45	RP-090934	0220	1	Introduction of Per-QCI radio link failure timers (option 1)	8.7.0	9.0.0
	RP-45	RP-090926	0222	-	Null integrity protection algorithm	8.7.0	9.0.0
	RP-45	RP-090926	0223	-	Emergency Support Indicator in BCCH	8.70	9.0.0
	RP-45	RP-090934	0230	2	CR to 36.331 for Enhanced CSFB to 1xRTT with concurrent PS handover	8.7.0	9.0.0
	RP-45	RP-090934	0243	-	REL-9 on Miscellaneous editorial corrections	8.7.0	9.0.0
	RP-45	RP-090934	0247	-	Periodic CQI/PMI/RI masking	8.7.0	9.0.0
	RP-45	RP-090933	0252	-	Introduction of CMAS	8.7.0	9.0.0
12/2009	RP-46	RP-091346	0253	1	(Rel-9)-clarification on the description of redirectedCarrierInfo	9.0.0	9.1.0
	RP-46	RP-091346	0254	1	Adding references to RRC processing delay for inter-RAT mobiltiy messages	9.0.0	9.1.0
	RP-46	RP-091314	0256	-	Alignment of srs-Bandwidth with 36.211	9.0.0	9.1.0
	RP-46	RP-091341	0257	5	Baseline CR capturing eMBMS agreements	9.0.0	9.1.0
	RP-46	RP-091343	0258	3	Capturing agreements on inbound mobility	9.0.0	9.1.0
	RP-46	RP-091314	0260	-	Clarification of preRegistrationZoneID/secondaryPreRegistrationZoneID	9.0.0	9.1.0
	RP-46	RP-091346	0261	-	Clarification on NCC for IRAT HO	9.0.0	9.1.0
	RP-46	RP-091314	0263	-	Clarification on P-max	9.0.0	9.1.0
	RP-46	RP-091314	0265	1	Clarification on the definition of maxCellMeas	9.0.0	9.1.0
	RP-46	RP-091346	0266	-	Correction of q-RxLevMin reference in SIB7	9.0.0	9.1.0
	RP-46	RP-091346	0267	-	Correction on SPS-Config field descriptions	9.0.0	9.1.0
	RP-46	RP-091346	0268	1	correction on the definition of CellsTriggeredList	9.0.0	9.1.0
	RP-46	RP-091345	0269	-	Correction relating to CMAS UE capability	9.0.0	9.1.0
	RP-46	RP-091314	0271	1	Feature grouping bit for SRVCC handover	9.0.0	9.1.0
	RP-46	RP-091314	0272	1	Correction and completion of extension guidelines	9.0.0	9.1.0
	RP-46	RP-091344	0273	-	RACH optimization Stage-3	9.0.0	9.1.0
	RP-46	RP-091345	0274	-	Stage 3 correction for CMAS	9.0.0	9.1.0
	RP-46	RP-091346	0276	1	SR prohibit mechanism for UL SPS	9.0.0	9.1.0
	RP-46	RP-091346	0277	-	Parameters used for enhanced 1xRTT CS fallback	9.0.0	9.1.0
	RP-46	RP-091346	0281	-	Correction on UTRAN UE Capability transfer	9.0.0	9.1.0
	RP-46	RP-091346	0285	-	Maximum number of CDMA2000 neighbors in SIB8	9.0.0	9.1.0
	RP-46	RP-091340	0288	1	Introduction of UE Rx-Tx Time Difference measurement	9.0.0	9.1.0
	RP-46	RP-091346	0297	-	Introduction of SR prohibit timer	9.0.0	9.1.0
	RP-46	RP-091346	0298	-	Remove FFSs from RAN2 specifications	9.0.0	9.1.0
	RP-46	RP-091343	0301	1	Renaming Allowed CSG List (36.331 Rel-9)	9.0.0	9.1.0
	RP-46	RP-091346	0305	-	Re-introduction of message segment discard time	9.0.0	9.1.0
	RP-46	RP-091346	0306	1	Application of ASN.1 extension guidelines	9.0.0	9.1.0
	RP-46	RP-091346	0309	1	Support for Dual Radio 1xCSFB	9.0.0	9.1.0
	RP-46	RP-091346	0311	-	Shorter SR periodicity	9.0.0	9.1.0
	RP-46	RP-091342	0316	-	CR to 36.331 for Introduction of Dual Layer Transmission	9.0.0	9.1.0
	RP-46	RP-091343	0318	1	Draft CR to 36.331 on Network ordered SI reporting	9.0.0	9.1.0
	RP-46	RP-091346	0322	-	UE e1xcsfb capabilities correction	9.0.0	9.1.0
	RP-46	RP-091331	0327	1	Clarification on coding of ETWS related IEs	9.0.0	9.1.0
03/2010	RP-47	RP-100285	0331	-	Clarification of CGI reporting	9.1.0	9.2.0
	RP-47	RP-100305	0332	-	Clarification on MCCH change notification	9.1.0	9.2.0
	RP-47	RP-100308	0333	-	Clarification on measurement for serving cell only	9.1.0	9.2.0
	RP-47	RP-100306	0334	-	Clarification on proximity indication configuraiton in handover to E-UTRA	9.1.0	9.2.0
	RP-47	RP-100308	0335	-	Clarification on radio resource configuration in handover to E-UTRA procedure	9.1.0	9.2.0
	RP-47	RP-100308	0336	-	Clarification on UE maximum transmission power	9.1.0	9.2.0

	RP-47	RP-100308	0337	-	Correction to field descriptions of UE-EUTRA-Capability	9.1.0	9.2.0
	RP-47	RP-100305	0338	-	Correction to MBMS scheduling terminology	9.1.0	9.2.0
	RP-47	RP-100308	0339	-	Corrections to SIB8	9.1.0	9.2.0
	RP-47	RP-100306	0340	-	CR 36.331 R9 for Unifying SI reading for ANR and inbound mobility	9.1.0	9.2.0
	RP-47	RP-100308	0341	1	CR to 36.331 for 1xRTT pre-registration information in SIB8	9.1.0	9.2.0
	RP-47	RP-100305	0342	-	CR to 36.331 on corrections for MBMS	9.1.0	9.2.0
	RP-47	RP-100306	0343	1	CR to 36.331 on CSG identity reporting	9.1.0	9.2.0
	RP-47	RP-100308	0344	2	CR to 36.331 on Optionality of Rel-9 UE features	9.1.0	9.2.0
	RP-47	RP-100308	0345	1	CR to 36.331 on Service Specific Acces Control (SSAC)	9.1.0	9.2.0
	RP-47	RP-100308	0346	-	Introduction of power-limited device indication in UE capability.	9.1.0	9.2.0
	RP-47	RP-100305	0347	-	Missing agreement in MCCH change notification.	9.1.0	9.2.0
	RP-47	RP-100305	0348	1	Corrections related to MCCH change notification and value ranges	9.1.0	9.2.0
	RP-47	RP-100306	0349	2	Prohibit timer for proximity indication	9.1.0	9.2.0
	RP-47	RP-100306	0350	1	Proximity Indication after handover and re-establishment	9.1.0	9.2.0
	RP-47	RP-100305	0351	-	Specifying the exact mapping of notificationIndicator in SIB13 to PDCCH bits	9.1.0	9.2.0
	RP-47	RP-100308	0352	-	Corrections out of ASN.1 review scope	9.1.0	9.2.0
	RP-47	RP-100308	0353	-	CR on clarification of system information change	9.1.0	9.2.0
	RP-47	RP-100285	0358	-	Measurement Result CDMA2000 Cell	9.1.0	9.2.0
	RP-47	RP-100304	0361	-	Correction on the range of UE Rx-Tx time difference measurement result	9.1.0	9.2.0
	RP-47	RP-100305	0362	-	Small clarifications regarding MBMS	9.1.0	9.2.0
	RP-47	RP-100308	0363	-	Introduction of REL-9 indication within field accessStratumRelease	9.1.0	9.2.0
	RP-47	RP-100306	0364	-	Extending mobility description to cover inbound mobility	9.1.0	9.2.0
	RP-47	RP-100308	0365	1	Clarification regarding enhanced CSFB to 1XRTT	9.1.0	9.2.0
	RP-47	RP-100308	0368	-	Handling of dedicated RLF timers	9.1.0	9.2.0
	RP-47	RP-100305	0370	1	Clarification on UE's behavior of receiving MBMS service	9.1.0	9.2.0
	RP-47	RP-100305	0371	-	MBMS Service ID and Session ID	9.1.0	9.2.0
	RP-47	RP-100305	0372	1	Inclusion of non-MBSFN region length in SIB13	9.1.0	9.2.0
	RP-47	RP-100309	0374	1	CR to 36.331 for e1xCSFB access class barring parameters in SIB8	9.1.0	9.2.0
	RP-47	RP-100308	0375	-	Multiple 1xRTT/HRPD target cells in MobilityFromEUTRACommand	9.1.0	9.2.0
	RP-47	RP-100308	0376	-	Independent support indicators for Dual-Rx CSFB and S102 in SIB8	9.1.0	9.2.0
	RP-47	RP-100285	0378	-	Clarification on DRX StartOffset for TDD	9.1.0	9.2.0
	RP-47	RP-100308	0379	1	Miscellaneous corrections from REL-9 ASN.1 review	9.1.0	9.2.0
	RP-47	RP-100308	0381	-	Need codes and missing conventions	9.1.0	9.2.0
	RP-47	RP-100308	0383	1	Introduction of Full Configuration Handover for handling earlier eNB releases	9.1.0	9.2.0
	RP-47	RP-100308	0385	-	Clarification to SFN reference in RRC	9.1.0	9.2.0
	RP-47	RP-100308	0390	-	RSRP and RSRQ based Thresholds	9.1.0	9.2.0
	RP-47	RP-100189	0392	3	Redirection enhancements to GERAN	9.1.0	9.2.0
	RP-47	RP-100308	0398	-	Cell reselection enhancements CR for 36.331	9.1.0	9.2.0
	RP-47	RP-100307	0401	3	CR on UE-originated RLFreporting for MRO SON use case	9.1.0	9.2.0
	RP-47	RP-100309	0402	3	CR to 36.331 on Redirection enhancements to UTRAN	9.1.0	9.2.0
	RP-47	RP-100306	0403	2	Proximity status indication handling at mobility	9.1.0	9.2.0
	RP-47	RP-100305	0404	-	Upper layer aspect of MBSFN area id	9.1.0	9.2.0
	RP-47	RP-100308	0405	-	Redirection for enhanced 1xRTT CS fallback with concurrent PSHO	9.1.0	9.2.0
	RP-47	RP-100301	0406	-	Avoiding interleaving transmission of CMAS notifications	9.1.0	9.2.0
	RP-47	RP-100308	0407	1	Introduction of UE GERAN DTM capability indicator	9.1.0	9.2.0
	RP-47	RP-100381	0408	2	Introducing provisions for late ASN.1 corrections	9.1.0	9.2.0
	RP-47	RP-100245	0411	-	Correction/ alignment of REL-9 UE capability signalling	9.1.0	9.2.0
06/2010	RP-48	RP-100553	0412	-	Clarification for mapping between warning message and CB-data	9.2.0	9.3.0
	RP-48	RP-100556	0413	-	Clarification of radio link failure related actions	9.2.0	9.3.0
	RP-48	RP-100554	0414	-	Clarification on UE actions upon leaving RRC_CONNECTED	9.2.0	9.3.0
	RP-48	RP-100553	0415	-	Correction on CMAS system information	9.2.0	9.3.0
	RP-48	RP-100554	0416	1	Corrections to MBMS	9.2.0	9.3.0
	RP-48	RP-100536	0418	-	Decoding of unknown future extensions	9.2.0	9.3.0
	RP-48	RP-100556	0419	1	Miscellaneous small corrections and clarifications	9.2.0	9.3.0
	RP-48	RP-100551	0420	-	Prohibit timer for proximity indication	9.2.0	9.3.0
	RP-48	RP-100556	0421	-	RLF report for MRO correction	9.2.0	9.3.0
	RP-48	RP-100546	0423	1	Missing UTRA bands in IRAT-ParametersUTRA-FDD	9.2.0	9.3.0
	RP-48	RP-100556	0424	-	Correction on handling of dedicated RLF timers	9.2.0	9.3.0
	RP-48	RP-100556	0431	1	Protection of RRC messages	9.2.0	9.3.0
	RP-48	RP-100556	0433	-	Handling missing Essential system information	9.2.0	9.3.0
	RP-48	RP-100551	0434	1	Clarification on UMTS CSG detected cell reporting in LTE	9.2.0	9.3.0
	RP-48	RP-100556	0436	-	Introducing provisions for late corrections	9.2.0	9.3.0
	RP-48	RP-100556	0437	-	Clarification regarding / alignment of REL-9 UE capabilities	9.2.0	9.3.0
09/2010	RP-49	RP-100845	0440	-	Correction to 3GPP2 reference for interworking with cdma2000 1x	9.3.0	9.4.0
	RP-49	RP-100851	0441	-	Clarification on UL handover preparation transfer	9.3.0	9.4.0
	RP-49	RP-100851	0442	1	Clarifications regarding fullConfiguration	9.3.0	9.4.0

	RP-49	RP-100851	0443	-	Clarifications regarding handover to E-UTRAN	9.3.0	9.4.0
	RP-49	RP-100854	0444	-	Correction on the table of conditionally mandatory Release 9 features	9.3.0	9.4.0
	RP-49	RP-100851	0445	-	Corrections to TS36.331 on MeasConfig IE	9.3.0	9.4.0
	RP-49	RP-100853	0446	2	CR to 36.331 on clarification for MBMS PTM RBs	9.3.0	9.4.0
	RP-49	RP-100851	0447	-	Introduction of late corrections container for E-UTRA UE capabilities	9.3.0	9.4.0
	RP-49	RP-100851	0448	-	Renaming of containers for late non-critical extensions	9.3.0	9.4.0
	RP-49	RP-100851	0452	-	Clarifications Regarding Redirection from LTE	9.3.0	9.4.0
	RP-49	RP-100845	0456	-	Description of multi-user MIMO functionality in feature group indicator table	9.3.0	9.4.0
	RP-49	RP-100845	0458	-	Correct the PEMAX_H to PEMAX	9.3.0	9.4.0
	RP-49	RP-100851	0460	-	Clarification for feature group indicator bit 11	9.3.0	9.4.0
	RP-49	RP-100851	0465	1	Clarification of FGI setting for inter-RAT features not supported by the UE	9.3.0	9.4.0
	RP-49	RP-101008	0475	1	FGI settings in Rel-9	9.3.0	9.4.0
12/2010	RP-50	RP-101197	0483	-	Clarification on Meaning of FGI Bits	9.4.0	9.5.0
	RP-50	RP-101197	0485	-	Clarification regarding reconfiguration of the quantityConfig	9.4.0	9.5.0
	RP-50	RP-101210	0486	1	Corrections to the presence of IE regarding DRX and CQI	9.4.0	9.5.0
	RP-50	RP-101210	0493	-	The field descriptions of MeasObjectEUTRA	9.4.0	9.5.0
	RP-50	RP-101197	0498	1	Clarification of FGI settings non ANR periodical measurement reporting	9.4.0	9.5.0
	RP-50	RP-101209	0500	-	Corrections to RLF Report	9.4.0	9.5.0
	RP-50	RP-101206	0519	1	T321 timer fix	9.4.0	9.5.0
	RP-50	RP-101197	0524	-	Restriction of AC barring parameter setting	9.4.0	9.5.0
	RP-50	RP-101210	0525	-	Removal of SEQUENCE OF SEQUENCE in UEInformationResponse	9.4.0	9.5.0
	RP-50	RP-101197	0526	1	Clarification regarding default configuration value N/A	9.4.0	9.5.0
	RP-50	RP-101431	0532	-	Splitting FGI bit 3	9.4.0	9.5.0
	RP-50	RP-101183	0476	4	36.331 CR on Introduction of Minimization of Drive Tests	9.4.0	10.0.0
	RP-50	RP-101293	0477	4	AC-Barring for Mobile Originating CSFB call	9.4.0	10.0.0
	RP-50	RP-101214	0478	-	Addition of UE-EUTRA-Capability descriptions	9.4.0	10.0.0
	RP-50	RP-101214	0481	-	Clarification on Default Configuration for CQI-ReportConfig	9.4.0	10.0.0
	RP-50	RP-101215	0487	-	CR to 36.331 adding e1xCSFB support for dual Rx/Tx UE	9.4.0	10.0.0
	RP-50	RP-101227	0488	1	Introduction of Carrier Aggregation and UL/ DL MIMO	9.4.0	10.0.0
	RP-50	RP-101228	0489	1	Introduction of relays in RRC	9.4.0	10.0.0
	RP-50	RP-101214	0490	1	Priority indication for CSFB with re-direction	9.4.0	10.0.0
	RP-50	RP-101214	0491	-	SIB Size Limitations	9.4.0	10.0.0
	RP-50	RP-101214	0513	-	Combined Quantity Report for IRAT measurement of UTRAN	9.4.0	10.0.0
	RP-50	RP-101214	0527	1	UE power saving and Local release	9.4.0	10.0.0
	RP-50	RP-101429	0530	1	Inclusion of new UE categories in Rel-10	9.4.0	10.0.0
03/2011	RP-51	RP-110282	0533	-	36331_CRxxx_Protection of Logged Measurements Configuration	10.0.0	10.1.0
	RP-51	RP-110294	0534	1	Stage-3 CR for MBMS enhancement	10.0.0	10.1.0
	RP-51	RP-110282	0535	-	Clean up MDT-related text	10.0.0	10.1.0
	RP-51	RP-110282	0536	-	Clear MDT configuration and logs when the UE is not registered	10.0.0	10.1.0
	RP-51	RP-110280	0537	-	Correction to the field description of nB	10.0.0	10.1.0
	RP-51	RP-110289	0538	-	CR on impact on UP with remove&add approach_2	10.0.0	10.1.0
	RP-51	RP-110282	0539	-	CR to 36.331 on corrections for MDT	10.0.0	10.1.0
	RP-51	RP-110290	0543	-	Introduction of CA/MIMO capability signalling and measurement capability signalling in CA	10.0.0	10.1.0
	RP-51	RP-110282	0544	-	MDT PDU related clarifications	10.0.0	10.1.0
	RP-51	RP-110282	0545	-	Correction on release of logged measurement configuration while in another RAT	10.0.0	10.1.0
	RP-51	RP-110289	0546	-	Miscellaneous Corrections for CA Running RRC CR	10.0.0	10.1.0
	RP-51	RP-110280	0547	1	Miscellaneous small clarifications and corrections	10.0.0	10.1.0
	RP-51	RP-110293	0548	4	Necessary changes for RLF reporting enhancements	10.0.0	10.1.0
	RP-51	RP-110282	0549	1	Memory size for logged measurements capable UE	10.0.0	10.1.0
	RP-51	RP-110289	0550	-	Parameters confusion of non-CA and CA configurations	10.0.0	10.1.0
	RP-51	RP-110272	0553	-	Presence condition for cellSelectionInfo-v920 in SIB1	10.0.0	10.1.0
	RP-51	RP-110282	0554	1	Removal of MDT configuration at T330 expiry	10.0.0	10.1.0
	RP-51	RP-110289	0556	1	Signalling aspects of existing LTE-A parameters	10.0.0	10.1.0
	RP-51	RP-110280	0557	1	Some Corrections on measurement	10.0.0	10.1.0
	RP-51	RP-110291	0558	-	Stored system information for RNs	10.0.0	10.1.0
	RP-51	RP-110291	0559	-	Support of Integrity Protection for Relay	10.0.0	10.1.0
	RP-51	RP-110290	0561	2	Updates of L1 parameters for CA and UL/DL MIMO	10.0.0	10.1.0
	RP-51	RP-110291	0571	1	Note for Dedicated SIB for RNs	10.0.0	10.1.0
	RP-51	RP-110272	0579	-	Correction to cs-fallbackIndicator field description	10.0.0	10.1.0
	RP-51	RP-110289	0580	-	Clarification to the default configuration of sCellDeactivationTimer	10.0.0	10.1.0
	RP-51	RP-110289	0581	-	Miscellaneous corrections to TS 36.331 on Carrier Aggregation	10.0.0	10.1.0
	RP-51	RP-110280	0584	-	Correction of configuration description in SIB2	10.0.0	10.1.0
	RP-51	RP-110265	0587	-	Clarification of band indicator in handover from E-UTRAN to GERAN	10.0.0	10.1.0
	RP-51	RP-110285	0588	1	36331_CRxxxx Support of Delay Tolerant access requests	10.0.0	10.1.0

	RP-51	RP-110292	0590	-	Update of R2-110807 on CSI measurement resource restriction for time domain ICIC	10.0.0	10.1.0
	RP-51	RP-110292	0591	-	Update of R2-110821 on RRM/RLM resource restriction for time domain ICIC	10.0.0	10.1.0
	RP-51	RP-110290	0592	-	Corrections on UE capability related parameters	10.0.0	10.1.0
	RP-51	RP-110282	0596	-	Validity time for location information in Immediate MDT	10.0.0	10.1.0
	RP-51	RP-110280	0597	-	CR to 36.331 adding UE capability indicator for dual Rx/Tx e1xCSFB	10.0.0	10.1.0
	RP-51	RP-110289	0598	-	Miscellaneous corrections to CA	10.0.0	10.1.0
	RP-51	RP-110280	0599	-	Further correction to combined measurement report of UTRAN	10.0.0	10.1.0
	RP-51	RP-110280	0600	-	Correction to the reference of ETWS	10.0.0	10.1.0
	RP-51	RP-110269	0602	1	Introduction of OTDOA inter-freq RSTD measurement indication procedure	10.0.0	10.1.0
	RP-51	RP-110280	0603	-	Correction of use of RRCConnectionReestablishment message for contention resolution	10.0.0	10.1.0
	RP-51	RP-110282	0604	-	CR to 36.331 on MDT neighbour cell measurements logging	10.0.0	10.1.0
	RP-51	RP-110272	0609	-	Minor ASN.1 corrections for the UEInformationResponse message	10.0.0	10.1.0
	RP-51	RP-110280	0613	-	Clarification regarding dedicated RLF timers and constants	10.0.0	10.1.0
	RP-51	RP-110282	0615	-	Release of Logged Measurement Configuration	10.0.0	10.1.0
	RP-51	RP-110280	0616	-	Some corrections on TS 36.331	10.0.0	10.1.0
	RP-51	RP-110280	0623	-	AC barring procedure clean up	10.0.0	10.1.0
	RP-51	RP-110282	0624	-	Counter proposal to R2-110826 on UE capabilities for MDT	10.0.0	10.1.0
	RP-51	RP-110280	0628	1	UE information report for RACH	10.0.0	10.1.0
	RP-51	RP-110289	0629	2	Measurement on the deactivated SCells	10.0.0	10.1.0
	RP-51	RP-110282	0632	1	Trace configuration paremeters for Logged MDT	10.0.0	10.1.0
	RP-51	RP-110282	0635	-	Clarification on stop condition for timer T3330	10.0.0	10.1.0
	RP-51	RP-110282	0637	-	User consent for MDT	10.0.0	10.1.0
	RP-51	RP-110280	0638	-	Correction on the range of CQI resource index	10.0.0	10.1.0
	RP-51	RP-110272	0640	1	Small corrections to ETWS & CMAS system information	10.0.0	10.1.0
	RP-51	RP-110290	0641	1	UE capability signaling structure w.r.t carrier aggregation, MIMO and measurement gap	10.0.0	10.1.0
	RP-51	RP-110289	0642	1	Normal PHR and the multiple uplink carriers	10.0.0	10.1.0
	RP-51	RP-110280	0643	1	Corrections to TS36.331 on SIB2 handling	10.0.0	10.1.0
	RP-51	RP-110280	0644	1	Adding a Power Management indication in PHR	10.0.0	10.1.0
	RP-51	RP-110289	0646	1	Clarification for CA and TTI bundling in RRC	10.0.0	10.1.0
	RP-51	RP-110443	0648	1	Updates to FGI settings	10.0.0	10.1.0
06/2011	RP-52	RP-110836	0651	-	Add MBMS counting procedure to processing delay requirement for RRC procedure Section 11.2	10.1.0	10.2.0
	RP-52	RP-110830	0653	-	Add pre Rel-10 procedures to processing delay requirement for RRC procedure Section 11.2	10.1.0	10.2.0
	RP-52	RP-110847	0654	1	Addition of a specific reference for physical configuration fields	10.1.0	10.2.0
	RP-52	RP-110839	0656	-	Clarification of inter-frequency RSTD measurement indication procedure	10.1.0	10.2.0
	RP-52	RP-110830	0658	-	Clarification of optionality of UE features without capability	10.1.0	10.2.0
	RP-52	RP-110839	0660	-	Clarification on the definition of maxCellBlack	10.1.0	10.2.0
	RP-52	RP-110839	0661	-	Clarification on upper layer requested connection release	10.1.0	10.2.0
	RP-52	RP-110850	0662	3	Clarification regarding eICIC measurements	10.1.0	10.2.0
	RP-52	RP-110839	0663	-	CR for s-measure handling	10.1.0	10.2.0
	RP-52	RP-110851	0664	1	CR on clarification of RLF Report in Carrier Aggregation	10.1.0	10.2.0
	RP-52	RP-110830	0669	-	FGI bit for handover between LTE FDD/TDD	10.1.0	10.2.0
	RP-52	RP-110847	0670	2	Further updates on L1 parameters	10.1.0	10.2.0
	RP-52	RP-110839	0671	2	General error handling for extension fields	10.1.0	10.2.0
	RP-52	RP-110851	0672	2	Additional information for RLF report	10.1.0	10.2.0
	RP-52	RP-110843	0673	-	Introduction of TCE ID for logged MDT	10.1.0	10.2.0
	RP-52	RP-110670	0674	4	Miscellaneous corrections (related to review in preparation for ASN.1 freeze)	10.1.0	10.2.0
	RP-52	RP-110843	0675	-	PLMN check for MDT logging	10.1.0	10.2.0
	RP-52	RP-110839	0677	-	UE actions upon leaving RRC_CONNECTED	10.1.0	10.2.0
	RP-52	RP-110847	0678	-	Clarification on bandEUTRA-r10 and supportedBandListEUTRA	10.1.0	10.2.0
	RP-52	RP-110837	0679	-	Updated value range for the Extended Wait Timer	10.1.0	10.2.0
	RP-52	RP-110839	0680	1	Value range of DRX-InactivityTimer	10.1.0	10.2.0
	RP-52	RP-110828	0693	1	Correction for SR-VCC and QCI usage	10.1.0	10.2.0
	RP-52	RP-110847	0694	-	Restructuring of CQI-ReportConfig-r10	10.1.0	10.2.0
	RP-52	RP-110839	0695	2	Correction on DL allocations in MBSFN subframes	10.1.0	10.2.0
	RP-52	RP-110850	0700	-	Reference SFN for MeasSubframePattern	10.1.0	10.2.0
	RP-52	RP-110846	0701	-	Clarifications to CA related field descriptions	10.1.0	10.2.0
	RP-52	RP-110847	0702	-	Corrections to codebookSubsetRestriction and SRS parameters	10.1.0	10.2.0
	RP-52	RP-110834	0704	-	Corrections to the handling of ri-ConfigIndex for TM9	10.1.0	10.2.0
	RP-52	RP-110715	0710	2	UE capabilities for Rel-10 LTE features with eICIC measurement restrictions as FGI (Alt.1)	10.1.0	10.2.0
	RP-52	RP-110839	0713	-	CR to 36.331 on redirected utra-TDD carrier frequency	10.1.0	10.2.0
	RP-52	RP-110839	0714	-	Explicit AS signalling for mapped PTMSI/GUTI	10.1.0	10.2.0
	RP-52	RP-110847	0718	-	Counter proposal for Updates of mandatory information in AS-Config	10.1.0	10.2.0

	RP-52	RP-110839	0719	-	CR for Reconfiguration of discardTimer in PDCP-Config	10.1.0	10.2.0
	RP-52	RP-110847	0723	-	On the missing multiplicity of UE capability parameters	10.1.0	10.2.0
	RP-52	RP-110830	0735	-	Radio frame alignment of CSA and MSP	10.1.0	10.2.0
	RP-52	RP-110847	0740	-	Reconfiguration involving critically extended IEs (using fullFieldConfig i.e. option 2)	10.1.0	10.2.0
	RP-52	RP-110839	0744	-	Counter proposal to R2-112753 on CR to remove CSG Identity validity limited to CSG cell	10.1.0	10.2.0
	RP-52	RP-110839	0746	1	Increase of prioritisedBitRate	10.1.0	10.2.0
	RP-52	RP-110847	0747	-	CA and MIMO Capabilities in LTE Rel-10	10.1.0	10.2.0
09/2011	RP-53	RP-111297	0752	-	TS36.331 Correction	10.2.0	10.3.0
	RP-53	RP-111297	0754	-	maxNumberROHC-ContextSessions when no ROHC profile is supported	10.2.0	10.3.0
	RP-53	RP-111280	0757	-	Correction to Subframe Allocation End in PMCH-Info	10.2.0	10.3.0
	RP-53	RP-111288	0761	-	Correction on PUCCH configuration for Un interface	10.2.0	10.3.0
	RP-53	RP-111297	0762	-	Miscellaneous corrections to 36.331	10.2.0	10.3.0
	RP-53	RP-111278	0764	2	36.331 correction on CSG identity validity to allow introduction of CSG RAN sharing	10.2.0	10.3.0
	RP-53	RP-111283	0770	2	AdditionalSpectrumEmissions in CA	10.2.0	10.3.0
	RP-53	RP-111297	0773	-	CR to 36.331 on Small correction of PHR parameter	10.2.0	10.3.0
	RP-53	RP-111283	0775	2	Clarifications to P-max on CA	10.2.0	10.3.0
	RP-53	RP-111280	0784	-	Clarification on for which subframes signalling MCS applies	10.2.0	10.3.0
	RP-53	RP-111283	0792	-	Corrections in RRC	10.2.0	10.3.0
	RP-53	RP-111297	0793	-	Replace the tables with exception list in 10.5 AS-Config	10.2.0	10.3.0
	RP-53	RP-111297	0796	-	Corrections to the field descriptions	10.2.0	10.3.0
	RP-53	RP-111283	0798	-	Configuration of simultaneous PUCCH&PUSCH	10.2.0	10.3.0
	RP-53	RP-111297	0806	-	Corrections to release of csi-SubframePatternConfig and cqi-Mask	10.2.0	10.3.0
	RP-53	RP-111272	0810	-	GERAN SI format for cell change order&PS handover& enhanced redirection to GERAN	10.2.0	10.3.0
	RP-53	RP-111283	0811	-	Corrections to PUCCH-Config field descriptions	10.2.0	10.3.0
12/2011	RP-54	RP-111711	0812	1	Clarification of PCI range for CSG cells	10.3.0	10.4.0
	RP-54	RP-111716	0813	-	Clarifications to Default Radio Configurations	10.3.0	10.4.0
	RP-54	RP-111716	0814	1	Corrections to enhancedDualLayerTDD	10.3.0	10.4.0
	RP-54	RP-111716	0815	-	Miscellaneous small corrections	10.3.0	10.4.0
	RP-54	RP-111716	0816	1	Correction on notation of SRS transmission comb	10.3.0	10.4.0
	RP-54	RP-111706	0823	1	36.331 CR SPS reconfiguration	10.3.0	10.4.0
	RP-54	RP-111716	0827	2	Clarification of list sizes in measurement configuration stored by UE	10.3.0	10.4.0
	RP-54	RP-111706	0835	-	Clarification of the event B1 and ANR related FGI bits	10.3.0	10.4.0
	RP-54	RP-111714	0840	1	Clarification on MBSFN and measurement resource restrictions	10.3.0	10.4.0
	RP-54	RP-111706	0845	-	Clarification on parallel message transmission upon connection re-establishment	10.3.0	10.4.0
03/2012	RP-55	RP-120326	0855	1	Limiting MBMS counting responses to within the PLMN	10.4.0	10.5.0
	RP-55	RP-120321	0857	-	CR to 36.331 on cdma2000 band classes and references	10.4.0	10.5.0
	RP-55	RP-120326	0862	1	Clarification on MBSFN and measurement resource restrictions	10.4.0	10.5.0
	RP-55	RP-120325	0871	-	On SIB10/11 Reception Timing	10.4.0	10.5.0
	RP-55	RP-120326	0875	1	Clarification on MBMS counting for uncipherable services	10.4.0	10.5.0
	RP-55	RP-120325	0876	-	Minor correction regarding limited service access on non-CSG-member cell	10.4.0	10.5.0
	RP-55	RP-120326	0894	-	Time to keep RLF Reporting logs	10.4.0	10.5.0
	RP-55	RP-120356	0895	1	Introducing means to signal different FDD/TDD Capabilities/FGIs for Dual-xDD UE	10.4.0	10.5.0
	RP-55	RP-120321	0899	-	Clarification on SRB2 resumption upon connection re-establishment (parallel message transmission)	10.4.0	10.5.0
	RP-55	RP-120321	0900	1	Duplicated ASN.1 naming correction	10.4.0	10.5.0
06/2012	RP-56	RP-120805	0909	-	SPS Reconfiguration	10.5.0	10.6.0
	RP-56	RP-120805	0912	1	Change in Scheduling Information for ETWS	10.5.0	10.6.0
	RP-56	RP-120807	0914	-	Clarification of mch-SchedulingPeriod configuration	10.5.0	10.6.0
	RP-56	RP-120808	0916	1	Change in Scheduling Information for CMAS	10.5.0	10.6.0
	RP-56	RP-120814	0919	1	Introducing means to signal different REL-10 FDD/TDD Capabilities/FGIs for Dual-xDD UE	10.5.0	10.6.0
	RP-56	RP-120812	0920	1	Clarification on setting of dedicated NS value for CA by E-UTRAN	10.5.0	10.6.0
	RP-56	RP-120808	0931	-	T321 value for UTRA SI acquisition	10.5.0	10.6.0
	RP-56	RP-120813	0957	1	Korean Public Alert System (KPAS) in relation to CMAS	10.5.0	10.6.0
	RP-56	RP-120812	0969	1	Introduction of supported bandwidth combinations for CA	10.5.0	10.6.0
	RP-56	RP-120734	0970	1	Introduction of multiple frequency band indicator	10.5.0	10.6.0
	RP-56	RP-120825	0934	-	Introduction of a new security algorithm ZUC	10.5.0	11.0.0
	RP-56	RP-120813	0973	1	EU-Alert in relation to CMAS	10.5.0	11.0.0
09/2012	RP-57	RP-121371	0982	1	Introduction of EAB	11.0.0	11.1.0
	RP-57	RP-121381	0990	-	Additional special subframe configuration related correction	11.0.0	11.1.0
	RP-57	RP-121423	1000	4	36.331 CR introducing In-Device Coexistence (IDC)	11.0.0	11.1.0
	RP-57	RP-121359	1008	-	Voice support Capabilities	11.0.0	11.1.0
	RP-57	RP-121361	1013	-	Differentiating UTRAN modes in FGIs	11.0.0	11.1.0
	RP-57	RP-121368	1022	1	Introduction of absolute priority based measurements and reselection in CELL_FACH State in 36.331	11.0.0	11.1.0
	RP-57	RP-121370	1024	-	Introducing MDT enhancements for REL-11	11.0.0	11.1.0

	RP-57	RP-121349	1025	2	Introducing Carrier aggregation enhancements for REL-11	11.0.0	11.1.0
	RP-57	RP-121375	1026	-	Introducing MBMS enhancements for REL-11	11.0.0	11.1.0
	RP-57	RP-121376	1052	2	Signaling support for CRS interference management in eICIC	11.0.0	11.1.0
	RP-57	RP-121395	1055	-	CR on scell measurement cycle	11.0.0	11.1.0
	RP-57	RP-121395	1056	-	CR on measurement report	11.0.0	11.1.0
	RP-57	RP-121378	1057	3	Introduction of 'Power preference indication'	11.0.0	11.1.0
	RP-57	RP-121280	1060	-	Correction for PUCCH/SRS Release	11.0.0	11.1.0
12/2012	RP-58	RP-121933	1063	-	Correction related to differentiating UTRAN modes in FGIs	11.1.0	11.2.0
	RP-58	RP-121936	1065	-	Processing delay for RRCConnectionReconfiguration	11.1.0	11.2.0
	RP-58	RP-121953	1066	2	Addition of the stage-3 agreements on IDC	11.1.0	11.2.0
	RP-58	RP-121951	1067	3	Carrier Aggregation Enhancement RAN1 parameters	11.1.0	11.2.0
	RP-58	RP-121957	1068	1	Clarification of SR period	11.1.0	11.2.0
	RP-58	RP-121957	1069	1	Clarification on HandoverCommand message	11.1.0	11.2.0
	RP-58	RP-121957	1070	-	Clarification on mobility related issues	11.1.0	11.2.0
	RP-58	RP-121946	1071	1	Correction of the signaling for Uncertainty and Confidence	11.1.0	11.2.0
	RP-58	RP-121940	1072	2	Corrections to MBMS Service Continuity	11.1.0	11.2.0
	RP-58	RP-121940	1073	-	CR to 36.331 on SIB15 acquisition	11.1.0	11.2.0
	RP-58	RP-121957	1074	1	Handling of 1xCSFB failure	11.1.0	11.2.0
	RP-58	RP-121957	1075	-	Miscellaneous corrections	11.1.0	11.2.0
	RP-58	RP-121958	1076	1	RAN overload control using RRC connection Rejection	11.1.0	11.2.0
	RP-58	RP-121954	1077	-	RRC support for CoMP in UL	11.1.0	11.2.0
	RP-58	RP-121951	1078	-	Some clarification to Carrier aggregation enhancements	11.1.0	11.2.0
	RP-58	RP-121939	1079	1	Validity of EAB SIB and acquisition of SIB1	11.1.0	11.2.0
	RP-58	RP-121922	1085	-	Clarification for Multiple Frequency Band Indicators feature	11.1.0	11.2.0
	RP-58	RP-121924	1089	1	Moving the TM5 capability	11.1.0	11.2.0
	RP-58	RP-121959	1093	1	CR to 36.331 on introducing ROHC context continue for intra-ENB handover	11.1.0	11.2.0
	RP-58	RP-121946	1100	-	Correction on MDT multi-PLMN support	11.1.0	11.2.0
	RP-58	RP-121953	1102	-	Clarification and alignment of handling of other configuration	11.1.0	11.2.0
	RP-58	RP-121970	1103	6	Introducing support for Coordinated Multi-Point (CoMP) operation	11.1.0	11.2.0
	RP-58	RP-121922	1105	2	Introducing further UE aspects regarding multi band cells	11.1.0	11.2.0
	RP-58	RP-121947	1120	-	CR to 36.331 on additional information in RLF report for inter-RAT MRO	11.1.0	11.2.0
	RP-58	RP-121952	1125	1	Correction on Power preference indication	11.1.0	11.2.0
	RP-58	RP-121950	1127	1	SIB1 provisioning via dedicated signalling	11.1.0	11.2.0
	RP-58	RP-121936	1128	2	Measurement reporting of Scells	11.1.0	11.2.0
	RP-58	RP-121956	1129	1	Introduction of EPDCCH parameters in TS 36.331	11.1.0	11.2.0
	RP-58	RP-121961	1130	2	Introduction of Rel-11 UE capabilities	11.1.0	11.2.0
	RP-58	RP-121958	1131	-	Introducion of wideband RSRQ measurements	11.1.0	11.2.0
	RP-58	RP-121958	1146	-	Introduction of network sharing for CDMA2000 inter-working	11.1.0	11.2.0
	RP-58	RP-121960	1157	-	Broadcast of Time Info by Using a New SIB	11.1.0	11.2.0
	RP-58	RP-121957	1175	-	GERAN measurement object at ANR	11.1.0	11.2.0
03/2013	RP-59	RP-130246	1182	2	Miscellaneous corrections from review preceeding ASN.1 freeze	11.2.0	11.3.0
	RP-59	RP-130243	1186	2	DL COMP capability related correction	11.2.0	11.3.0
	RP-59	RP-130231	1193	1	Mandatory supporting of B1 measurement to UMTS FDD (FGI bit 15)	11.2.0	11.3.0
	RP-59	RP-130241	1197	-	Clarification on MBMS Service Continuity	11.2.0	11.3.0
	RP-59	RP-130241	1198	-	IDC Problem Reporting	11.2.0	11.3.0
	RP-59	RP-130247	1210	-	Corrections on definition of CSG member cell	11.2.0	11.3.0
	RP-59	RP-130237	1211	-	Extension of FBI and EARFCN	11.2.0	11.3.0
	RP-59	RP-130228	1220	-	Invalidation of ETWS with security feature	11.2.0	11.3.0
	RP-59	RP-130225	1224	-	Invalid measurement configuration with different (E)ARFCN	11.2.0	11.3.0
	RP-59	RP-130241	1231	2	PPI and IDC indication upon handover	11.2.0	11.3.0
	RP-59	RP-130227	1235	1	Correcting further UE aspects regarding multi band cells	11.2.0	11.3.0
	RP-59	RP-130248	1236	1	Behaviour in case of excessive dedicated priority information	11.2.0	11.3.0
	RP-59	RP-130225	1241	-	Clarification on EARFCN signalling in Mobility control info	11.2.0	11.3.0
	RP-59	RP-130241	1244	-	IDC-SubframePattern length for FDD	11.2.0	11.3.0
	RP-59	RP-130249	1252	-	Introduction of wideband RSRQ measurements in RRC_IDLE	11.2.0	11.3.0
	RP-59	RP-130240	1255	-	Optional support of RLF report for inter-RAT MRO	11.2.0	11.3.0
	RP-59	RP-130233	1258	2	The presence of bandcombination for non-CA capable UEs	11.2.0	11.3.0
	RP-59	RP-130248	1259	-	Correction for event A5	11.2.0	11.3.0
	RP-59	RP-130332	1265	-	Mandating the settings of FGI bit 14, 27 and 28 to true	11.2.0	11.3.0
06/2013	RP-60	RP-130805	1267	-	Clarification on the redirection to UTRA-TDD frequency in case of CSFB High Priority	11.3.0	11.4.0
	RP-60	RP-130804	1269	1	Correction of wrong reference	11.3.0	11.4.0
	RP-60	RP-130809	1270	-	Clarification to support of deprioritisation feature	11.3.0	11.4.0
	RP-60	RP-130809	1271	-	Clarification on KASME key usage	11.3.0	11.4.0
	RP-60	RP-130808	1272	-	Correction on multi-TA capability	11.3.0	11.4.0
	RP-60	RP-130808	1273	-	MBMS interest indication upon handover/ re-establishment	11.3.0	11.4.0
	RP-60	RP-130808	1274	-	Conditions RI reference inheriting CSI process (DL CoMP)	11.3.0	11.4.0
	RP-60	RP-130808	1275	-	Clarification on NZP CSI-RS resource configuration for UE supporting 1 CSI process	11.3.0	11.4.0
	RP-60	RP-130808	1276	-	Corrections to field description of pdsch-Start-r11	11.3.0	11.4.0

	RP-60	RP-130809	1277	-	Need code corrections in Rel-11 RRC	11.3.0	11.4.0
	RP-60	RP-130808	1278	-	Miscellanous small corrections	11.3.0	11.4.0
	RP-60	RP-130809	1279	1	FDD/TDD diff column correction for FGI31	11.3.0	11.4.0
	RP-60	RP-130804	1282	-	measCycleSCell upon SCell configuration	11.3.0	11.4.0
	RP-60	RP-130809	1294	-	Clarification on RRC Connection Reconfiguration with Critical Extension	11.3.0	11.4.0
	RP-60	RP-130802	1298	-	Security key generation in case of MFBI	11.3.0	11.4.0
	RP-60	RP-130804	1303	1	Clarification on inclusion of non-CA band combinations	11.3.0	11.4.0
	RP-60	RP-130809	1308	-	CR on ROHC parameter configuration in Rel-11 RRC	11.3.0	11.4.0
	RP-60	RP-130804	1315	2	Clarification on UE CA capability	11.3.0	11.4.0
	RP-60	RP-130809	1321	-	Updating 3GPP2 specification references	11.3.0	11.4.0
	RP-60	RP-130805	1323	-	Clarification on the configuration of the extended PHR	11.3.0	11.4.0
	RP-60	RP-130805	1324	-	Clarifications on SystemTimeInfoCDMA2000 IE	11.3.0	11.4.0
	RP-60	RP-130808	1325	-	MFBI impact on MBMS service continuity	11.3.0	11.4.0
	RP-60	RP-130819	1329	1	MFBI aspects for dedicated signalling	11.3.0	11.4.0
09/2013	RP-61	RP-131311	1335	-	Clarification on PhysCellIdRange	11.4.0	11.5.0
	RP-61	RP-131311	1339	1	Correction on the first subframe of the measurement gap	11.4.0	11.5.0
	RP-61	RP-131319	1340	1	Correction for MFBI in SIB15 and SIB6	11.4.0	11.5.0
	RP-61	RP-131319	1343	-	Clarification of MFBI impact on MBMS service continuity	11.4.0	11.5.0
	RP-61	RP-131238	1344	2	Clarification of UE action for otherwise in conditions	11.4.0	11.5.0
	RP-61	RP-131311	1348	-	Corrections to the 3GPP2 specification references in 36.331	11.4.0	11.5.0
	RP-61	RP-131318	1353	-	Clarifications regarding the usage of "rlf-Cause" in case of handover failure	11.4.0	11.5.0
12/2013	RP-62	RP-131986	1366	-	Introduction of capability bit for UTRA MFBI	11.5.0	11.6.0
	RP-62	RP-131984	1368	1	Addition of inter-frequency RSTD measurement capability indicator for OTDOA	11.5.0	11.6.0
	RP-62	RP-131989	1370	-	Clarification on supportedBand	11.5.0	11.6.0
	RP-62	RP-132003	1371	-	Capturing mandatory/optional agreements on Rel-11 UE features	11.5.0	11.6.0
	RP-62	RP-131995	1372	-	Clarification on otherwise behaviour	11.5.0	11.6.0
	RP-62	RP-131995	1373	-	Corrections of the 3GPP2 references in TS 36.331	11.5.0	11.6.0
	RP-62	RP-131991	1374	-	measResultLastServCell for SON-HOF report	11.5.0	11.6.0
	RP-62	RP-131729	1375	1	Clarification to timeInfoUTC field in SIB16	11.5.0	11.6.0
	RP-62	RP-131991	1389	-	Clarification on eRedirection to UMTS TDD with multiple UMTS TDD frequencies	11.5.0	11.6.0
	RP-62	RP-131995	1390	-	Delta signalling for critical extension	11.5.0	11.6.0
	RP-62	RP-132005	1391	-	Capability signalling for CSI processes	11.5.0	11.6.0
	RP-62	RP-131991	1395	1	Clarifications on Measurement	11.5.0	11.6.0
	RP-62	RP-131984	1397	-	Correction to InterFreqRSTDMeasurementIndication field descriptions	11.5.0	11.6.0
	RP-62	RP-131984	1404	-	Correction of Inter-frequency RSTD indication for multiple frequencies	11.5.0	11.6.0
	RP-62	RP-131993	1405	1	Enabling SRVCC from GERAN without forwarding UE-EUTRA-Capability	11.5.0	11.6.0
	RP-62	RP-131995	1409	1	System information and change monitoring procedure	11.5.0	11.6.0
	RP-62	RP-131991	1410	1	Correction on presence of codebookSubsetRestriction-r10	11.5.0	11.6.0
	RP-62	RP-131998	1376	-	Introducing UE support for inbound mobility to a shared CSG cell	11.5.0	12.0.0
	RP-62	RP-132002	1378	2	Introduction of support of further DL MIMO enhancement	11.5.0	12.0.0
	RP-62	RP-131988	1379	-	CR for SSAC in CONNECTED	11.5.0	12.0.0
	RP-62	RP-132002	1406	-	Update of CMAS reference to E-UTRAN specific sections in TS23.041	11.5.0	12.0.0
03/2014	RP-63	RP-140359	1424	1	CR on introduction of Cell-specific time-to-trigger	12.0.0	12.1.0
	RP-63	RP-140346	1435	-	UE autonomous modification of cellsTriggered upon serving cell addition/ release	12.0.0	12.1.0
	RP-63	RP-140359	1436	1	Introduction of T312	12.0.0	12.1.0
	RP-63	RP-140362	1439	1	Introduction of UE-supported EARFCN list in handover preparation information for MFBI	12.0.0	12.1.0
	RP-63	RP-140352	1442	-	Correction of Connection Establishement Failure Report	12.0.0	12.1.0
	RP-63	RP-140356	1450	1	Clarification on the presence of TDD special subframe	12.0.0	12.1.0
	RP-63	RP-140359	1453	-	Introduction of UE mobility history reporting (option 2)	12.0.0	12.1.0
	RP-63	RP-140340	1455	1	Clarification regarding need codes, conditions and ASN.1 defaults for extension fields	12.0.0	12.1.0
	RP-63	RP-140340	1456	-	ASN.1 issue with inter-node signalling (AS-Config)	12.0.0	12.1.0
	RP-63	RP-140357	1457	1	Clarification for the SIB occurrence in a single SI message	12.0.0	12.1.0
	RP-63	RP-140364	1462	-	New UE categories for DL 450Mbps class	12.0.0	12.1.0
	RP-63	RP-140354	1463	-	IoT indication for inter-band TDD CA with different UL/DL configuration	12.0.0	12.1.0
06/2014	RP-64	RP-140869	1471	-	Removal of comment line from EUTRA-UE-Variables imports	12.1.0	12.2.0
	RP-64	RP-140871	1475	-	Correction on measObjectList in VarMeasConfig	12.1.0	12.2.0
	RP-64	RP-140879	1477	-	Minor correction inbound mobility to shared CSG cell	12.1.0	12.2.0
	RP-64	RP-140873	1478	-	Clarificaton on precedence of SCell SI provided dedicately	12.1.0	12.2.0
	RP-64	RP-140887	1479	-	Support of the enhancement for TTI bundling for FDD	12.1.0	12.2.0
	RP-64	RP-140885	1490	-	Corrections on timer T312	12.1.0	12.2.0
	RP-64	RP-140885	1486	-	Correction to the description of physCellIdRange in MeasObjectEUTRA	12.1.0	12.2.0

	RP-64	RP-140885	1506	-	Corrections to UE mobility history information	12.1.0	12.2.0
	RP-64	RP-140873	1489	-	ACK/NACK feedback mode on PUSCH	12.1.0	12.2.0
	RP-64	RP-140878	1556	-	SIB15 enhancement for service availability information	12.1.0	12.2.0
	RP-64	RP-140888	1557	-	Introduction of FDD/TDD CA UE capability	12.1.0	12.2.0
	RP-64	RP-140871	1545	-	Clarification of E-UTRA MFBI signalling	12.1.0	12.2.0
	RP-64	RP-140892	1520	1	Extended RLC LI field	12.1.0	12.2.0
	RP-64	RP-140873	1517	1	Network-requested CA Band Combination Capability Signalling	12.1.0	12.2.0
	RP-64	RP-140873	1554	1	Allowing TDD/FDD split for FGI111 and FGI112	12.1.0	12.2.0
	RP-64	RP-140871	1551	1	Inter-RAT ANR capability signalling in FGI33 when UE supports UTRA TDD only	12.1.0	12.2.0
	RP-64	RP-140884	1495	1	Introduction of TDD eIMTA	12.1.0	12.2.0
	RP-64	RP-140885	1499	1	Minor Corrections to T312	12.1.0	12.2.0
	RP-64	RP-140892	1510	1	Introduction of RRC Connection Establishment failure temporary Qoffset handling	12.1.0	12.2.0
	RP-64	RP-140849	1555	2	Introduction of UE capability for eMBMS reception on SCell and Non-Serving Cell	12.1.0	12.2.0
09/2014	RP-65	RP-141494	1632	-	FDD&TDD split for CA	12.2.0	12.3.0
	RP-65	RP-141505	1599	-	UE capabilities for Hetnet mobility in TS 36.331	12.2.0	12.3.0
	RP-65	RP-141499	1584	-	Introduction of UE eIMTA capabilities	12.2.0	12.3.0
	RP-65	RP-141511	1567	-	Corrections to extended RLC LI field	12.2.0	12.3.0
	RP-65	RP-141511	1603	-	TAI reporting of last serving cell	12.2.0	12.3.0
	RP-65	RP-141498	1630	1	Correction to Network-requested CA Band Combination Capability Signalling	12.2.0	12.3.0
	RP-65	RP-141496	1577	1	Clarification on double indication of SAI in SIB15	12.2.0	12.3.0
	RP-65	RP-141496	1597	-	Clarification on MBMSCountingResponse	12.2.0	12.3.0
	RP-65	RP-141496	1623	-	Clarification on the setting of SupportedBandCombination-v1130	12.2.0	12.3.0
	RP-65	RP-141489	1574	1	Correction of E-UTRAN UE capabilities description in HandoverPreparationInformation message field descriptions	12.2.0	12.3.0
	RP-65	RP-141507	1570	-	Introducing MBSFN measurement by extension of logged measurements	12.2.0	12.3.0
	RP-65	RP-141510	1572	1	Introduction of ACB skip for MMTEL voice/video and SMS	12.2.0	12.3.0
	RP-65	RP-141496	1615	1	Clarification on determining MBMS frequencies of interest in MBMSInterestIndication	12.2.0	12.3.0
	RP-65	RP-141506	1579	1	Introduction of signaling support for low complexity UEs	12.2.0	12.3.0
	RP-65	RP-141499	1601	1	Rel-12 ASN.1 correction	12.2.0	12.3.0
	RP-65	RP-141511	1560	1	Introduction of shorter MCH scheduling period	12.2.0	12.3.0
	RP-65	RP-141493	1611	-	Clarification for time-domain resource restriction pattern applicable to neighbour cell RSRQ measurements	12.2.0	12.3.0
	RP-65	RP-141511	1559	2	Correction to stop condition for "Chiba offset"	12.2.0	12.3.0
	RP-65	RP-141115	1636	-	Mandating the FGI bit 31 to true	12.2.0	12.3.0
	RP-65	RP-141618	1566	2	Connected mode procedures and RRC signaling of WLAN/3GPP Radio Interworking for LTE	12.2.0	12.3.0
12/2014	RP-66	RP-142122	1643	-	Clarification on WLAN interworking	12.3.0	12.4.0
	RP-66	RP-142122	1644	-	Correction on handling of dedicated parameters during re-establishment	12.3.0	12.4.0
	RP-66	RP-142122	1645	-	Corrections to WLAN/3GPP Radio Interworking for LTE	12.3.0	12.4.0
	RP-66	RP-142122	1646	-	Reduction of possible values for WLAN backhaul rate thresholds in LTE	12.3.0	12.4.0
	RP-66	RP-142140	1648	-	PDCP SN size change during HO for RLC-UM mode bearers	12.3.0	12.4.0
	RP-66	RP-142124	1651	-	Support of TTI bundling without resource allocation restriction for LTE coverage enhancements for Rel-12	12.3.0	12.4.0
	RP-66	RP-142123	1652	-	Corrections to eIMTA capabilities	12.3.0	12.4.0
	RP-66	RP-142140	1653	-	ACB, ACB-skip, CSFB and SSAC signalling per PLMN	12.3.0	12.4.0
	RP-66	RP-142122	1642	1	Minor corrections regarding WLAN interworking	12.3.0	12.4.0
	RP-66	RP-142115	1659	-	Correction of remaining TBD for Rel-10 FGIs	12.3.0	12.4.0
	RP-66	RP-142117	1663	-	New UE categories for DL 600Mbps	12.3.0	12.4.0
	RP-66	RP-142135	1687	-	Introduction of Dual Connectivity	12.3.0	12.4.0
	RP-66	RP-142140	1697	1	Prohibit timer for SR	12.3.0	12.4.0
	RP-66	RP-142133	1666	-	Support of 256QAM in TS 36.331 (per band 256QAM capability report)	12.3.0	12.4.0
	RP-66	RP-142128	1690	1	Introduction of increased number of frequencies to monitor	12.3.0	12.4.0
	RP-66	RP-142140	1696	2	Introduction of extended RSRQ value range and new RSRQ definition	12.3.0	12.4.0
	RP-66	RP-142115	1650	1	Introduction of signalling for serving cell interruptions	12.3.0	12.4.0
	RP-66	RP-142123	1655	-	Correction for p0-Persistent-SubframeSet2 Handling	12.3.0	12.4.0
	RP-66	RP-142134	1681	-	Introduction of missing Rel-12 UE capabilities	12.3.0	12.4.0
	RP-66	RP-142140	1647	1	Extended RLC LI field correction	12.3.0	12.4.0
	RP-66	RP-142140	1656	-	Outstanding Need OP for non-critical extension removal	12.3.0	12.4.0
	RP-66	RP-142140	1669	2	Clarification on statusReportRequired handling	12.3.0	12.4.0
	RP-66	RP-142131	1698	2	MCH BLER and RSRQ update for MBSFN MDT	12.3.0	12.4.0
	RP-66	RP-142130	1699	1	Optionality support of UE mandatory features for Category 0 UEs	12.3.0	12.4.0
	RP-66	RP-142123	1661	-	Further Clarifications on eIMTA and eICIC	12.3.0	12.4.0
	RP-66	RP-142113	1686	1	UE capability for modified MPR behavior	12.3.0	12.4.0
	RP-66	RP-142132	1664	1	Support of Discovery Signals measurement in TS 36.331	12.3.0	12.4.0

	RP-66	RP-142139	1670	2	RRC Parameters for NAICS	12.3.0	12.4.0
	RP-66	RP-141979	1700	-	UE capability signaling for WLAN/3GPP radio interworking	12.3.0	12.4.0
	RP-66	-	-	-	MCC editorial update	12.4.0	12.4.1
03/2015	RP-67	RP-150373	1737	-	Clarification on the setting of measScaleFactor without reducedMeasPerformance	12.4.1	12.5.0
	RP-67	RP-150371	1747	-	Clarification on Measurement Configuration handling	12.4.1	12.5.0
	RP-67	RP-150371	1765	-	Clarification to usage of field deltaTxD-OffsetPUCCH-Format1bCS-r11 in dedicated uplink power control parameter signalling	12.4.1	12.5.0
	RP-67	RP-150370	1751	-	Clarification on CSI measurement subframe set	12.4.1	12.5.0
	RP-67	RP-150368	1795	-	The absence of supportedMIMO-CapabilityUL-r10	12.4.1	12.5.0
	RP-67	RP-150370	1798	-	Presence of codebookSubsetRestriction	12.4.1	12.5.0
	RP-67	RP-150377	1768	2	Miscellaneous changes resulting from review for REL-12 ASN.1 freeze	12.4.1	12.5.0
	RP-67	RP-150374	1770	2	Introduction of ProSe	12.4.1	12.5.0
06/2015	RP-68	RP-150921	1800	-	Correction field description of networkControlledSyncTx	12.5.0	12.6.0
	RP-68	RP-150921	1801	-	Clarification on SCG reconfiguration	12.5.0	12.6.0
	RP-68	RP-150921	1802	-	Correction for aperiodic CSI trigger	12.5.0	12.6.0
	RP-68	RP-150920	1804	-	Correction on handling of wlan-OffloadConfigDedicated upon leaving RRC_CONNECTED	12.5.0	12.6.0
	RP-68	RP-150921	1805	-	Reconfiguration of SPS	12.5.0	12.6.0
	RP-68	RP-150916	1809	-	CR on Aperiodic CSI Reporting for 1.4MHz cell	12.5.0	12.6.0
	RP-68	RP-150921	1815	-	Clarification on PDCP reconfiguration	12.5.0	12.6.0
	RP-68	RP-150921	1816	-	Correction to SCG change	12.5.0	12.6.0
	RP-68	RP-150921	1817	-	Minor corrections for PSCell configuration in DC	12.5.0	12.6.0
	RP-68	RP-150921	1818	-	CR on ROHC for split bearer	12.5.0	12.6.0
	RP-68	RP-150921	1819	-	Clarification on FDD/TDD differentiation of FGIs/capabilities in TDD-FDD CA	12.5.0	12.6.0
	RP-68	RP-150921	1803	1	Correction to SCG and split bearer configuration	12.5.0	12.6.0
	RP-68	RP-150921	1810	1	Clarifications on use of preconfigComm for direct communication	12.5.0	12.6.0
	RP-68	RP-150921	1811	1	Miscellaneous corrections (a.o. Sidelink)	12.5.0	12.6.0
	RP-68	RP-150921	1813	1	Conditions for establishing RRC Connection for sidelink transmission	12.5.0	12.6.0
	RP-68	RP-150921	1814	1	Correction on field description on SL-TF-ResourceConfig	12.5.0	12.6.0
	RP-68	RP-150917	1806	1	Mandatory present of supportedMIMO-CapabilityDL-r10	12.5.0	12.6.0
	RP-68	RP-150923	1853	-	Clarification on Cell barring for downlink only bands	12.5.0	12.6.0
	RP-68	RP-150917	1852	-	Clarification regarding no MBMS sessions ongoing	12.5.0	12.6.0
	RP-68	RP-150917	1827	1	Correction to additionalSpectrumEmission	12.5.0	12.6.0
	RP-68	RP-150923	1820	4	Clarification on extended RSRQ range support	12.5.0	12.6.0
	RP-68	RP-150917	1838	-	Restriction to CA capability signalling	12.5.0	12.6.0
	RP-68	RP-150921	1823	-	Clarification on PUCCH and SRS	12.5.0	12.6.0
	RP-68	RP-150926	1849	-	Introduction of new DL UE categories 15&16	12.5.0	12.6.0
	RP-68	RP-150923	1824	-	Clean-up corrections to TS 36.331	12.5.0	12.6.0
	RP-68	RP-150918	1846	1	Correction to IDC signalling	12.5.0	12.6.0
	RP-68	RP-150921	1822	1	Change of LCID upon DC-specific DRB reconfiguration	12.5.0	12.6.0
	RP-68	RP-150921	1832	1	Correction to PHR format	12.5.0	12.6.0
	RP-68	RP-150921	1842	1	Correction on conditions for sidelink operation	12.5.0	12.6.0
	RP-68	RP-150811	1834	2	Correction on the SL-TF-IndexPair values for ProSe Direct Discovery	12.5.0	12.6.0
09/2015	RP-69	RP-151443	1866	-	Correction on UE band combinition capability	12.6.0	12.7.0
	RP-69	RP-151438	1869	-	Correction on Restriction to CA capability signalling	12.6.0	12.7.0
	RP-69	RP-151443	1884	-	The support of UL64QAM	12.6.0	12.7.0
	RP-69	RP-151442	1889	-	Small corrections concerning RadioResourceConfig	12.6.0	12.7.0
	RP-69	RP-151441	1900	-	Sidelink discovery related corrections	12.6.0	12.7.0
	RP-69	RP-151440	1905	2	Clarification of Beacon RSSI Encoding	12.6.0	12.7.0
	RP-69	RP-151439	1911	1	CR for IDC signalling enhancement for UL CA	12.6.0	12.7.0
	RP-69	RP-151440	1880	2	Clarification on cell selection sequence upon leaving RRC_CONNECTED	12.6.0	12.7.0
	RP-69	RP-151438	1908	-	Correction to additionalSpectrumEmission - Option 1	12.6.0	12.7.0
	RP-69	RP-151439	1879	1	Correction on the reference of EPDCCH	12.6.0	12.7.0
	RP-69	RP-151441	1891	1	Introducing general handling and guidelines concerning critical extensions within a release	12.6.0	12.7.0
	RP-69	RP-151443	1909	1	Applicability of longCodeState1XRTT for 1xRTT IRAT ANR	12.6.0	12.7.0
	RP-69	RP-151441	1912	1	Sidelink terminology alignment in TS 36.331	12.6.0	12.7.0
	RP-69	RP-151442	1906	2	Clarification for NAICS capability signalling	12.6.0	12.7.0
	RP-69	RP-151467	1861	2	Additional MIMO/CSI capability for intra-band contiguous CA	12.6.0	12.7.0
	RP-69	RP-151466	1887	2	Signalling for 4-layer MIMO with TM3 and TM4	12.6.0	12.7.0
	RP-69	RP-151625	1914	2	Allowing NAICS with TM10	12.6.0	12.7.0
12/2015	RP-70	RP-152053	1916	-	Correction on SCG release	12.7.0	12.8.0
	RP-70	RP-152053	1932	-	Clarification to SCG RLF timers and constants reconfiguration	12.7.0	12.8.0
	RP-70	RP-152053	1933	-	Correction to triggerQuantityCSI-RS	12.7.0	12.8.0
	RP-70	RP-152053	1946	-	Correction to NAICS field descriptions	12.7.0	12.8.0
	RP-70	RP-152055	1947	-	Correction of need code definition terminology	12.7.0	12.8.0
	RP-70	RP-152050	1964	-	Clarification on FDD/TDD difference for UL CA IDC indication	12.7.0	12.8.0
	RP-70	RP-152046	1975	-	Correction to SystemTimeInfoCDMA2000 IE	12.7.0	12.8.0

	RP-70	RP-152053	1928	1	highPriorityAccess for MMTEL voice, MMTEL video and SMS	12.7.0	12.8.0
	RP-70	RP-152053	1986	1	Correction to the support of Mobility State reporting	12.7.0	12.8.0
	RP-70	RP-152046	1971	1	MaxLayerMIMO in HandoverPreparationInformation	12.7.0	12.8.0
	RP-70	RP-152046	1987	-	Correction to ASN.1 field names for 4-layer TM3/4	12.7.0	12.8.0
	RP-70	RP-152053	1969	1	Correction on measurement identity autonomous removal in dual connectivity	12.7.0	12.8.0
	RP-70	RP-152053	1979	1	Clarification on tdd-FDD-CA-PCellDuplex	12.7.0	12.8.0
	RP-70	RP-152049	1919	2	Alternative new maximum transport block sizes for DL 64QAM and 256QAM in TM9/10	12.7.0	12.8.0
	RP-70	RP-152050	1934	1	Some general RRC issues	12.7.0	12.8.0
	RP-70	RP-152055	1965	1	Correction on capability rsrq-OnAllSymbols	12.7.0	12.8.0
	RP-70	RP-152056	1931	2	Addition of establishment cause for mobile-originating VoLTE calls and network indication in SIB2	12.7.0	12.8.0
	RP-70	RP-152048	1927	2	CR to correct UE messages to be sent only after security activation	12.7.0	12.8.0
	RP-70	RP-152053	1973	3	Clarification of MCG	12.7.0	12.8.0
	RP-70	RP-152113	1923	4	Enabling multiple NS and P-Max operation per cell	12.7.0	12.8.0

Appendix 1

Curriculum Vitae

Name: Craig Bishop

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Email: craig@bishopcom.co.uk

Current job title: Independent Consulting Engineer, CEO

Address: 43 Ospringe Street, Faversham, Kent, ME13 8TW

Key Skills and Experience

- 33 years Telecoms, Radio and Broadcast experience
- 26 years experience of 2G/3G/4G telecoms standardisation
- Extensive knowledge of 3GPP and ETSI specifications and procedures including document handling and publication practices
- Sound understanding of 3GPP systems, including Radio Access Interfaces and Networks, Access Stratum protocols, Core Networks, Non-Access Stratum protocols, and IMS
- Experience of ETSI role from regulatory perspective (harmonised standards, mandates, spectrum, etc)
- Depositions, reports, and declarations as expert witness in cases on 3GPP technologies and on 3GPP & ETSI practices and procedures.
- Intellectual property analysis including prior art search and evaluation of patent essentiality
- Application of data analytics and machine learning techniques to standards and IP data
- Programming in Java, Python, C, Octave (Matlab)

Career History

Bishop Communications Ltd. 01/13 –

Independent Telecommuncations Standards and Intellectual Property Consultant

Company is a full ETSI member

Activities have included:

- Provision of expertise for EC funded ETSI Specialist Task Force (STF489) to produce implementation guidelines for Total Conversation for emergency services. Project delivered on time / budget and well received. Ouput published March 2016 as ETSI TR 103 201.
- Provision of expertise for ETSI Specialist Task Force (STF555) assessing the impact on existing standards of communications involving IoT devices in all types of emergency situations. Project delivered on time / budget and well received. Ouput published July 2019 as ETSI TR 103 582.
- Provision of expert support for IPR litigation from standards landscape analysis / background technical reports to expert testimony reports / declarations and depositions on matters including the public availability of 3GPP and ETSI prior art.
- Intellectual property analysis assessing strengths and weaknesses of patents and patent portfolios, conducting searches for prior art, evaluating patent essentiality, and acquring relevant documentation.
- Provision of standards consultancy services for Samsung Electronics in ETSI including membership of the ETSI Board until November 2014

Technologies covered in patent related work include: 3GPP GSM, UMTS, LTE radio interface technologies (Phy, MAC, RLC, RRC), 3GPP access and core networks (GPRS/UMTS & EPC NAS), IMS. Organisations covered include 3GPP & ETSI.

Clients served during last 10 years include: Addy Hart LLP, Alston & Bird LLP, AT&T, Baker Botts LLP, Banner Witcoff LLP, DLA Piper LLP, European Telecommunications Standards Institute (ETSI),

Fish & Richardson P.C., Gibson Dunn LLP, Haynes and Boone LLP, Hillebrand-CE GmbH (working for third party clients as Consulting Engineer for Hillebrand-CE), Kilpatrick Townsend & Stockton, Kirkland & Ellis LLP, K&L Gates LLP, Morgan, Lewis & Bokius LLP, MckoolSmith LLP, PV Law LLP, Paul Hastings LLP, Perkins Coie LLP, Powell Gilbert LLP, Sidley Austin LLP, Samsung Electronics Research & Development Institute UK (SRUK), Taylor Wessing LLP, Williams & Connolly LLP, WilmerHale LLP.

Expert testimony through deposition:

- *Huawei Technologies Co. Ltd. vs. T-Mobile US, Inc., et al.*, Case Nos. 2:16-cv-0052-JRG-RSP, 2:16-cv-0055-JRG-RSP, 2:16-cv-0056-JRG-RSP, and 2:16-cv-0057-JRG-RSP (E.D. Tex.). On behalf of T-Mobile US Inc.
- *T-Mobile US, Inc., et al.* v. *Huawei Technologies Co. Ltd.*, Case Nos. IPR2017-00696 and IPR2017-00697 (PTAB). On behalf of T-Mobile US Inc.
- *LG Electronics, Inc., v. Koninklijke KPN N.V.*, Case No. IPR2018-00558 (PTAB). On behalf of LG Electronics, Inc.
- *Nokia of America Corp. and Ericsson Inc. v. IPCOM, GMBH & Co.,* Case No. IPR2021-00533 (PTAB). On behalf of Ericsson Inc.
- *IPCom, GmbH & Co., Plaintiff, v. AT&T Inc., et al, Defendant, Nokia of America Corp., Intervenor, Ericsson Inc., Intervenor.,* Civil Action No. 2:20-CV-322-JRG*, and IPCom, GmbH & Co., Plaintiff, v. Verizon Communications, et al., Defendant, Nokia of America Corp., Intervenor, Ericsson* nc*., Intervenor.,* Civil Action No. 2:20-CV-323-JRG. On behalf of Ericsson Inc.
- *Ericsson Inc. v. Koninklijke KPN N.V.,* Case No. IPR2022-00069 (PTAB). On behalf of Ericsson Inc.

Expert testimony in court:

- *Between IPCom GmbH and Vodafone, et al.,* Claim No. HP-2018-000030 Claim No. HP-2018-000031, High Court of Justice, Business & Property Courts of England and Wales, Intellectual Property List (ChD), Patents Court. Retained by Vodafone.
- *Between (1) Mitsubishi Electric Corporation (2) Sisvel International SA and Oneplus Mobiletech UK Limited, Oppo Mobile UK Ltd, Xiaomi Technology UK Limited, et al.,* Claim No. HP-2019-000014, High Court of Justice, Business & Property Courts of England and Wales, Intellectual Property List (ChD), Patents Court. Retained by Oneplus, Oppo, and Xiaomi (trial held remotely due to COVID-19 restrictions)

Samsung Electronics Research Institute (SERI) 12/96 – 01/13

Director Standards and Industry Affairs 03/11 – 01/13

Mission and Tasks as for previous role plus:

- Proactive member of ETSI Board following election as Board member in November 2011
- Worked with Samsung internal and external legal counsel in response to EC investigation into Samsung suspected abuse of Standards Essential Patents.
- Deposed by Apple as fact witness in ITC investigation 337-TA-794.

Head of Advanced Technologies Standards & Regulation 09/05 - 03/11

Mission: To help position Samsung and SERI at the forefront of mobile telecommunication developments through participation in and leadership of mobile communications standards and European regulatory affairs

Key tasks:

- Developed standards and research strategy and coordinated activites with head office, acting as official Samsung contact for the European Telecommunications Standars Institute.
- Programme managed standardisation and regulation projects covering 3GPP (RAN2, CT1, SA2, SA1, SA, RAN, CT), OMA, and mobile Broadcast strategies and technologies (DVB Forum),

European Framework projects (FP7), Spectrum Management (CEPT, ETSI EM, TFES, BRAN, …) and European Regulatory affairs (Digital Europe, relations with European Commission, …). - Grew department from 3 to 12 persons to cater for these activities.

- Participated and actively contributed to 3GPP SA1 (11/08 – 11/11), SA2 (10/05 – 08/11) , SA and ETSI TC SCP groups on issues including IMS / CS Interworking (VCC / SRVCC, VoLTE, T-ADS, ICS), Local IP Access & Selected IP Traffic Offload (LIPA-SIPTO), MOSAP, M2M/MTC, Embedded / 4FF UICC.
- Drafted and filed communication technology related patents related to 3GPP SA2 and CT1 technologies – 18 filed, mainly IMS and 3GPP NAS related
- Supported Samsung IP team with analysis of Samsung and 3rd party communication technology related patents and claim charts including GSM/GPRS, UTRAN, NAS, and IMS patents
- Chaired SERI Patent Committee from 2007-2009 - SERI achieved patent targets for first time in 2007 and did so in every year following

Standards consultant – part time 09/04 – 09/05

(Whilst studying fulltime for MSC)

During this time, I conducted a review of the wireless communication technolgies and the associated standards space, with a particular emphasis on 802.16a, as well as 3G and 802.11 evolutions. I was also involved in analysis of 3rd party patents and claim charts on request from Samsung IP team.

Technology Manager System Engineering group 06/03 – 09/04

Mission: To establish a System Engineering group within SERI to support development of SERI's dual mode GSM/UMTS radio modem platform.

Key Tasks:

- Defined and implemented System Engineering group strategy including recruitment and line management of the group which grew from 3 to 10 engineers during this period.
- Developed detailed system requirements for SERI's dual mode 2G/3G radio modem platform(s) including production of background documentation describing system wide behaviour
- Defined system test programme for platform, including example test cases using off the shelf test equipment. This project outsourced (under my supervision) to a third party company for completion.
- Provided continued support to development engineers in terms of understanding specification and system requirements, particularly with respect to Access Stratum and Non Access Stratum specifications and protocols.
- Instigated and managed studies investigating optimised system architecture for future Samsung mobile platforms.
- Analysed Samsung and 3rd party 3GPP technology related patents and claim charts on request by Samsung IP team and reported on their value and standards essentiality.

Technology Manager Standards & System Group 04/02 – 06/03

Mission: To provide Standards support to SERI development teams and Samsung's global standardisation activities.

Key Tasks:

- Devised and implemented revised strategy to improve the focus of activities and provide improved support for software developers from a system perspective.
- Attended 3GPP TSG SA plenary and occasional SA WG1 meetings - acted as rapporteur for 3GPP Evolution technical report 3GPP TR 21.902.

- Analysed 3rd party GSM/GPRS technology related patents and claim charts on request by Samsung IP team and reported on their value and standards essentiality.
- Line managed 3 engineers, ensuring that the group provided expert support for SERI SW and HW developers in terms of standards interpretation and system requirements, particularly with respect to the Radio Access Network.

Project Manager 04/00 – 04/02

Mission: To establish and manage development of a dual mode GSM/UMTS modem platform.

Key tasks:

- Defined and managed work relating to core technology development for Samsung's 3G handsets.
- Determined major technical architecture and parameters for the platform producing high level system requirements specification and project development plan.
- As a technical authority on UMTS, supported the project in terms of requirements specification and interpretation (L1, MAC/RLC, RRC, and NAS specifications), and contributed towards the training of UMTS project team members.
- Acting in a consultative capacity, interfaced with other departments in Samsung and with external customers/suppliers on issues relating to 2G and 3G technologies
- Responsible for the overall planning, work allocation and co-ordination of engineers for the project, as well as being involved in recruitment – during this period the number of engineers working on the project increased from 10 to over 40.
- Instigated, defined and managed a feasibility study involving HW and SW engineers, as essential preparation for the development of a dual mode GSM/UMTS radio modem platform.

Senior/Principal Standards Engineer 12/96 – 04/00

Mission: To support Samsung standards and development activities in ETSI and 3GPP.

Key Tasks:

- Gathered and disseminated information throughout Samsung concerning latest specifications and trends in telecommunications, providing advice to Senior Management on future strategies for telecommunications development.
- Acted as sole Samsung representative in ETSI TC SMG2 from December 1996 and during the selection phase for the UMTS Radio Acces Technology providing training for Samsung engineers on elaborated technologies
- Participated in 3GPP TSG RAN WG1 (UTRA Physical Layer), and RAN WG2 (L2/3) contributing specifically in areas related to FEC, Common Packet Channel, and Transmit Diversity
- In 3GPP TSG T WG2 I initiated and acted as rapporteur for the UE capabilities work item. I also acted as liaison officer between TSG T WG2, TSG RAN WG1 and TSG SA WG1 (Service Aspects) on issues of common interest
- Acted as main spokesperson for and advisor on Samsung strategic activities in, 3GPP TSG RAN from 3GPP's creation until April 2000
- Acted in a consultative capacity advising the company on technical, commercial and regulatory issues relating to 3rd generation telecommunications development and implementation.
- Developed and promoted programme to co-ordinate standards activities throughout Samsung. – Samsung Global Standards Strategy Group established in September 1998.
- Attended ETSI TCs, SMG1, SMG4, SMG5, SMG7, SMG9 and SMG11 as required by Samsung to keep abreast of developments prior to establishment of 3GPP

Radiocommunications Agency 06/93 -11/96

HPTO Spectrum Engineer

- Responsible for the management of spectrum for use by PMR and Wireless LAN technologies.
- Defined and instigated development of an improved assignment methodology for Private Mobile Radio (PMR) channels, promoting increased quality and spectrum efficiency.
- Managed research projects involving the assessment and selection of bids from external companies, submitted under competitive tender.
- Represented the Agency in the National and International fora associated with the use of Land Mobile Radio, acting as rapporteur for PMR voice and data standards in ETSI Sub-Technical-Committee RES02, and as chairman of a sub-working group under ITU WP8A drafting the recommendation for use of the radio spectrum by Radio LANs.
- Involved in CEPT Spectrum Engineering Project Teams, dealing with spectrum for Narrow band PMR technology and co-ordination between that technology and T-DAB transmissions in Band III.
- Dispensed technical advice both within the Agency and to external customers, on national and international PMR standards, assessing requests for additional frequencies, and providing technical justification for assignments and wider spectrum policy

BBC Radio 11/89 – 05/93

Radio Operations Engineer

- Worked on projects requiring the design, development, maintenance and testing of equipment for use within the broadcasting chain.
- Responsible for acceptance testing of new studios for Radio 5, and in particular redesign of outside source circuits for the main sports continuity studio.
- Involved in acceptance testing for NICAM transmission routers. Designed and implemented modifications to synchronise transmission feeds, resulting in seamless switching between routers.

Education

1. MSC in Computer Science from the University of Kent

   Awarded (with distinction): 07/2006

   Dissertation title: Roles Variables and Program Analysis – Received prize for outstanding achievement

2. B.Eng. (Hons) in Electronic Engineering from the Polytechnic of Central London

   Awarded: 07/1989

3. In house and external technical and management training including: Learning Tree courses on System Analysis and Design, User Requirements, UML, and Project Management.
4. On-line courses from: Cousera, Udemy, and Zenva courses covering Machine Learning, Python, Data Science, and Natural Language Processing

Appendix 2

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THIRD GENERATION PARTNERSHIP PROJECT (3GPP)

PARTNERSHIP PROJECT DESCRIPTION

During the meeting held in Copenhagen, 2 - 4 December 1998 ARIB, ETSI, T1, TTA and TTC agreed this Partnership Project Description.

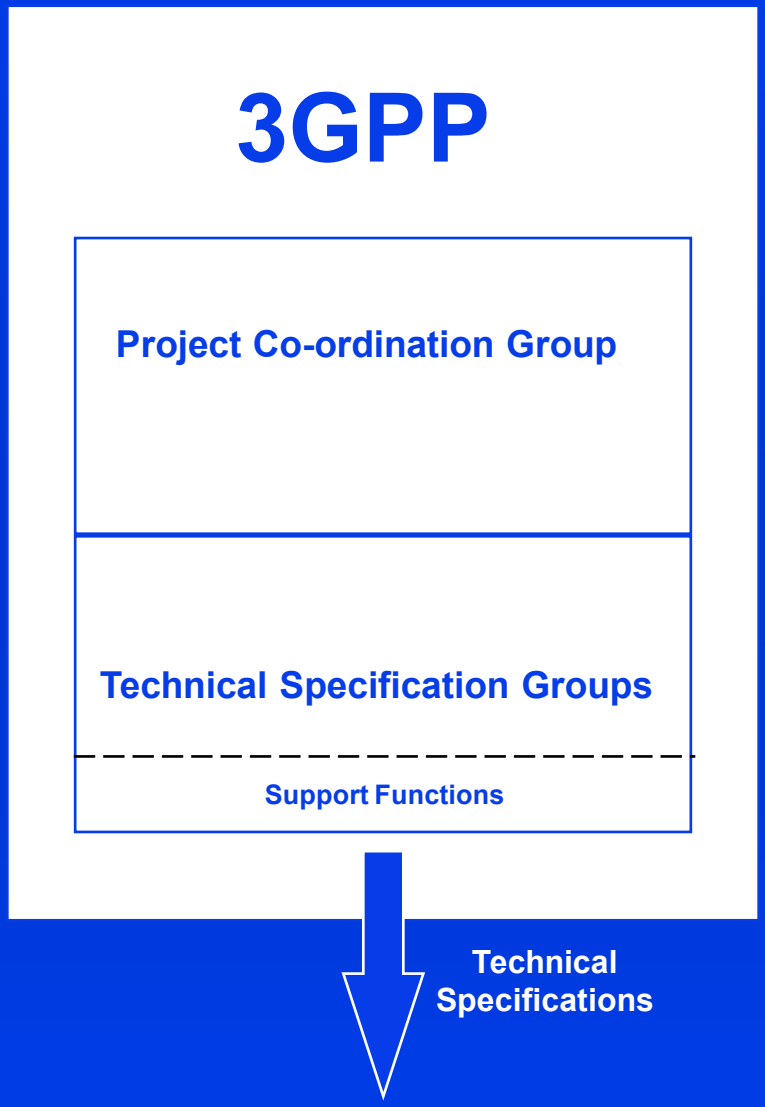
Preamble

Standards organizations and other related bodies have agreed to co-operate for the production of a complete set of globally applicable Technical Specifications for a 3rd Generation Mobile System based on the evolved GSM core networks and the radio access technologies supported by 3GPP partners (i.e., UTRA both FDD and TDD modes).

The Project is entitled the "Third Generation Partnership Project" and may be known by the acronym "3GPP".

3GPP has been established for the preparation and maintenance of the above mentioned Technical Specifications, and is not a legal entity.

3GPP Overview



Definition of the Third Generation Partnership Project

3GPP will provide globally applicable Technical Specifications for a 3rd Generation Mobile System based on the evolved GSM core network, and the Universal Terrestrial Radio Access (UTRA), to be transposed by relevant standardization bodies (Organizational Partners) into appropriate deliverables (e.g., standards).

Scope and objectives (1)

The Technical Specifications will be developed in view of global roaming and circulation of terminals.

The 3rd Generation Mobile System and its capabilities will be developed in a phased approach. Initially, 3GPP will elaborate, approve and maintain the necessary set of Technical Specifications for the first phase of a 3rd Generation Mobile System including:

- **UTRAN (including UTRA; W-CDMA in Frequency Division Duplex (FDD) mode and TD-CDMA in Time Division Duplex (TDD) mode)**
- **3GPP Core Network (Third Generation networking capabilities evolved from GSM . These capabilities include mobility management and global roaming.)**
- **Terminals for access to the above (including specifications for a UIM)**
- **System and service aspects**

Scope and objectives (2)

The set of global specifications for the first phase of the 3GPP core network and the specifications for the GSM core network should be common to the largest extent possible and should not be needlessly different.

The results of the 3GPP work will form the basis of member contributions to the ITU in accordance with existing procedures.

3GPP will take account of emerging ITU recommendations on interworking between IMT-2000 family members.

In the framework of agreed relationships, 3GPP will elaborate Technical Specifications that will form the basis of standards, or parts of standards, of the Organizational Partners.

Characteristics of 3GPP (1)

3GPP is characterized by the following attributes:

- **Minimum production time for Technical Specifications from conception to approval**
- **Fast, electronic based approval process**
- **Maximum use of modern (electronic) working methods**
- **Minimum number of hierarchical levels with decision making taking place at the lowest appropriate levels**

Characteristics of 3GPP (2)

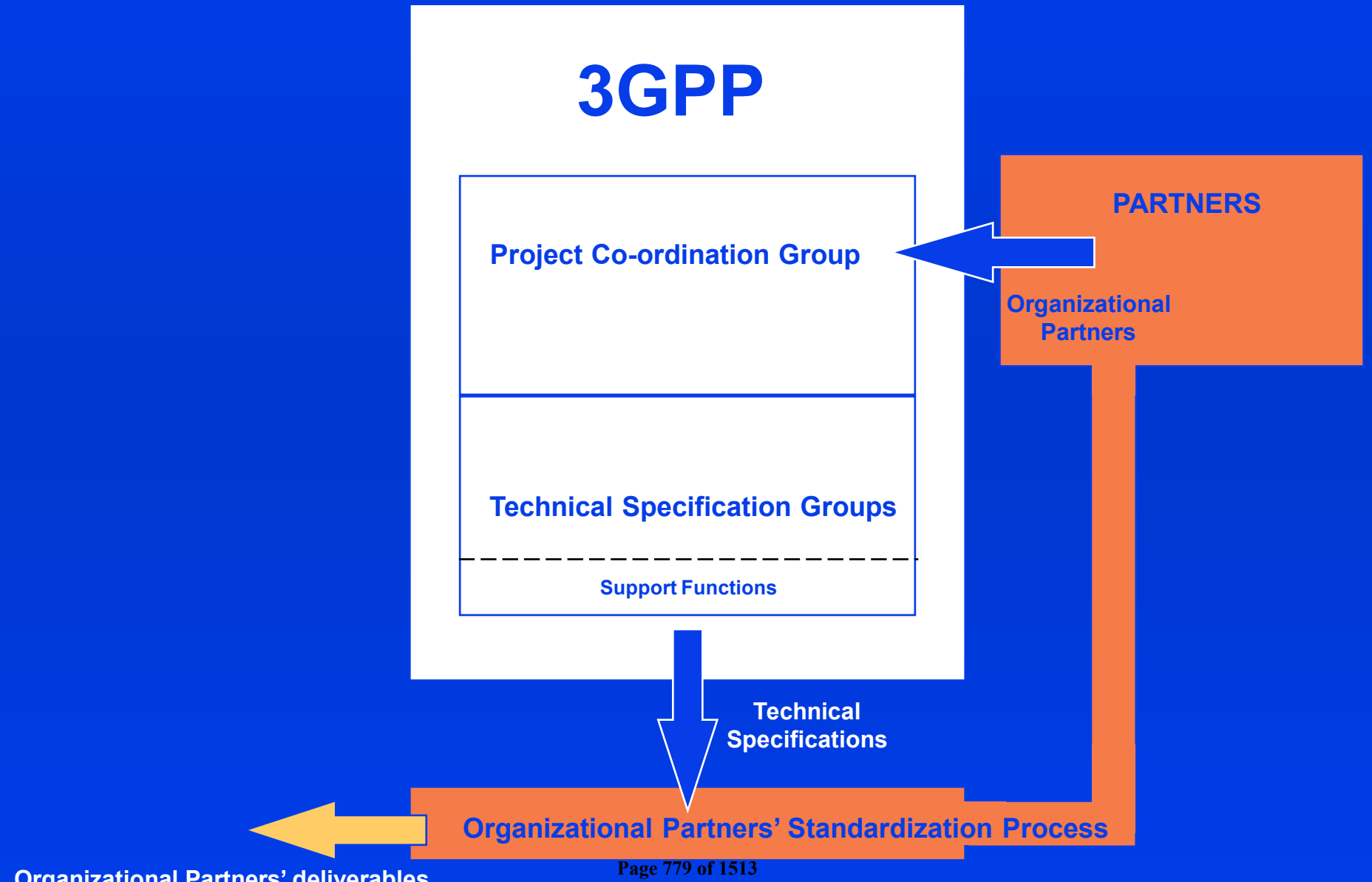
- **A Project Co-ordination function and a Technical Specification function**
- **Task oriented, ensuring that on completion of the tasks the future of the project is re-evaluated**
- **Cost effective use of financial/human resources provided by Partner Organizations (if required)**

Partnership and Membership

3GPP comprises of:

- **Partners:**
  - **Organizational Partners**
    - **3GPP is open to all standards organizations irrespective of the geographical location.**
  - **Market Representation Partners**
- **Individual Members**

Organizational Partners (1)



Organizational Partners (2)

An Organizational Partner is:

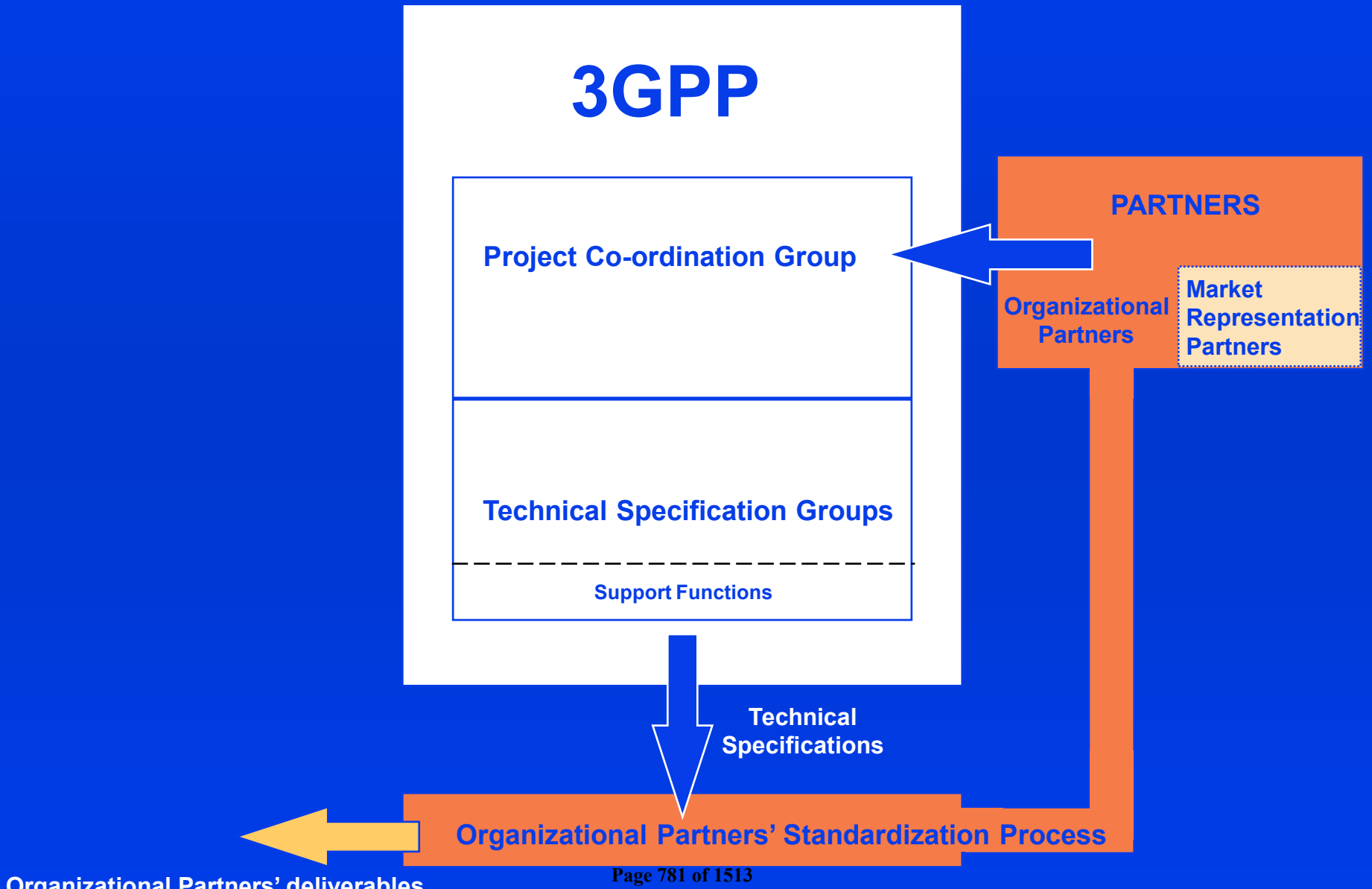
An open standards organization with a national, regional or other officially recognized status (in their country or region)

that:

- **has the capability and authority to define, publish and set standards nationally or regionally and**
- **has signed (or whose sponsor has signed) the Partnership Project Agreement**

Organizational Partners will meet as approriate and make decisions by consensus.

Market Representation Partners (1)



Market Representation Partners (2)

Standardization should meet market needs.

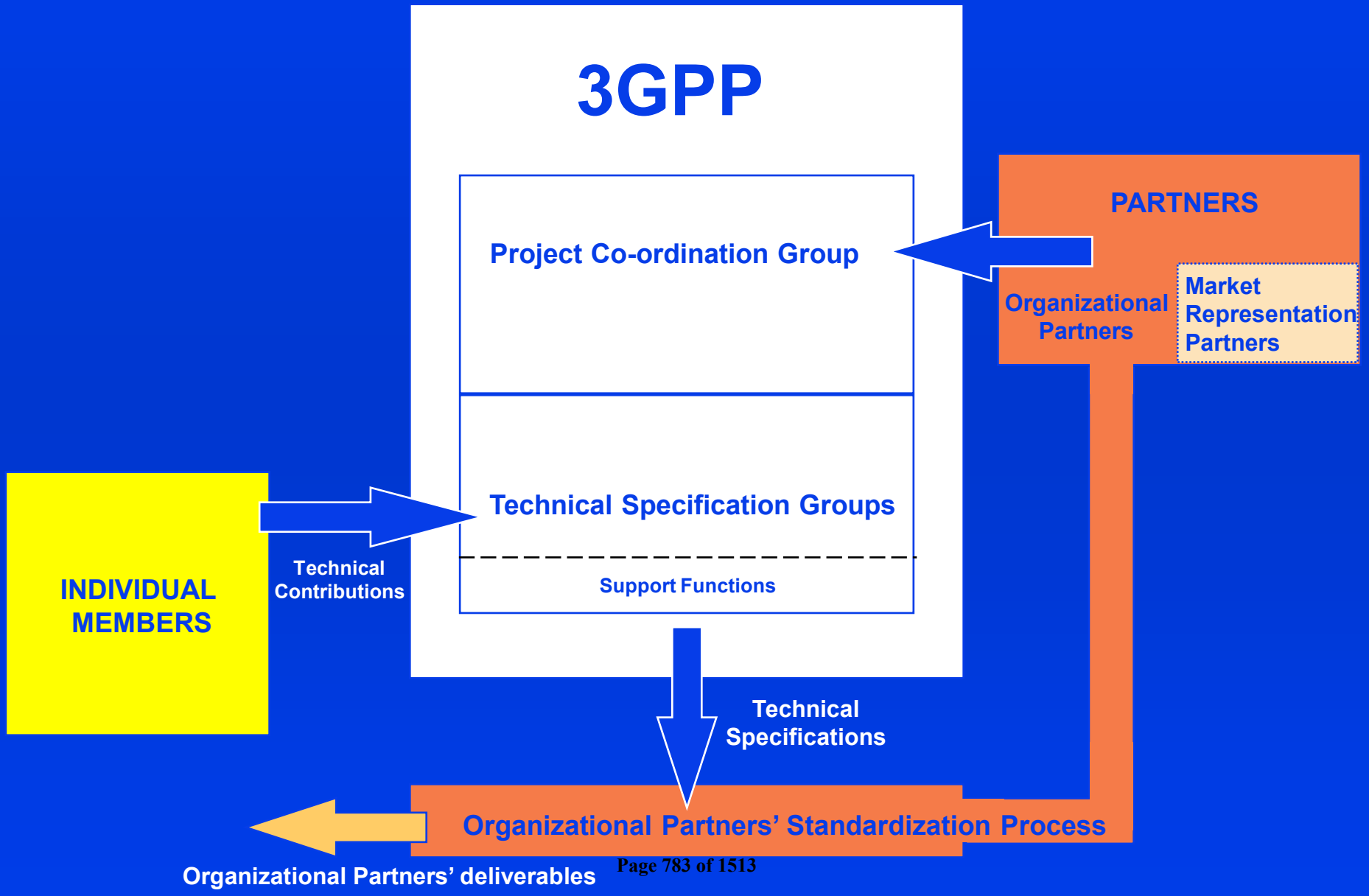
In order to identify market requirements, the high competence of Market Representation Partners should be used.

A Market Representation Partner is an organization invited to participate by the Organizational Partners to offer market advice to 3GPP and to bring into 3GPP a consensus view of market requirements (e.g. services, features and functionality) falling within the 3GPP scope.

A Market Representation Partner:

- **does not have the capability and authority to define, publish and set standards nationally or regionally**
- **has signed (or whose sponsor has signed) the Partnership Project Agreement**
- **has committed itself to the 3GPP scope**

Individual Members (1)



Individual Members (2)

Membership in an Organizational Partner is a pre-requisite for Individual Membership in 3GPP.

Individual Membership is open to legal entities committed to support 3GPP and to:

- **contribute technically or otherwise to one or more of the Technical Specification Groups within the 3GPP scope**
- **use the 3GPP results to the extent feasible**

Individual Membership in 3GPP will be terminated by dissolution, abolition, resignation or expulsion from the related Organizational Partner.

Individual Members (3)

All entities registered as members of an Organizational Partner and eligible for participation in the technical work of that Partner, can become Individual Members of 3GPP. Individual members shall apply to their Organizational Partner to participate in 3GPP.

Individual Members act in the 3GPP in their own right; they carry the full responsibility for their contributions.

Individual Membership applicants residing in a country/area without an Organizational Partner can apply for membership in an Organizational Partner according to the rules of each Partner. (e.g. ETSI Associate Membership is available)

Observership

In order to ensure globally applicable Technical Specifications, the status of "Observer" may be granted by the Organizational Partners to an entity which has the qualifications to become a future Organizational Partner. The status of "Observer" includes obligations to:

- identify as early as possible any regulatory requirements that may lead to options within Technical Specifications
- make their IPR policy available for consideration
- contribute to the common objective of the 3GPP and avoid duplication of work related to the 3GPP

The participation rights of an Observer will be decided on a case by case basis.

The following 3 documents describe 3GPP:

- **The Partnership Project Agreement**
- **The Partnership Project Description (this present document)**
- **The Partnership Project Working Procedures**

The Partnership Project Agreement (1)

The Partnership Project Agreement is a concise legal document signed by participating Partners (or their sponsor).

It contains the minimum legal text necessary for 3GPP to function correctly.

The Partnership Project Agreement refers to the Partnership Project Description and the Partnership Project Working Procedures.

The Partnership Project Agreement (2)

The Partnership Project Agreement includes obligations on Organizational Partners to commit themselves to the 3GPP scope:

- **to encourage their members to contribute to the common set of Technical Specifications and to avoid duplication of work**
- **to convert / transpose / adopt all relevant Technical Specifications resulting from 3GPP into their own relevant deliverables through their normal processes**
- **to identify as early as possible, any national / regional regulatory requirements that may lead to options within the Technical Specifications**
- **to make their IPR Policy available for consideration**

The Partnership Project Agreement (3)

The Partnership Project Agreement includes obligations on Market Representation Partners to identify market and service requirement of 3GPP and to contribute to:

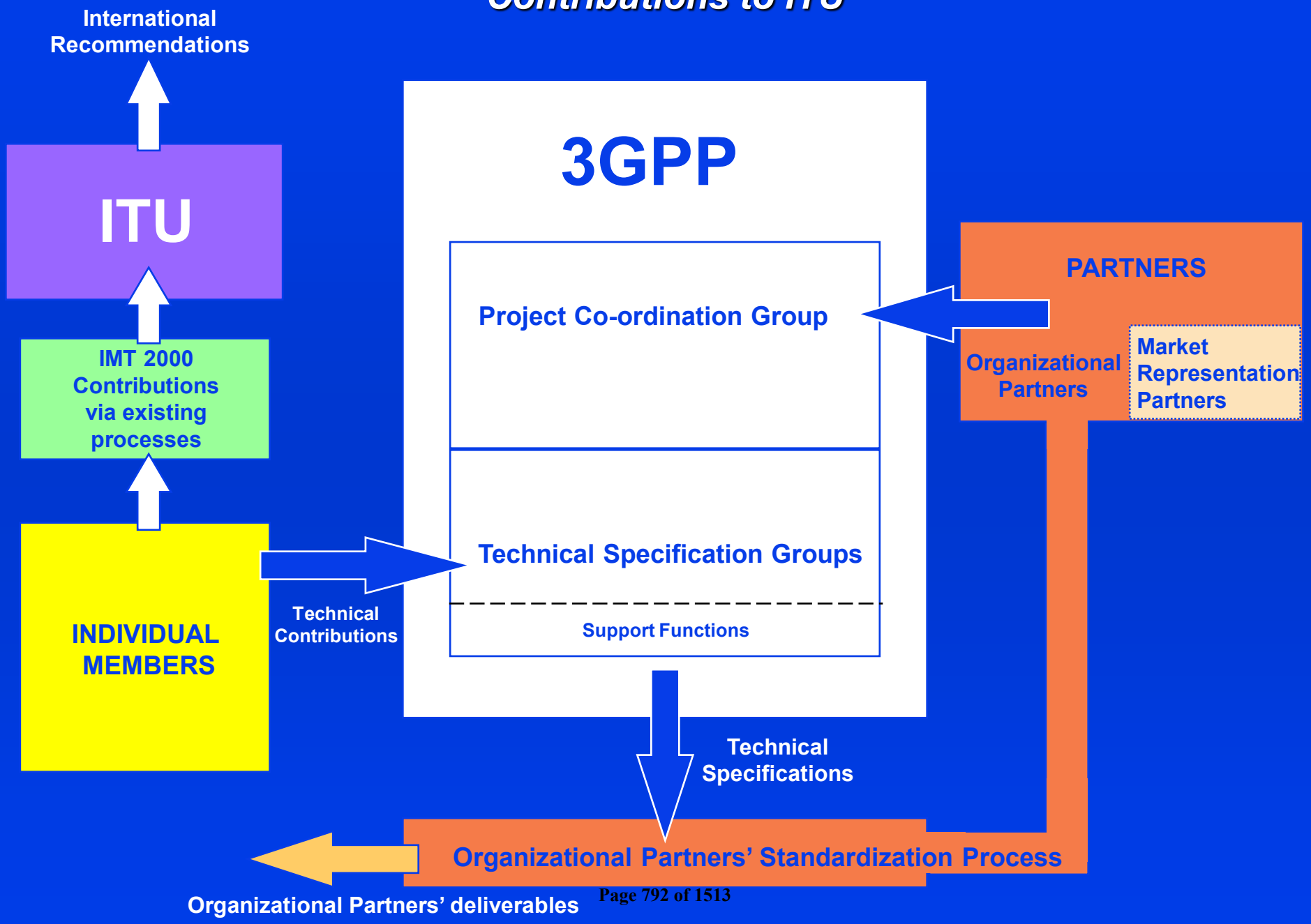
- **the promotion of 3GPP**
- **the definition of 3GPP System and Service scenarios**

The Market Representation Partners should also encourage their members to contribute to the common objectives of 3GPP and to avoid duplication of work.

Ownership of the Partnership Project results

The Organizational Partners of 3GPP will have joint ownership (including copyright) of the Technical Specifications.

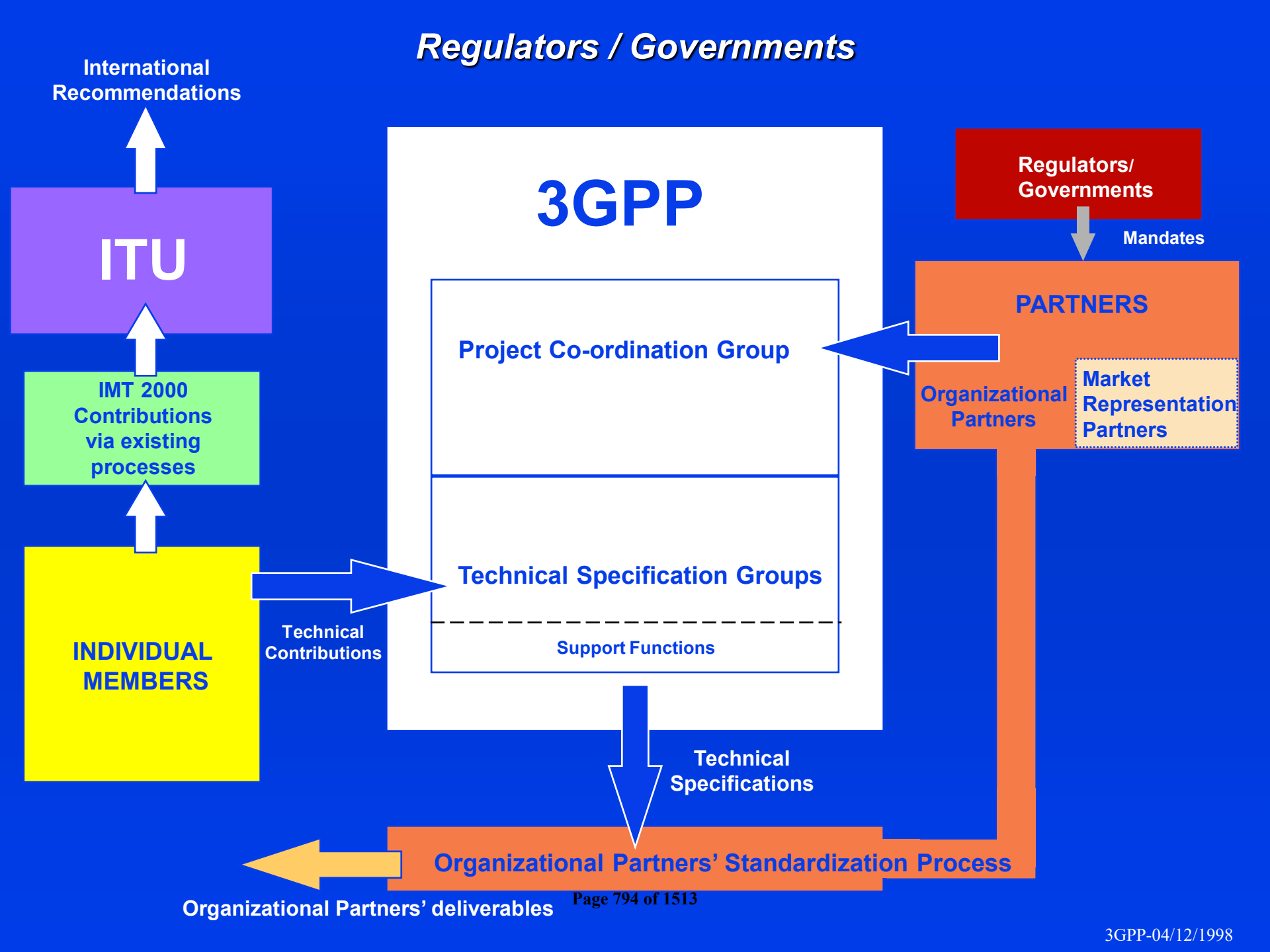
Contributions to ITU



Submission of 3GPP results to ITU

3GPP will not contribute directly to the ITU.

Formal contributions to ITU Study Groups are made by ITU members following existing national/regional processes.


Regulators / Governments
International Recommendations
ITU
IMT 2000 Contributions via existing processes
INDIVIDUAL MEMBERS
Technical Contributions
3GPP
Project Co-ordination Group
Technical Specification Groups
Support Functions
Technical Specifications
Organizational Partners' Standardization Process
Organizational Partners' deliverables
Regulators/ Governments
Mandates
PARTNERS
Organizational Partners
Market Representation Partners

National / regional regulatory requirements

Variations imposed by national / regional regulatory requirements will be included in the Technical Specifications as defined by the Technical Specification Groups.

Resource requirements for establishing 3GPP

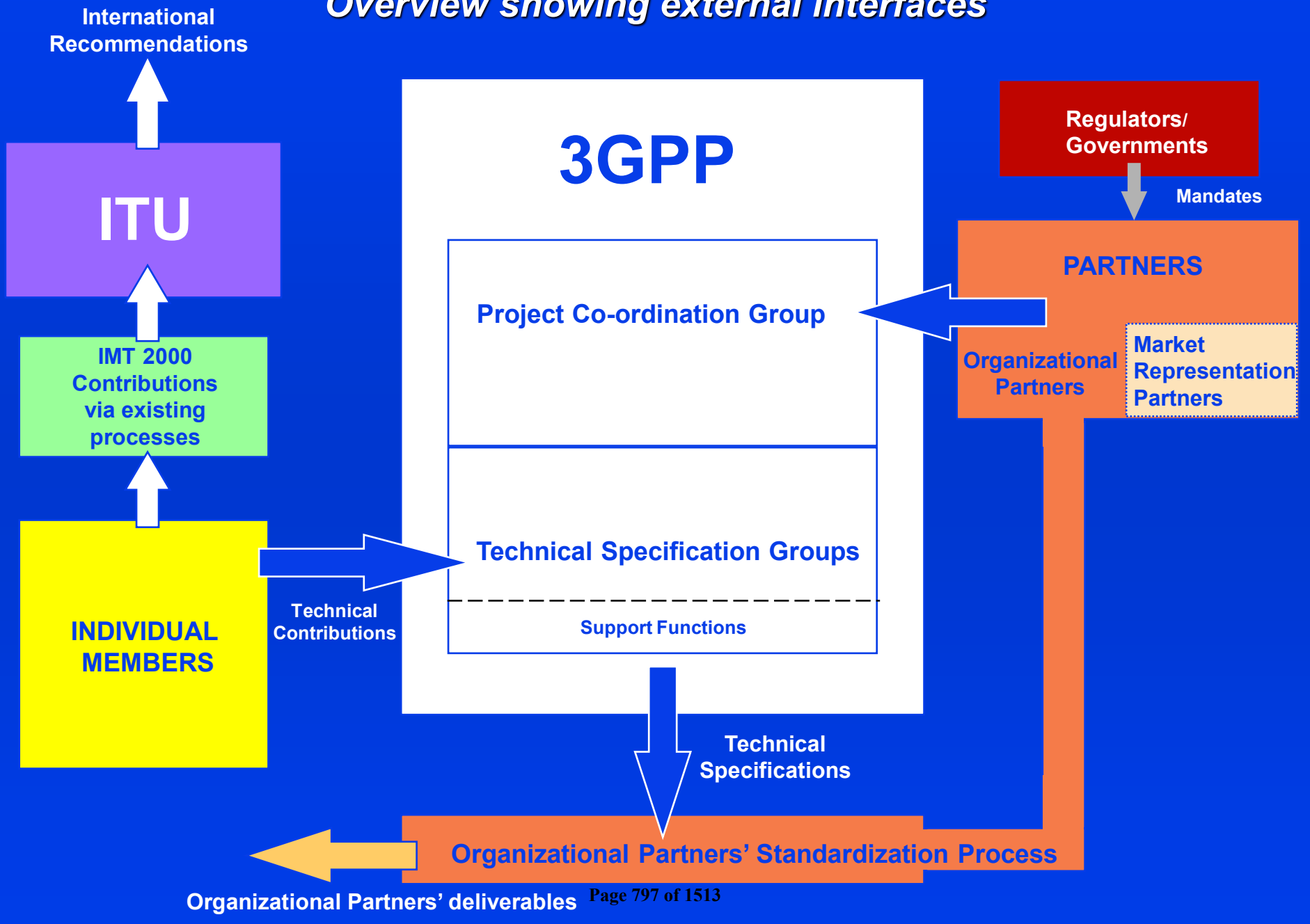
ETSI will absorb the initial cost of establishing the 3GPP, if required.

Thereafter, the costs will be shared by the Organizational Partners. There will be no direct 3GPP membership fee for Individual Members.

Partners and Individual Members may provide support functions to the extent that they are able (eg hosting of meetings and provision of Secretariat support).

The longer term financial requirements are for further study.

Overview showing external interfaces

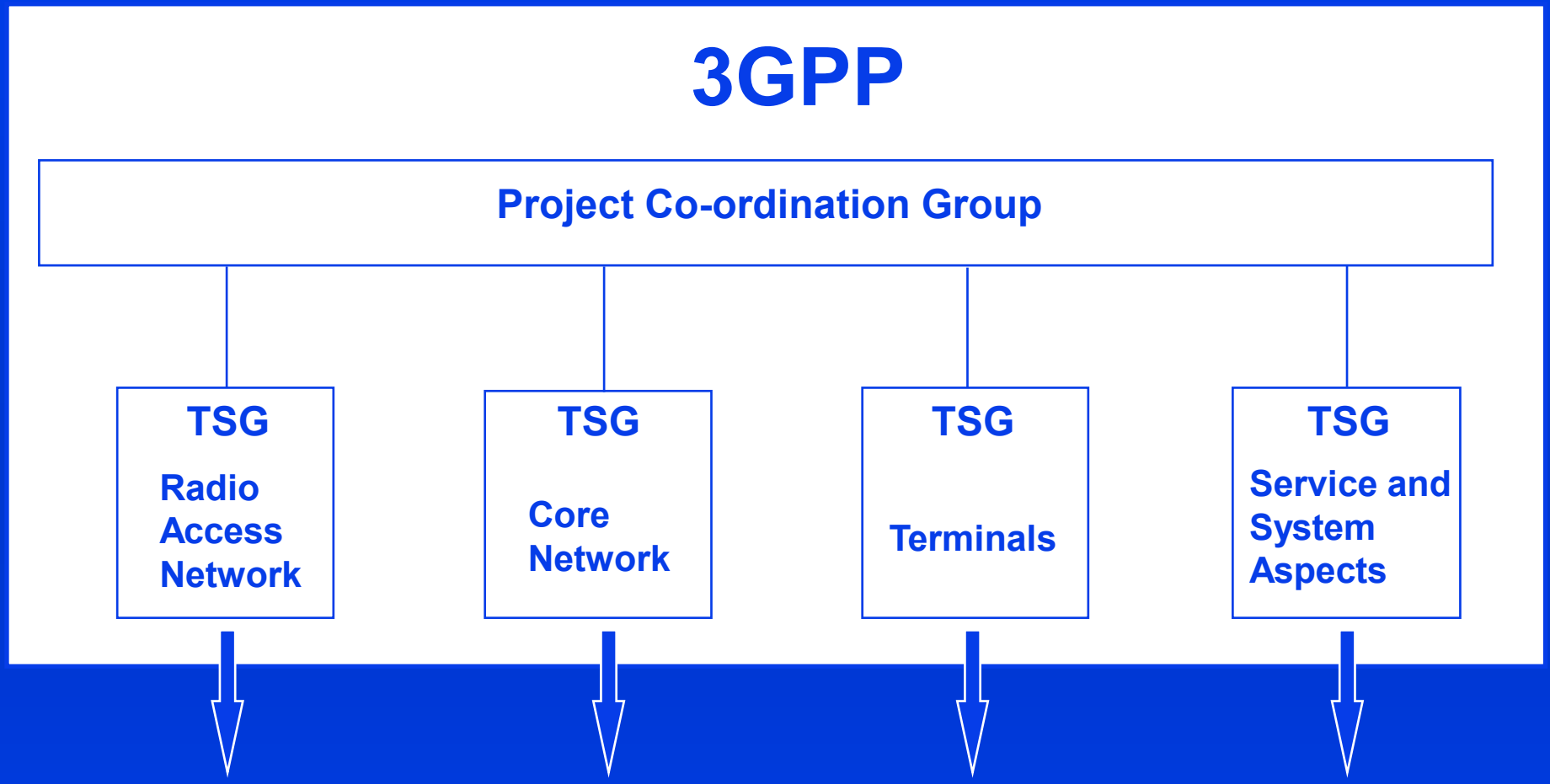


Internal structure of 3GPP (1)

3GPP consists of a Project Co-ordination Group (PCG) and Technical Specification Groups (TSGs).

To assist in the co-ordination of the technical activities, the TSGs are encouraged to meet at the same time and place, as and when appropriate (e.g. twice per year).

Internal structure of 3GPP (2)



Work areas to be covered by the Radio Access Network TSG

- Radio Layer 1 specification
- Radio Layer 2 specification
- Radio Layer 3 RR specification
- Iub specification
- Iur Interface
- Iu Interface
- UTRAN O&M requirements
- Base station radio performance specification
- Conformance test specification for testing of radio aspects of base stations
- Specifications for radio performance aspects from the system point of view

Work areas to be covered by the Core Network TSG

- **Mobility management, call connection control signalling between the user equipment and the core network**
- **Core network signalling between the core network nodes. the signalling supports functionality such as user location information, subscription information and control of network services**
- **Definition of interworking functions between the core network and external networks**
- **Packet related questions such as mapping of QoS (e.g. transparency for IP domain applications, general for bearer types, special for optimized applications such as Voice over IP)**
- **Core network aspects of the Iu interface**
- **Core network O&M requiremnents**

Work areas to be covered by the Terminal TSG

- **Service capability protocols**
- **Messaging**
- **Services end-to-end interworking**
- **USIM to Mobile Terminal interface**
- **Model/framework for terminal interfaces and services (application) execution**
- **Conformance test specifications of terminals, including radio aspects**

Work areas to be covered by the Service and System Aspects TSG

- **Service capabilities**
  - **Definition of services and feature requirements**
  - **Development of service capabilities and a service architecture for cellular, fixed (and cordless) applications**

- **Stage one and two descriptions for:**
  - **Charging and accounting**
  - **Network Management**
  - **Security Aspects**

- **Architecture**
  - **Definition, evolution, and maintenance of overall architecture, including assignment of functions to particular sub-systems and identification of key information flows**
  - **In co-operation with other TSGs, define required services, service capabilities and bearer capabilities offered by the different sub-systems**

- **Codec aspects**
  - **Principles for definition of end-to-end transmission**
  - **Definition, evolution and maintenance of relevant specifications**

- **Project co-ordination**
  - **High level co-ordination of the work performed in other TSGs and monitoring of progress**

Primary responsibilities of PCG and TSGs (1)

The primary responsibilities of PCG, TSGs and Organizational Partners are given in the following tables:

	Function	Org Partners collectively	PCG	TSGs
1	Approval of new Partners for 3GPP	X		
2	Approval of Organizational Partner funding requirements and contributions	X		
3	Allocation of human and financial resources provided by Partners to PCG	X		
4	Allocation of resources to TSGs		X	
5	Allocation of resources within TSGs			X

Primary responsibilities of PCG and TSGs (2)

	Function	Org Partners collectively	PCG	TSGs
6	Allocation of voluntary human and financial resources by Market Representation Partners and Individual Members		X	X
7	Handling of appeals from Individual Members on procedural matters	2nd step	1st step	
8	Handling of appeals from Individual Members on technical matters		2nd step	1st step
9	Determine overall time frame and manage overall work progress		X	

Primary responsibilities of PCG and TSGs (3)

	Function	Org Partner collectively	PCG	TSGs
10	Detailed time frame and manage detailed work progress			X
11	Approval of Technical Specifications			X
12	Proposal and approval of work items within the agreed scope and terms of reference			X
13	Final adoption of work items within the agreed scope and terms of reference		X	
14	Management of work items			X

Primary responsibilities of PCG and TSGs (4)

	Function	Org Partners collectively	PCG	TSGs
15	Technical Co-ordination (System Aspects TSG will play a role here)			X
16	Appointment of Org Partners meeting Chairman (provided by host on a rotational basis)	X		
17	Appointment of PCG Chairman (for one year term)		X	
18	Election of TSG Chairman and Vice Chairmen			X
19	Creation of TSGs and approval of their terms of reference	X		

Primary responsibilities of PCG and TSGs (5)

	Function	Org Partners collectively	PCG	TSGs
20	Creation of TSG working groups and approval of their terms of reference			X
21	Election of TSG Working Group Chairmen and Vice Chairmen			X
22	Confirmation of individual member participation rights	X		
23	Approval of 3GPP scope and terms of reference	X		
24	Maintain Partnership Project Agreement, Project Description and Working Procedures (consensus agreement by all Partners)	X		

Participation rights in PCG and TSGs

The following have a right to participate in the PCG:

- **Representatives of participating Organizational Partners**
- **Representatives of participating Market Representation Partners**
- **Chairman and Vice Chairmen of the TSGs, as ex-officio members**

The following have a right to participate in the TSGs :

- **Representatives of members of participating Organizational Partners (i.e. Individual Members)**
- **Representatives of participating Organizational and Market Representation Partners**

Principles for decision making within 3GPP

Decision making within PCGs

- **By consensus amongst the Organizational Partners**
- **By vote amongst the Organizational Partners in unavoidable cases**

Decision making within TSGs

- **By consensus amongst the Individual Members**
- **By vote amongst the Individual Members in unavoidable cases**

The Organizational Partners will conduct a fairness review of the decision making process six months after 3GPP start-up, taking into account all concerns raised

(Note: voting will not be permitted on National/Regional regulatory requirements)

Principles for voting within TSGs

The following principles will be applied for voting within the TSGs

- **One "Individual company Member", one vote**
- **Organizational Partners to interpret " Individual company Member" according to its own rules of membership**
- **The PCG will maintain a register of eligible voters for the TSGs**
- **Each Individual Member may carry the proxy for up to five other Individual Members**

Working language for 3GPP

The working language for 3GPP shall be English

- **Meetings of the PCG and TSGs shall be conducted in English**
- **3GPP Technical Specifications shall be prepared in English**

Relationship with other groups

3GPP will establish and maintain good relationships with groups working on standards for other IMT-2000 family members.

Intellectual Property Rights (IPR) Principles (1)

The Individual Members of 3GPP are bound by the IPR Policies of their respective Organizational Partner.

Individual Members are encouraged to declare at the earliest opportunity, any IPRs which they may have and believe to be essential, or potentially essential, to any work ongoing within 3GPP.

After comparing their respective IPR policies, ARIB, ETSI, T1, TTA and TTC have agreed that their IPR policies share common principles are quite similar and have agreed on the following additional principles to maximize the success of 3GPP.

Intellectual Property Rights (IPR) Principles (2)

(i) **To encourage their respective members' declaration of willingness to grant licences on fair, reasonable terms and conditions on a non-discriminatory basis, and consistent with the respective Organizational Partners' IPR policies.**

(ii) **To encourage their respective members who may have IPR which they believe to be essential, or potentially essential, and are unwilling to license such IPR, that early indication of such unwillingness be provided to their respective Organizational Partners.**

(iii) **To understand that essential IPRs mean essential IPRs relative to any or all parts of the content of the 3GPP technical specifications.**

(iv) **A mechanism for exchanging information associated with the patent statement among the Organizational Partners will be introduced so that such information may be used when adopting relevant standards in each Partner Organization.**

Appendix 3

Introducing 3GPP



The 3rd Generation Partnership Project (3GPP) unites seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC), known as “Organizational Partners” providing their members with a stable environment to produce the Reports and Specifications that define 3GPP technologies.

3GPP specifications cover cellular telecommunications technologies, including radio access, core network and service capabilities, which provide a complete system description for mobile telecommunications. The 3GPP specifications also provide hooks for non-radio access to the core network, and for interworking with non-3GPP networks

The Project’s Scope

The original scope of 3GPP (1998) was to produce Technical Specifications and Technical Reports for a 3G Mobile System based on evolved GSM core networks and the radio access technologies that they support (i.e., Universal Terrestrial Radio Access (UTRA) both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes).

The scope was subsequently amended to include the maintenance and development of the Technical Specifications and Technical Reports for evolved 3GPP technologies, beyond 3G.

- The latest 3rd Generation Partnership Project Agreement (Annex 42).
- The discussions that led to the signing of the 3GPP Project Agreement were recorded in a series of slides called the “Partnership Project Description” that describes the basic principles and ideas on which the project is based. The document has not been maintained since its first creation, but the principles within do still remain valid.

Organizing the work

The 3GPP Working Procedures are the rule book of 3GPP, with sections covering:

- Description, Purpose, Scope and objectives
- Participation
- Structure
- Partners' collective responsibilities
- Project Coordination Group (PCG)
- Technical Specification Groups (Incl. Elections)
- Work Programme & technical co-ordination
- Deliverables (Technical Specifications and Technical Reports)
- Reporting

The 3GPP production of specifications and studies (TRs) are contribution-driven, by member companies, in Working Groups and at the Technical Specification Group (TSG) level. The Technical Specification Groups in 3GPP are:

- Radio Access Networks (RAN)
- Services & Systems Aspects (SA)
- Core Network & Terminals (CT)

The Working Groups, within the TSGs, meet regularly and come together for their quarterly TSG Plenary meeting, where their work is presented for information, discussion and approval. The last meeting of the week of TSG Plenary meetings is TSG SA, which also has responsibility for the overall coordination of the technical work and for the monitoring of its progress.

Generational Approach

The 3GPP technologies from these groups are constantly evolving through Generations of commercial cellular / mobile systems (see table below). With LTE and 5G work, 3GPP has become the focal point for the vast majority of mobile systems beyond 3G.

Although these Generations have become an adequate descriptor for the type of network under discussion, real progress on 3GPP standards is measured by the milestones achieved in particular Releases. New features

are 'functionality frozen' and are ready for implementation when a Release is completed. 3GPP works on a number of Releases in parallel, starting future work well in advance of the completion of the current Release. Although this adds some complexity to the work of the groups, such a way of working ensures that progress is continuous & stable.

Backward Compatibility

The major focus for all 3GPP Releases is to make the system backwards and forwards compatible where possible, to ensure that the operation of user equipment is uninterrupted.

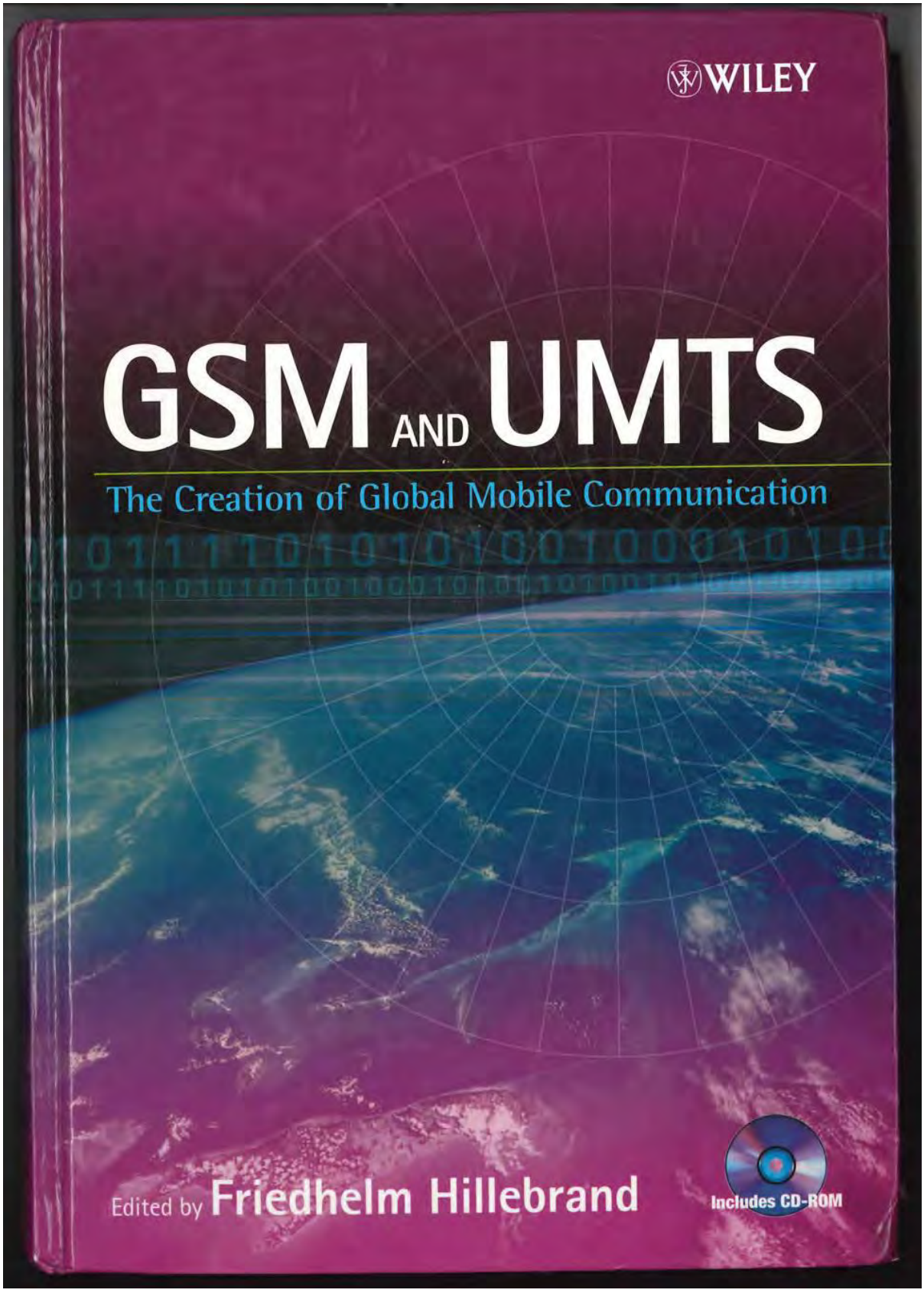
For 5G, many operators are starting with dual connectivity between LTE and 5G NR equipment – using the 'Non-Standalone' work completed early in Release 15. In the process of completing the early drop of 5G NR care has been taken to build 'forward compatibility' into Non-Standalone NR equipment, to ensure that it will be fit for use on Standalone 5G NR systems.

For details of the contents of each Release, see the appropriate 'Release Description' document or go to our dedicated Release page.

Details of all 3GPP Work Items are in the 3GPP Work Plan, which provides details of the cooperation between all of the 3GPP groups on "Features", defined as 'new or substantially enhanced functionality which represents added value to the existing 3GPP system'.

Previous Next

Appendix 4


WILEY
GSM AND UMTS
The Creation of Global Mobile Communication
Edited by Friedhelm Hillebrand
Includes CD-ROM

GSM and UMTS

The Creation of Global Mobile Communication

Edited by

Friedhelm Hillebrand
Consulting Engineer, Germany

With contributions from 37 key players involved in the work for GSM and UMTS



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Chapter 9: The Third Generation Partnership Project (3GPP)

Section 1: The Creation of 3GPP

Karl Heinz Rosenbrock[1]

Having read the title, it should not surprise you that this section deals with the creation of the Partnership Project for the standardisation of a Third Generation Mobile Communications System (3GPP).

Why, you may ask, in a history book about the GSM and UMTS development, do I want to talk about the establishment of a partnership project? Isn't it the most natural thing to do? This is, of course, a stance an insider can take today – after nearly 30 months of 3GPP's creation and the smooth and successful running of this project.

As this section will eventually show, it took quite some time, filled with tough and even passionate discussions, before the goal was achieved. Approaching this idea from a rather philosophical point of view, one should not be too surprised about the big efforts needed, because already the old Greek ancestors knew that "prior to being successful the Gods will demand some sweat"...[2]

This section starts with some general considerations leading the European Telecommunications Standards Institute (ETSI) membership towards a global approach in standardisation and then deals with the establishment of an ad hoc group of the ETSI Board (UGG = UMTS Globalisation Group) to address the matter of global standardisation in this context and the related meetings and discussions. Afterwards, the 3GPP will be described in a rather general manner, highlighting how it works, who the stakeholders are and dealing with the results achieved so far. The section is rounded up with the relationship towards the International Telecommunication Union (ITU) and other initiatives as well as a few concluding remarks.

9.1.1 First Approaches to Globalisation

The re-engineering process ETSI, the "Excellent" Telecommunications Standards Institute in Europe, undertook in the years 1995/1996 – only 7 years after its creation – resulted in among others a kind of mission statement for the Institute: "Making international standards happen first in Europe".

[1] The views expressed in this section are those of the author and do not necessarily reflect the views of his affiliation company.

[2] One of my cruel translations of a German idiom "Vor den Erfolg haben die Götter den Schweiß gesetzt"...

- unanimously requested the ETSI Board (through its UMTS Globalisation Group) to complete the negotiations with potential partners and to oversee the creation of the Partnership Project;
- unanimously requested the ETSI Board to agree and maintain on behalf of ETSI the final versions of the Partnership Project Description, the Partnership Project Working Procedures, and the Partnership Project Agreement;
- unanimously authorised the director-general to sign the Partnership Project Agreement.

9.1.2.4.14 Happy End in Copenhagen

It was in Copenhagen where the last 3GPP preparatory meeting with all six OPs took place on 2–4 December 1998.

Here, the final fine-tuning of the 3GPP documentation was achieved. In addition, the 3GPP agreement[8] was signed (in a nice framework provided by the host, TeleDenmark) by the following OPs: ARIB, ETSI, T1, TTA, and TTC.

Unfortunately, the partners from CWTS (China) were not authorised to sign the 3GPP agreement yet. Furthermore, owing to the fact that the UMTS Forum was unable to participate in Copenhagen, they were prevented from co-signing the 3GPP agreement as a first Market Representative Partner (MRP).

During that Copenhagen meeting, another discussion ensued about the role the MRPs should play. Finally, it was concluded that the high competence of MRPs should be used in order to identify market requirements, thus enabling 3GPP standardisation to meet the needs of the market. An MRP is an organisation invited by the OPs to participate in 3GPP with the objective of offering market advice to 3GPP and to bring into 3GPP a consensus view of market requirements.

9.1.3 What is 3GPP?

The 3GPP is a global standardisation initiative created in December 1998. Its task was to develop a complete set of globally applicable Technical Specifications for a third generation (3G) mobile telecommunications system based on the evolved GSM core network and an innovative radio interface known as UTRA. The Project is based on a concept devised by ETSI aimed at facilitating better co-operation between regional standards organisations, fora and other industry groupings. 3GPP is a collaborative activity between officially recognised SDOs, with the participation of other industry groups and individual members.

Partnership in 3GPP is open to all national, regional or other SDOs, irrespective of their geographical location – within the project the participating SDOs are referred to as OPs. The OPs may invite MRPs to participate: these may be any organisation from anywhere in the world that can offer market advice to 3GPP and bring a consensus view of market requirements that fall within the project's scope. Individual membership is open to companies and organisations within the communications industry that are active members of one of the OPs. The truly global nature and the breadth of the market interest in the task of specifying this 3G system is evident from the identity of the 3GPP partners (see further in sub-paragraph 9.1.3.2) and all agree that 3GPP is proving a highly successful initiative.

[8] The 3GPP Agreement and the 3GPP Project Description can be found on the attached CD-ROM in [illegible]

The 3GPP has no legal status. Ownership (including copyright) of the specifications and reports it produces is shared between the partners. The 3GPP process includes a conversion (transposition) of the project's output into official standards and reports by one or more of the OPs.

The specifications being prepared by 3GPP are evolved in part from the enormously successful GSM standard, which is currently (February 2001) serving over 400 million subscribers in more than 140 countries. Building on this massive installed base, the system being specified by 3GPP will be an attractive upgrade path for existing operators and users. It also has an assured compatibility with GSM – good news for both operators and users who are unable, or unwilling, to upgrade to 3G.

Paramount among the 3GPP specifications is the definition of UTRA, the innovative radio access technology that is the key to the new system's high data rates and dramatically improved performance. UTRA is spectrum-efficient and supports FDD and TDD modes. This interface has been accepted by ITU as a member of the IMT-2000 family – or more correctly, as *two* family members: IMT-DS, the FDD mode; and IMT-TC, the TDD mode. IMT-2000 family membership requires the ability for users to roam globally and seamlessly, which implies interoperability with other family members: 3GPP thus co-operates closely with the 3GPP2 project which is specifying another family member, a 3G CDMA system based on an evolution of the ANSI-41 architecture.

9.1.3.1 How Does 3GPP Work?

3GPP has been designed to minimise delays and inefficiencies. As a result, it has a "flat" organisational structure and a large degree of distributed autonomy. Overall project planning and co-ordination is the responsibility of the PCG, with input primarily from the OPs, guided by the MRPs. It is mainly at this level that regulatory requirements, provided by the telecommunications administrations and governments around the world, are taken into account.

The development of the specifications is performed by TSGs and their subordinate working groups. Here, the main participation is by technical experts from the individual members of the OPs. Individual members in their capacity as ITU members are also responsible for carrying the results of the 3GPP work to the ITU.

At the time of the creation, 3GPP had structured around four principal aspects of the 3G system being defined as TSGs:

- TSG CN: core network
- TSG RAN: radio access network
- TSG SA: services and systems aspects
- TSG T: terminals

Each TSG is authorised to develop and approve specifications and reports within its scope, and TSG SA also has a role of co-ordinating the work of the TSGs at a more detailed level than the PCG. The result is a process that is able to rapidly produce and approve specifications and reports in response to the needs of the market, although it is important to note that the deliverables do not have a formal status until they have been transposed by one or more of the OPs.

The formal status is necessary for regulatory and other purposes in the various regions, and all the OPs have committed themselves to complete this process rapidly. Each OP will apply

its own procedures, appropriate to their respective regions. As the official European SDO within 3GPP, ETSI recognises the 3GPP output as ETSI Technical Specifications and ETSI Technical Reports without a need for any further endorsement within the Institute. This means that the 3GPP documents are published – within a matter of a few weeks – as identical text directly as ETSI deliverables. In addition, ETSI is transposing, i.e. adapting, a few of the initial 3GPP specifications into ENs for specific European regulatory requirements. This is happening in parallel with the publication of the initial Technical Specifications and will not impede the implementation of 3G in Europe.

9.1.3.1.1 Electronic Working

3GPP has taken a leading role in changing the traditional ways of standards making. A very heavy dependence is now placed on electronic working, both outside and within meetings, advancing a trend that started in ETSI a year or two ago. This means that paper copies of draft documents have been almost entirely eliminated, saving time and expense, and making a significant contribution to the environment.

Given that 3GPP has participants from all over the world, the use of the Internet, e-mail exploders and other such facilities have proved invaluable for distributing and sharing information, working drafts and so on. Delegates to meetings had already become used to downloading working documents from the Internet and having updates to the documents distributed in meetings on CD-ROM. But in recent months, in meetings around the world participants have experienced the benefits of a local area network (LAN) solution as the latest step in improving working methods. ETSI's headquarters premises already have LANs in all its meeting rooms, but most other venues currently rely on temporary LANs (wired or radio), using equipment and support kindly donated by individual members.

Such facilities permit delegates to access all the meeting documents electronically from their laptop computers. As a result, the huge burden of producing paper copies (as many as 10 000 pages per delegate for some meetings) can be eliminated. Delegates can access new documents as soon as they are available, rather than having to wait for paper copies to be made or for the documents to be distributed by other means, such as diskette or CD-ROM.

9.1.3.1.2 Project Support

For administrative and support purposes the 3GPP Partners have established a Mobile Competence Centre (MCC) which is hosted by ETSI at its premises in Sophia Antipolis, Southern France. The MCC was created in March 1999 to provide support not only to the 3GPP but also to ETSI's own studies in mobile technologies. A full description of MCC including the financing is given in Chapter 15, Section 3.

9.1.3.2 Who are the Stakeholders in 3GPP?

3GPP has attracted a very strong commitment from organisations and companies around the world, reflecting the truly global nature of the project. There are currently six OPs (in alphabetical order):

- The Association of Radio Industries and Businesses (ARIB), Japan

being TD-SCDMA, proposed by CWTS. A similar group, 3GPP2, is preparing the cdma2000 specifications, UWC-136 TDMA specifications are being developed principally by UWCC, and DECT specifications are defined by a set of ETSI standards (Figure 9.1.1).

Since the UWCC and ETSI are both partners in 3GPP (as an MRP and OP respectively), there is direct liaison between the Project and these two sources of specifications for other IMT-2000 family members.

When 3GPP and 3GPP2 were created it was felt that the interests of each group were sufficiently different to require them to remain separate but here again many of the OPs and MRPs are common to both groups, so there are natural channels for information exchange. Particular instances of formal co-operation between the groups were the two joint 3GPP-3GPP2 workshops held in 1999 to address the "Hooks and Extensions" issue aimed at ensuring interworking between the respective technologies.

In addition to all this, the 3GPP TSGs and their working groups are encouraged to liase directly with relevant technical bodies within the Project as well as among the Partners.

9.1.6 Conclusions

The attentive reader, and let's assume that you are one, may still be astonished to learn what big efforts have been necessary in order to establish 3GPP.

In the meantime, i.e. in the course of year 2000 nearly the whole work of the former ETSI TC SMG has been incorporated into 3GPP, to a large extent within the new TSG GERAN.

Well, our Japanese friends were not happy about this shift because they feared that it could result in delays in the 3G introduction in their country. They accepted this because a separate TSG for the GSM work was created.

Trying to recall the heated discussions within ETSI about the scope of 3GPP from 1998, one has to admit that such a move would have been violently rejected by a lot of ETSI members, maybe even by the majority. Using a philosophic approach, one can, of course, state that time helps healing (even wounds).

Today, i.e. February 2001, we can conclude from ETSI's point of view that all standardisation work related to further evolution of the second generation mobile system, i.e. GSM, and to UMTS is being done well within 3GPP. Thus, the objective to avoid parallel work within ETSI TBs and 3GPP has been fully achieved.

The ability of organisations and individuals around the world to co-operate and make available a full set of stable, agreed 3GPP specifications in 1 year is a remarkable achievement, one that is unprecedented in the world of standardisation. 3GPP meetings have taken place in many parts of the world, emphasising the strong commitment of the SDOs from China, Europe, Japan, Korea and the US. The MRPs have also lent very strong support to the work. Thanks to this widespread and determined commitment it has been possible to meet the very aggressive targets for 3G.

But Release 99 was only the first step – the workload has continued to intensify this year, as the initial specifications are refined and many new ones added, opening the path to full, seamless, global 3G services, changing forever the way that people communicate.

In the meantime, 3GPP has changed the designation of the releases and dropped to mention the year in order to avoid irritations and wrong expectations. Release 99 was first established in December 1999 and got its maturity in the course of year 2000. In 2000, more than 5700 change requests were implemented. The next big event will be Release #4 as a result of the

series of TSG meetings scheduled for March 2001 in Palm Springs, US. This will obviously result in a further stabilisation and extension of the UMTS specifications.

3GPP is running very well. The individual members from the six OPs seem to be very satisfied with this arrangement – and the production line is in full swing.

Without exaggeration, one can give 3GPP the attribute of a success story. One may quote again here Mr Ed Roney who even addressed the 3GPP concept – prior to its realisation – as a "paradigm shift".

As the results of the GSM and UMTS related standardisation work represent a great part of ETSI's deliverables, it might be justified to note here that during the year 2000, ETSI published more than seven new deliverables each working day (Monday through Friday), i.e. one deliverable per hour!

Further information may be found on the 3GPP website at http://www.3gpp.org.

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Chapter 9: The Third Generation Partnership Project (3GPP)

Section 2: UMTS in 3GPP (December 1998–May 2001)

Niels Peter Skov Andersen[1]

9.2.1 A Change of Environment

In the period 1982 until end of 1998 the work on the GSM standard, and in the later part of the period on UMTS, had been performed in the same environment, starting under CEPT and later transferred into ETSI. The Technical Committee GSM, during this period renamed to SMG, and its working groups (Sub Technical Committees) had continuously existed and evolved. The same was the case for the working methods and procedures used within the work. Over time with the success of the GSM system more and more interested parties became involved in the work including parties from outside the original CEPT area. However, this was all a relatively slow evolution and no major revolutions in the organisation or the working methods occurred in this period.

After all these years of continuity in the work the discussions around the creation of 3GPP and the decision to establish 3GPP for the initial phase of UMTS[2] naturally created some uncertainty amongst the members of SMG. Especially the resulting split of the GSM standardisation, with the responsibility for the GSM core network transferred to 3GPP, but the responsibility for the GSM radio access Network maintenance remained in ETSI in SMG. This caused some concern amongst many delegates. Also the internal structure for the technical work within 3GPP was different from the well-known structure in SMG. SMG was based on a technical plenary with a number of working groups (SMG1, SMG2, ..., SMG12) performing the detailed technical work. The SMG plenary was the approving authority for the results of the work performed by the working groups. Also the plenary was the group responsible for approval of all new work items and the content of the releases. The structure for the work in 3GPP, as agreed by the partners, was quite different. The project

[1] The views expressed in this section are those of the author and do not necessarily reflect the views of his affiliation [illegible].

[2] The term UMTS is throughout this section used to keep consistency of terminology with the other chapters and sections. The term UMTS do not appear in the in 3GPP agreement, which defines the system as a third generation mobile system based on an evolved GSM core network and UTRAN (including UTRAN (FDD and TDD modes)).

was organised with four equal Technical Specification Groups (TSGs), who had complete autonomy for their area of responsibility, i.e. they were responsible for approval of new work items and final approval of deliverables. The four technical groups originally defined were:

TSG CN	Responsible for the core network development
TSG-RAN	Responsible for the radio access network based on UTRAN (FDD and TDD modes)
TSG-SA	Responsible for services and system aspects
TST-T	Responsible for Terminal and UIM

In addition to the technical groups the 3GPP organisation has a Project Coordination Group (PCG). However, the role of this PCG cannot be compared to the role the SMG plenary played. The SMG plenary was an open technical group with the approving authority in all technical questions including approval of new work items. The 3GPP PCG is a closed group with a defined membership consisting of a limited number representative of each of the partners (SDOs, MRPs) and the leadership (chairman and two vice-chairmen) of each TSG. Thus as a closed group the role of the PCG becomes more like a board overlooking the overall well being of the project.

This structure made many long-term SMG delegates concerned about how the overall coordination of the project could be ensured. This new structure was not introduced to overcome known deficits of the SMG organisation, but in my opinion, by political considerations to ensure than no single individual, individual member, organisational partner could obtain a controlling position in the project.

9.2.2 The First Two TSG Meetings

The inauguration meeting of the 3GPP TSGs was held in December 1998 in Sophia Antipolis, France. In the process of creation of 3GPP this was the first time that the 3GPPs real work force – the technical experts – met. The main objectives for this first meeting was to get the work started. One of the elements of the meeting was a presentation from the different partners on the status of their work on the third generation mobile system, the work which they now were in the process of handing over to 3GPP.

Listening to the presentations and the discussions during the breaks it was very obvious that the background for standardization amongst the delegates was quite different. As an example, I remember that during the coffee break just after I, as chairman of ETSI SMG2, had presented the status of the UMTS radio work in ETSI, and had ended my presentation by stating that the UMTS radio work would only be on the agenda of one more meeting of ETSI SMG2. This was in order to complete the documentation to be handed over to 3GPP and then the work on UMTS radio in ETSI would cease, a small group of non-ETSI delegates came to me and asked "if all work on UMTS radio in ETSI ceases, how do the Europeans then coordinate their views on 3GPP?" Coming from the ETSI SMG background this was a completely unexpected question, as the working procedures for 3GPP were very similar to those of ETSI, it was clear to me that the contributions to 3GPP in general should come from the individual members – the companies, regulators etc. – in their own name and not as regional contributions. I explained this, but I also understood that for delegates with a background in international standardization from, e.g. ITU this was the normal way of thinking. During the

Annex 2: Organisation Evolution of the Technical Groups

Section 3: 3GPP

Adrian Scrase[1]

A2.3.1 December 1998 to Mid-1999

During the preparatory talks that led to the creation of 3GPP, many discussions took place to find the optimum organizational structure. The ETSI TC SMG model had worked well for many years and it was very tempting to adopt a similar structure and just widen the sphere of participation. However, some voices called for a more radical approach in order to streamline the structure and to reduce the time taken for specifications production. As a result of these discussions, the following key principles were established on which 3GPP was structured:

- Minimum number of hierarchical levels;
- Large degree of distributed autonomy;
- Clear separation of technical activities from political and administrative activities.

When 3GPP was created, four Technical Specification Groups (TSGs) were formed to undertake the preparation of technical specifications. The four TSGs were as follows:

- TSG CN – core network
- TSG RAN – radio access network
- TSG SA – services and system aspects
- TSG T – terminals

Each of the TSGs was authorized to develop and approve specifications and reports within its terms of reference. This represented a departure from the more traditional approach where a single entity (i.e. a plenary) within a project has the authority to approve a project's output. It was believed that by distributing the approval authority, the time taken to produce specifications would be reduced since this effectively removes one level of hierarchy from the approval procedure. However, it was apparent from the outset that distributing the approval of specifications would lead to a greater requirement for technical co-ordination and thus TSG SA was tasked to perform a co-ordination role across all TSGs. This co-ordination role

[1] The views expressed in this section are those of the author and do not necessarily reflect the views of his affiliation entity.

Appendix 5



Third Generation Partnership Project

3GPP

Working Procedures

01 September 2022

Foreword

These Working Procedures of the Third Generation Partnership Project (3GPP) are effective from 01 September 2022.

An electronic version of these Partnership Project Working Procedures is available from the following address:

http://www.3gpp.org

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SECTION A: GENERAL

Article 1: Description

The Partnership Project is not a legal entity but is a collaborative activity between the following recognized Standards Development Organizations:

ARIB (Japan)

CCSA (China)

ETSI (Europe)

ATIS (US)

TTA (Korea)

TTC (Japan)

TSDSI (India)

The Partnership Project is entitled the “THIRD GENERATION PARTNERSHIP PROJECT” and may be known by the acronym “3GPP”.

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Article 2: Purpose

The purpose of 3GPP is to prepare, approve and maintain globally applicable Technical Specifications and Technical Reports for

- a 3rd Generation Mobile System based on the evolved GSM core network, and the Universal Terrestrial Radio Access (UTRA),
- further development of radio technologies such as LTE, coupled with evolution of core network elements such as the Evolved Packet Core (EPC),
- continuing evolution of the 2nd generation GSM/EDGE Radio Access Network (GERAN),

to be transposed by the Organizational Partners into appropriate deliverables (e.g., standards).

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Article 3: Scope and objectives

The 3rd Generation Mobile System and its capabilities shall be developed in a phased approach. Initially, 3GPP shall prepare, approve and maintain the necessary set of Technical Specifications and Technical Reports for a 3rd Generation Mobile System including:

- UTRAN (including UTRA; in Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes);
- 3GPP Core Network (Third Generation networking capabilities evolved from GSM. These capabilities include mobility management, global roaming, and utilisation of relevant Internet Protocols);
- Terminals for access to the above (including specifications for a UIM); and
- System and service aspects.

3GPP shall prepare, approve and maintain the necessary set of Technical Specifications and Technical Reports for:

- the Global System for Mobile communication (GSM) including GSM evolved radio access technologies (e.g., General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE)).

3GPP shall consider the long term evolution.

The Technical Specifications and Technical Reports shall be developed in view of global roaming and circulation of terminals.

The set of 3GPP Technical Specifications and Technical Reports for the 3GPP core network and the specifications for the GSM core network should be common to the greatest extent possible and should not be unnecessarily different.

Options in the form of a regulatory requirement particular to one or more regions / nations shall be included in 3GPP specifications. TSGs should not debate the inclusion or rejection of such options.

The results of the 3GPP work shall form the basis of member contributions to the ITU in accordance with existing procedures.

3GPP shall take account of emerging ITU recommendations on interworking between IMT-2000 family members.

In the framework of agreed relationships, the 3GPP Technical Specifications and Technical Reports will form the basis of standards, or parts of standards, of the Organizational Partners.

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SECTION B: PARTICIPATION

Article 4: Categories

Participation in 3GPP shall be classified into one of the following categories:

- Partners;
- Individual Members;
- ITU Representatives;
- Observers;
- Guests.

top

Article 5: Partnership

Partners in 3GPP shall be classified into one of the following two categories:

- Organizational Partners;
- Market Representation Partners.

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Article 6: Organizational Partnership

Organizational Partnership is open to any Standards Organization, irrespective of its geographical location, which has:

- a national, regional or other officially recognized status and the capability and authority to define, publish and set standards within the 3GPP scope, in that nation or region;
- an Intellectual Property Rights (IPR) Policy which is compatible with those of the Organizational Partners;
- committed itself to all or part of the 3GPP scope;
- signed the Partnership Project Agreement.

Standards Organizations may apply to become an Organizational Partner by writing to any of the existing Organizational Partners.

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Article 7: Market Representation Partnership

The Organizational Partners may invite Market Representation Partners to take part in 3GPP.

An invitation for Market Representation Partnership is open to any organization, irrespective of its geographical location, which:

- has the ability to offer market advice to 3GPP and to bring into 3GPP a consensus view of market requirements (e.g., services, features and functionality) falling within the 3GPP scope;
- does not have the capability and authority to define, publish and set standards within the 3GPP scope, nationally or regionally;
- has committed itself to all or part of the 3GPP scope;
- has signed the Partnership Project Agreement.

Organizations may apply to become Market Representation Partners by writing to any of the existing Partners. Further guidance for MRP applicants can be found in annex E.

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Article 8: Individual Membership

Membership in an Organizational Partner is a pre-requisite for Individual Membership of 3GPP. All entities registered as members of an Organizational Partner and eligible for participation in the technical work of that Organizational Partner, can become Individual Members of 3GPP if they are committed to support 3GPP and:

- to contribute technically or otherwise to one or more of the Technical Specification Groups within the 3GPP scope;
- to use the 3GPP results to the extent feasible.

An Individual Member has the right to participate in the work of 3GPP by attending meetings of the Technical Specification Groups and subtending groups.

Applications for Individual Membership of a Technical Specification Group shall be made in writing to the relevant Organizational Partner using the form given at annex C. Applications may also be made on-line using the template available at http://www.3gpp.org.

Individual Members act in 3GPP in their own right and carry the full responsibility for their contributions.

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Article 9: Termination of Individual Membership

Individual Membership of 3GPP may be terminated by dissolution, abolition, resignation or expulsion from the related Organizational Partner.

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Article 10: Observers and Guests

The status of Observer may be granted by the Organizational Partners to an entity which has the qualifications to become a future Partner.

An Observer may send a single representative to an Organizational Partners or PCG meeting. An Observer may also have representatives at TSG meetings. Representatives of Observers may receive documents and contribute documents for information, but shall not submit documents that propose changes to the specifications, reports, work item descriptions, work plan, or any other document under the control of the TSG. Observers shall not take part in decision making or hold any leadership positions.

Additional participation rights of an Observer shall be decided by the Organizational Partners on a case-by-case basis.

The status of Guest may be granted for a limited period, by the Organizational Partners to an entity which has the qualifications to become a future Individual Member. The limited period shall be decided by the Organizational Partners on a case-by-case basis.

A Guest may have representatives at TSG and subtending group meetings. Representatives may receive documents but shall not take part in decision making, participate in discussions, contribute documents, or hold any leadership positions.

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SECTION C: STRUCTURE

Article 11: Structure of 3GPP

3GPP shall consist of a Project Co-ordination Group (PCG) and Technical Specification Groups (TSGs). The Technical Specification Groups may establish Working Groups if required.

The Organizational Partners may decide to call a meeting of the full 3GPP membership if required.

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SECTION D: PARTNERS' COLLECTIVE RESPONSIBILITIES

Article 12: Organizational Partners' Collective Responsibilities

The Organizational Partners shall determine the general policy and strategy of 3GPP.

In addition the Organizational Partners shall perform the following tasks:

- approval and maintenance of the 3GPP scope;

- maintenance of the Partnership Project Description;
- taking decisions on the creation or cessation of Technical Specification Groups, and approving their scope and terms of reference;
- approval of Organizational Partner funding requirements;
- allocation of human and financial resources provided by the Organizational Partners to the Project Co-ordination Group;
- acting as a body of appeal on procedural matters referred to them;
- conduct compliance training at least annually for elected leadership, relevant Support Team personnel and interested parties on best practices to follow to
  - avoid issues with respect to antitrust/competition laws and regulations;
  - fulfil the leadership/support role with impartiality and in the interests of 3GPP.

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Article 13: Collective responsibilities of all Partners

Organizational Partners and Market Representation Partners shall perform the following tasks:

- maintenance of the Partnership Project Agreement;
- approval of applications for 3GPP partnership;
- taking decisions relating to the dissolution of 3GPP.

top

SECTION E: PROJECT CO-ORDINATION GROUP (PCG)

Article 14: PCG tasks

The PCG shall perform the following tasks:

- appointment of PCG Chair and Vice Chairs;
- allocation of human and financial resources provided by Organizational Partners to TSGs;
- allocation of voluntary human and financial resources provided by Market Representation Partners and Individual Members;
- management of the 3GPP Support Team;
- handling of appeals from Individual Members on procedural matters referred to them;
- propose and approve modifications to the Partnership Project Working Procedures;
- handling of appeals from Individual Members on technical matters referred to them;
- determination of the overall time frame and manage overall work progress;
- final adoption of new and stopped work items proposed by the TSGs within the agreed 3GPP scope and objectives;
- when a work item is outside the scope of the 3GPP, and where a common global solution is desired, recommend how to achieve a global solution;

- appointment or dismissal of TSG Chairs and Vice Chairs, as proposed by TSGs based on election results. (The proposed candidate shall be appointed unless there are extraordinary reasons that prevent such an appointment, e.g., severe company or geographical imbalance within 3GPP. In such cases the TSG shall be requested to elect an alternative candidate. The decision not to appoint a candidate shall be made by consensus.);
- authorizing requests from the TSGs for approval to liaise with external organizations, and maintain a list of approved requests;
- maintenance of the register of Individual Members eligible to participate in 3GPP;
- maintenance of the register of IPR declarations relevant to 3GPP, received by the Organizational Partners.

The PCG may decide to call a meeting of the full 3GPP membership if required.

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Article 15: PCG participation

The following shall have a right to participate in the PCG:

- Typically, a maximum of five representatives of each Organizational Partner (not counting the Chair and Vice-Chairs);
- A maximum of three representatives of each Market Representation Partner. (MRPs are however urged to limit their participation to one representative wherever possible.);
- The Chairs and Vice Chairs of the TSGs as ex-officio members;
- A maximum of three ITU representatives;
- One representative of each Observer.

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Article 16: PCG appointment of Chair and Vice Chairs

The PCG shall appoint their Chair and Vice Chairs from amongst the Organizational Partner representatives.

The Chair and Vice Chairs shall be appointed for a one year term of office.

The Chair and Vice Chairs shall normally serve one term of office. If no other candidates are available, the Chair or Vice Chairs may be appointed for a further term.

Successive Chairs and Vice Chairs should not be from the same Organizational Partner, the same region or from the same group of companies, unless no other candidate is available.

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Article 17: PCG Chair and Vice Chair Responsibilities

The PCG Chair is responsible for the overall management of the co-ordination work within 3GPP.

The Chair has the overall responsibility to ensure that the Partnership Project Agreement, Partnership Project Description and Partnership Project Working Procedures are followed.

The Chair may nominate officials to assist in the work.

The Chair may be assisted by the Support Team.

The Chair may delegate tasks to the Vice Chairs.

In performing their leadership role, the Chair and Vice Chairs shall maintain impartiality and act in the interests of 3GPP.

At the commencement of each meeting of the PCG, the group shall be reminded that:

(i) compliance with all applicable antitrust and competition laws is required; and

(ii) the leadership will conduct the meeting with impartiality and in the interests of 3GPP.

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Article 18: PCG meetings

A meeting of the PCG shall be held at least twice per year.

At least thirty days before the due date, a calling notice, draft agenda and supporting documents shall be issued.

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Article 19: PCG decision making

In any meeting of the PCG, the quorum required for decision making shall be 50% of the total number of Organizational Partners. Proxies shall not be permitted.

The PCG shall endeavour to reach consensus on all issues. The views and opinions of the Market Representation Partners and the Chairs and Vice Chairs of the TSGs shall be taken into account during the consensus building process. If consensus cannot be achieved, the PCG Chair can decide to take a vote. The vote may exceptionally be performed by a secret ballot if decided by the PCG.

Each Organizational Partner shall have one vote. A proposal shall be deemed to be approved if 71% of the votes cast are in favour. Abstentions or failure to submit a vote shall not be included in determining the number of votes cast.

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SECTION F: TECHNICAL SPECIFICATION GROUPS

Article 20: TSG tasks

The TSGs shall prepare, approve and maintain the 3GPP Technical Specifications and Technical Reports taking into account the market requirements provided by Market Representation Partners.

The TSGs shall also perform the following tasks:

- Propose to the PCG for appointment TSG Chair and Vice Chairs based on election results;
- Creation of TSG Working Groups and approval of their terms of reference;
- When a new Working Group is created, the appointment of TSG Working Group Convenor;
- Allocation of resources within the TSG;
- Allocation of voluntary human and financial resources provided by Market Representation Partners and Individual Members;
- Handling of appeals from Individual Members on technical matters;
- Preparation of a detailed time frame and management of detailed work progress;

- Management of work items;
- Technical Co-ordination;
- Proposal and approval of work items within the agreed scope and terms of reference of the TSG;
- Where a work item is outside the scope of the 3GPP, but a common global solution is desired, recommend an approach to the PCG;
- Assignment of work to Partners. (Specification development may be accomplished using various methods, including the assignment of work to Partners.);
- Maintenance of the list of Individual Members eligible to vote within the TSG (Voting Members).

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Article 21: TSG participation

The following shall have a right to participate in the TSGs:

- Representatives of members of participating Organizational Partners (i.e. Individual Members);
- Representatives of Organizational Partners;
- Representatives of Market Representation Partners;
- Representatives of Observers;
- Representatives of Guests.

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Article 22: TSG and WG election of Chair and Vice Chairs

22.1 TSG elections

Regular TSG elections shall be held every two years in the first semester of odd numbered years.

The TSG Chair and Vice Chairs shall be elected by the Technical Specification Group from amongst the Individual Member representatives. Each TSG shall elect a maximum of three Vice Chairs.

A candidate for election to a TSG Chair or Vice Chair position shall provide a letter of support from the Individual Member that they represent. The support letter from the Individual Member shall indicate that the candidate will avail or has availed themselves of 3GPP supplied antitrust and competition law training in order to comply with all applicable antitrust/competition laws and regulations while acting in the capacity of TSG Chair or Vice Chair.

Nominations may be made up to the point when an election takes place.

The Chair and the Vice Chairs shall be elected for a two year term of office. The Chair and Vice Chairs may offer themselves for election for a second consecutive term. The term “consecutive” is taken to mean terms one after the other without another person being elected to the position in the interim. Exceptionally, they may offer themselves for further consecutive terms, subject to the following:

- A two week deadline that expires at noon Central European Time on the Friday which falls between 20 and 14 days prior to the first day of the meeting at which elections are due to be held shall be established.
- A Chair is not permitted to stand for another consecutive term if another candidate is announced via the 3GPP web site or via the relevant 3GPP email reflector prior to this deadline.
- A Chair is not permitted to stand for another consecutive term until after this deadline.

- A Vice Chair is not permitted to stand for another consecutive term in a Vice Chair position for which there is a candidate announced via the 3GPP web site or via the relevant 3GPP email reflector prior to this deadline.
- A Vice Chair is not permitted to stand for another consecutive term until after this deadline. If, by the deadline, the number of candidatures is less than the number of Vice Chair positions, then any incumbent Vice Chair may put forward their candidature.

There is no restriction on a Vice Chair whose term of office is due to expire offering himself for the position of Chair; neither is there any restriction on a Chair whose term of office is due to expire offering himself as a Vice Chair. There is no restriction of a retiring Chair or Vice Chair of one TSG offering himself for election as either Chair or Vice Chair of any other TSG (or WG).

Should the office of Chair or Vice Chair of a TSG become vacant for reasons other than expiration of term of office, a special election shall be conducted to fill the unexpired term. This special election shall be conducted at a meeting of the TSG, and shall be announced in the agenda according to the provisions of article 32.

When such a special election is held to fill the office of Chair, and one or more of the Vice Chairs of the TSG intends to stand for election to that position, the announcement shall also indicate that there will be an election to fill the position of Vice Chair in the event that a Vice Chair be elected to the office of Chair. If at the special election the Vice Chair is elected to the office of Chair, that individual shall become Chair immediately, and, the position of Vice Chair thus being vacant, an election shall be held for the office of Vice Chair.

Similarly, if an incumbent Chair intends to stand for election to the position of Vice Chair, the same applies, with the necessary changes to the text above.

If a Chair or Vice Chair changes the Individual Member that they represent (e.g., job change, merger or acquisition) during their term of office, a new letter of support shall be provided. In order to provide a new letter of support, a Chair or Vice Chair may request a grace period allowing their term to be extended the lesser of 6 weeks or until the day before the next scheduled regular term (e.g., every 2 years) election. Although the term is extended, under the rules of article 22, the Chair or Vice Chair can only chair meetings when representing an Individual Member. This rule continues to apply during the grace period. If the change of company affiliation is due to a move to another company, then the decision for the Chair or Vice Chair to continue in office to the end of the present term shall be made by consensus of the TSG. If consensus cannot be achieved, a special election shall be held for the office. The incumbent Chair or Vice Chair is permitted to offer their candidacy in a special election even if they have held the position for 2 terms or more.

The term of office for a Chair or Vice Chair elected at a special election is a partial term lasting until the end of the current term. If a new Chair or Vice Chair is elected at a special election then the partial term of office does not count towards the two consecutive term limit. If the previous Chair or Vice Chair is re-elected at a special election then the entire term (of two parts) is considered as a single term and does count towards the two consecutive term limit.

Chairs and Vice Chairs should not be from the same region, Organizational Partner, or from the same group of companies, unless no other candidate is available.

Successive Chairs should not be from the same Organizational Partner, the same region or from the same group of companies, unless no other candidate is available. This does not apply to special elections or to regular elections for a second or subsequent consecutive term of office .

When a new TSG is established, the Organizational Partners shall appoint a convenor for the first two TSG meetings. The election for TSG Chair and Vice Chairs shall take place at the second TSG meeting. If the election takes place other than at the normal time for TSG elections (see above), the elected Chair and Vice Chairs shall serve until the next regular TSG election. This partial term of office does not count towards the two consecutive term limit. The provisions of this paragraph may be overridden by consensus of the PCG where a new TSG is formed by the merger of existing TSGs; under these circumstances, the PCG shall establish a set of ad hoc rules for the creation of the new TSG.

Following election by the TSG, the TSG Chair and Vice Chairs shall be appointed by the PCG on the proposal of the TSG.

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22.2 WG elections

The provisions concerning the election of WG Chairs and Vice Chairs shall be as for TSG Chairs and Vice Chairs as defined in 22.1 above, changing TSG to WG wherever TSG is mentioned, with the following differences.

Each WG shall elect a maximum of two Vice Chairs.

WG elections shall be held when the corresponding terms of office expire or when an existing Chair or Vice Chair resigns. WG elections need not be synchronized within the WG (i.e. elections for Chair and each Vice Chair may occur at different times), across different WGs of the same or other TSGs, nor with the regular TSG elections.

WG Chairs and Vice Chairs are always elected for a period of two years (and not, as is the case with special elections in TSGs, for the unexpired period of the present term of office). An exception to this is where the previous Chair or Vice Chair is re-elected in the special election. In this case the Chair or Vice Chair continues for the unexpired period of the present term of office.

Note: For this reason, elections for WG Chairs and Vice Chairs are likely to become spread over a period of time, rather than being grouped like the TSGs' regular elections.

When a new WG is established, the parent TSG is responsible for appointing a convenor for the first two meetings.

Following election by the WG, the Chair and Vice Chairs hold office immediately, without need of appointment by TSG or PCG.

If a WG does not meet physically with enough frequency to maintain an up to date voting list, the working group may elect to escalate the voting for officers to the parent TSG.

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Article 23: TSG and WG Chair and Vice Chair responsibilities

The TSG Chair is responsible for the overall management of the technical work within the TSG and its Working Groups. The Chair has an overall responsibility to ensure that the activities of the TSG follow the Partnership Project Working Procedures.

The WG Chair is responsible for the overall management of the technical work within the WG and its sub-groups.

The Chair may nominate officials to assist in the work.

The Chair may delegate tasks to the Vice Chairs.

The Chair may be assisted by the Support Team.

The Chair shall form a Management Team, including the Vice Chairs and Support Team, in order to assist in discharging the Chair’s duties.

Recognizing the need to balance the requirement of rapid specification development with the limited resources of delegates, the Chair should encourage a minimum number of meetings, especially parallel meetings, and maximize the use of electronic means to advance the work.

In performing their leadership role, the Chair and Vice Chairs shall maintain impartiality and act in the interests of 3GPP.

At the commencement of each meeting of a TSG or WG, the group shall be reminded that:

(i) compliance with all applicable antitrust and competition laws is required;

(ii) timely submissions of work items in advance of TSG or WG meetings are important to allow for full and fair consideration of such matters; and

(iii) the leadership will conduct the meeting with impartiality and in the interests of 3GPP.

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Article 24: TSG and WG Chair and Vice Chair dismissal

A secret ballot shall be taken for the proposal to dismiss a TSG or WG Chair or Vice Chair because of a failure to effectively perform their duties, if requested by 30% of the TSG or WG membership list. 71% of the votes cast are required to recommend dismissal.

The PCG shall dismiss a Chair or Vice Chair on the proposal of the TSG.

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Article 25: TSG and WG decision making

TSGs and WGs shall endeavour to reach consensus on all issues, including decisions on Technical Specifications and Technical Reports. Informal methods of reaching consensus are encouraged (e.g., a show of hands). If consensus cannot be achieved, the Chair can decide to take a vote. The vote may exceptionally be performed by a secret ballot if decided by the TSG or WG. A vote may be conducted during a TSG or WG meeting or by correspondence.

A proposal shall be deemed to be approved if 71% of the votes cast are in favour. Abstentions or failure to submit a vote shall not be included in determining the number of votes cast.

It is the responsibility of the Chair to ensure that questions to be voted upon are phrased in a positive yes/no manner, with 71% required to approve the question. Questions should not be phrased as the TSG shall not do something. Examples of appropriate questions are; Shall the TSG approve the Specification and send it to the SDOs? Shall the liaison be approved? Shall the new WI be approved? Shall the existing WI be stopped? If the issue is to choose option A or B, the question should be split into two questions, with the Chair selecting the order. First, shall the TSG take option A as the way forward? If this question fails the second question is, shall the TSG take option B as the way forward?

Contributions on which decisions will be based should be made available in good time before each meeting. TSGs may establish informal guidelines for dealing with late contributions.

If a WG does not meet physically with enough frequency to maintain an up to date voting list, the working group may elect to escalate the voting to the parent TSG.

Working Agreements may be used to establish tentative agreements in cases where consensus cannot be obtained. The working agreement process is described in annex G.

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Article 26: TSG and WG voting during a meeting

The following procedures apply for voting during a TSG or WG meeting:

- before voting, a clear definition of the issues shall be provided by the Chair;
- Voting Members shall only be entitled to one vote;
- if a Voting Member has more than one representative present, only one representative may vote;
- each Voting Member may only cast the vote once;
- each Voting Member may carry proxy votes for up to five other Voting Members. All proxy votes shall be accompanied by a letter of authority from the authorising Voting Member. Proxies will not be taken into account when determining the quorum;
- the quorum required for voting during a TSG or WG meeting shall be 30% of the total number of Voting Member companies on the TSG or WG voting list;
- the result of the vote shall be recorded in the meeting report.

For the determination of the quorum, see annex H.

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Article 27: TSG or WG voting by correspondence

The following procedures apply for voting by correspondence:

- before voting, a clear definition of the issues shall be provided by the Chair and disseminated to all on the TSG or WG membership list;
- Voting Members shall only be entitled to one vote;
- each Voting Member may only cast the vote once within the voting period;
- the voting period shall be 30 days;
- there are no quorum requirements;
- The result of the vote should be disseminated to the TSG or WG.

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Article 28: TSG or WG voting for the election of TSG or WG Chair and Vice Chair

In the case where there is more than one candidate for TSG or WG Chair or Vice Chair, a secret ballot shall be used. For interpreting the result of the secret ballot the following procedure shall apply:

When, in the first ballot, no candidate has obtained 71% of the votes cast, a second ballot shall be held. In the second ballot, in cases where there are only two candidates, the candidate obtaining the higher number of votes is elected. In cases where there are more than two candidates, if none of them has obtained 71% of the votes, a third and final ballot shall be held among the two candidates who have obtained the highest number of votes in the second ballot. The candidate obtaining the higher number of votes in the third ballot is then elected.

The TSG or WG Chair shall be responsible for the voting process and shall ensure that confidentiality is maintained.

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Article 29: TSG or WG appeal process

An Individual Member of 3GPP who opposes a Chair's ruling on a vote taken within a TSG or WG may submit their case to the PCG for decision. In such cases the Individual Member shall also inform the relevant TSG or WG Chair.

When a TSG or WG Chair has made a ruling, their decision shall be taken as the basis for future operations, unless or until overturned by the PCG.

If an Individual Member in a TSG or WG believes that a Chair or Vice Chair of any such group is acting without impartiality and not in the interests of 3GPP, such Individual Member may object to such actions within the relevant group, and may request that such objection be recorded in the minutes of the applicable group meeting and it shall be so recorded. The objecting Individual Member may ultimately take their objection to the PCG for consideration. In such cases the Individual Member shall also inform the relevant TSG or WG Chair.

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Article 30: TSG and WG meetings

TSGs and WGs shall meet as necessary to complete their work within the prescribed timeframe. TSGs should endeavour to hold their meetings at the same time and place to assist in the overall co-ordination of the work.

Meeting locations should reflect the geographical diversity of the TSG and WG delegates.

Further information on meetings is given in annex F.

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Article 30A: TSG and WG participation

IMs wishing to progress work on topics in 3GPP are expected to participate physically in the meetings.

If a 3GPP IM is materially interested in a specific topic but is unable to participate in a meeting by sending a delegate, the IM is urged to engage the support of other IMs whose delegates will be present at the meeting to present its views. If this is not possible for any reason, the IM may advise the Chair of the situation and may provide documents supporting their position. The Chair may facilitate the introduction of these documents during the meeting and the record of the meeting can include the discussion and outcome. Note that physical participation in meetings is considered the norm and the option to engage the Chair is intended for exceptional situations. The Chair has the right to decline the request.

top

Article 31: TSG and WG meeting invitation

The invitation to a TSG or WG meeting and the necessary logistical information should be disseminated as soon as practically possible, taking into account the need to obtain travel documentation. It shall be disseminated at least 28 days before the meeting to all on the TSG or WG membership list.

top

Article 32: TSG and WG meeting agenda

The draft agenda for a TSG or WG meeting shall be disseminated by the responsible Chair to all on the TSG or WG membership list at least 21 days before a meeting. The draft agenda should indicate subject matters where voting may be required. The draft agenda shall indicate elections to be held (including known candidates). The draft agenda shall indicate the deadlines (dates and times) for registration and meeting document submission to the TSG/WG meeting. Other deadlines may also be indicated (whenever required).

top

Article 33: TSG and WG meeting registration

Delegates and officials must register before participating in any 3GPP meeting. Each delegate or official who represents an Individual Member shall declare the precise name of that Individual Member. A delegate or official may only register to represent one Individual Member.

The deadline for registration for all delegates and officials is one week in advance of the start of the meeting. Registrations after this deadline will still be processed, but timely receipt of meeting related information is not guaranteed for late registrants.

To aid in communication, delegates or officials at co-located meetings may briefly visit a meeting they have not registered for. However, any extensive involvement such as presenting a contribution or formally objecting requires prior registration to the meeting.

top

Article 34: TSG and WG meeting document and file naming

Documents for a TSG or WG meeting shall follow a consistent numbering system as shown in the following example:

xminnzzzz

This numbering system has six logical elements:

1) **x**: a single letter corresponding to the TSG;

   where x : **R** (Radio Access Network)

   N (Core Network) [TSG closed March 2005]

   S (Service and System Aspects)

   T (Terminals) [TSG closed March 2005]

   G (GSM/EDGE Radio Access Network)

   C (Core network and Terminals)

2) **m** A single character corresponding to the Working Group identity (typically 1, 2, 3, etc) or, in the case of the TSG itself, the letter "**P**".

3) **i**: Normally the hyphen character "-". May take on other values depending on the nature of the meeting at which the document is presented, eg the identity of a subgroup.

4) **nn**: two digits to indicate the year, i.e. 99, 00, 01, etc;

5) **zzzz**: unique number of the document

No provision is made for the use of revision numbers. Documents which are a revision of a previous version should indicate the document number of that previous version.

The filename of documents shall be the document number. Documents may be compressed to .Zip files (and thus bear a file extension ".zip"). For example, document **S1-060357** will be contained in file **S1-060357.zip**.

top

Article 35: TSG and WG Voting Membership List

35.1 Voting list

Each TSG and WG shall maintain a list of Individual Members eligible to vote in that group.

The voting list shall be used to establish quorum and for determining those eligible to take part in a vote.

NOTE 1: The term "membership list" has no particular significance in the context of TSG and WG meetings. The term "attendance list" is used for a list of individuals who attend a given meeting representing an Individual Member or other entity entitled to participate in meetings – see annex F.

For the determination of the quorum, see annex H.

top

35.2 On creation of new TSG or WG

When a new TSG or WG is formed an Individual Member is added to the voting list at the first meeting at which it is represented, and may vote at the second meeting where it is represented.

Exceptionally, if inadequate notice (less than the period of time given in article 31) had been given for the first meeting of the new group, an Individual Member shall be added to the voting list on its delegate's attending the second meeting (the election meeting) and vote at that meeting even if it had not been represented at the group's first meeting.

Only an Individual Member that had been represented at the group's first meeting may provide a proxy for the second meeting.

top

35.3 Established TSGs and WGs

To qualify for the voting list it is necessary for at least one delegate of an Individual Member to attend at least two meetings of the group concerned, without being removed according to the provisions of article 35.4..

An Individual Member having been represented at at least two ordinary meetings of the group has the right to cast a vote by proxy (see article 26). Thus an Individual Member may not cast a vote by proxy during a meeting at which it is not represented unless it had already been represented at two or more qualifying meetings of the group.

top

35.4 Removal from and reinstatement to voting list

An Individual Member which is not represented at three consecutive meetings of the TSG or WG shall be removed from the voting list.

The right to vote is reinstated at the second meeting which a delegate of the Individual Member attends without missing the number of consecutive meetings mentioned in the previous paragraph (but see article 35.3 for eligibility to cast a proxy vote).

EXAMPLE 1: If Individual Member Z is represented at meeting K and K+3 (and is thus eligible to vote) but is not represented at meetings K+4, K+5 and K+6, it is removed from the voting list.

EXAMPLE 2: If Individual Member X, not previously having been represented at a meeting of the group, is represented at meetings N and N+3, it may cast a vote at meeting N+3.

NOTE: Individual Member X might choose to cast a vote by proxy at meeting N+3, even though its delegate is physically present. This is sometimes useful for coordinating company positions where one large company has several Individual Memberships, possibly via several different Organizational Partners.

EXAMPLE 3: If Individual Member Y, not previously having been represented at a meeting of the group, is represented at meeting N only, it may not cast a vote by proxy at meeting N+2.

top

35.5 Meetings other than ordinary meetings

Any group that wants to call an electronic meeting (audio, video, document distribution by posting or e-mail, etc) may do so, although this works best with smaller groups. Therefore, all electronic meetings are allowed but only ordinary meetings (see annex F) count towards attendance. However, if a meeting is designated as face-to-face, provision of bridge and speakerphone capabilities for those requesting it would be at the discretion of the host. Those participating by speakerphone are not to be counted toward quorum or attendance, and are not allowed to vote.

For the determination of the quorum, see annex H.

top

Article 36: TSG Sub Working Groups

A Working Group may establish a Sub Working Group (SWG) with defined Terms of Reference. The Working Group shall appoint a SWG Chair. The SWG shall work by consensus. The meeting notice requirements for a SWG meeting are the same as for TSGs and WGs.

top

SECTION G: WORK PROGRAMME AND TECHNICAL CO-ORDINATION

Article 37: Work Programme

The 3GPP Work Programme shall consist of Work Items defined by the TSGs.

top

Article 38: Work Items

A 3GPP Work Item is a specification task defined in terms of the following principal parameters:

- title;
- intended output (i.e. Technical Specifications or Technical Reports);
- impact on other Technical Specifications and Technical Reports;
- technical scope, including the field of application of the intended output;
- impact on other 3GPP Work Items;
- the schedule of tasks to be performed;
- the identities of the supporting Individual Members;
- the identity of the Work Item Rapporteurs.

- top

Article 39: Work Item creation

Each proposed new Work Item shall be supported by at least four Individual Members, and their names shall be recorded in the Work Item definition prepared for the TSG approval. One or more persons shall be named as Rapporteur for the proposed Work Item, and the Rapporteur shall act as the prime contact point on technical matters and for information on progress throughout the drafting phases. The supporting Individual Members are expected to contribute to and progress the new work item throughout the drafting phases.

In addition to the above, TSGs shall approve new Work Items, giving all essential parameters. The proposal shall be entered into the 3GPP work programme, clearly marked as a new entry, for which a unique reference identity shall be allocated.

top

Article 40: Work Item adoption by PCG

The 3GPP work programme shall be made available to all Individual Members. A new Work Item shall remain flagged as "new" until the end of the month following the month during which the 3GPP work item was entered into the 3GPP work programme. A new Work Item shall be adopted by the PCG unless a substantial objection is received from an Individual Member or Partner during this period. At the end of the period, the "new" flag shall be removed (even if there is an objection) and it is the responsibility of any objecting Individual Member or Partner to discuss their objections with the TSG Chair. If it is not possible to resolve the objection, it is the responsibility of the Individual Member or Partner to raise the issue with the PCG.

The TSGs shall ensure that the 3GPP Work Item details are maintained at regular intervals.

top

Article 41: Work Item stopping

Prior to completion of the intended 3GPP output, the responsible TSG may conclude that a Work Item is no longer required. Any Work Item shall automatically be considered by a TSG for stopping, if no progress has been achieved in a given period of time, typically six months, e.g. due to a lack of contribution. In such cases, the Work Item shall be flagged as "stopped" in the Work Programme. The proposal to stop a Work Item shall be fully justified.

The Work Programme shall be updated accordingly, and shall show the Work Item as "stopped" until the end of the month following the month during which the Work Item was initially flagged.

The Work Item will be stopped by the PCG unless substantial objection is received from an Individual Member during this period. It is the responsibility of any objecting Individual Member to discuss their objections with the TSG Chair. If it is not possible to resolve the objection, it is the responsibility of the Individual Member to raise the issue with the PCG.

top

Article 42: Technical co-ordination

The PCG shall be responsible for determining the overall time frame and for managing the overall work progress. The System Aspects TSG shall have a particular responsibility for the technical co-ordination of work being undertaken within 3GPP, and for overall system architecture and system integrity. Problems encountered in performing this technical co-ordination role shall be reported immediately to the PCG.

top

SECTION H: DELIVERABLES

Article 43: Deliverable types

3GPP shall prepare, approve and maintain documents known as Technical Specifications and Technical Reports. Such documents shall be drawn up by the TSGs and shall, following approval at that level, be submitted to the participating Organizational Partners to be submitted to their respective standardization processes.

top

Article 44: Approval process

Approval of Technical Specifications and Technical reports by a TSG shall normally be by consensus.

Where consensus cannot be achieved in the TSG a vote may be taken.

When Technical Specifications and Technical Reports become sufficiently stable, they shall be put under change control of the relevant TSG. The further elaboration of these Technical Specifications and Technical Reports shall be achieved by change requests to be approved by the TSG.

top

Article 45: Drafting rules

The Technical Specifications and Technical Reports drafted by the TSGs shall follow the 3GPP drafting rules, using document processing facilities, format, languages and notations agreed by the Organizational Partners, and on a medium suited for electronic document handling and publishing.

top

Article 46: Copyright and ownership

The Organizational Partners will have joint ownership (including copyright) of the Technical Specifications and Technical Reports produced by 3GPP.

top

Article 47: Conversion by Organizational Partners

Organizational Partners shall use their best endeavours to convert the Technical Specifications and Technical Reports approved by the Partnership Project into national/regional deliverables in a timely manner through their normal processes.

The Organizational Partners are urged not to change the technical parts of the Technical Specifications and Technical Reports; they may add non-technical parts required by their own deliverable schemes and they may add descriptions of options selected.

Organizational Partners should ensure that all unresolved comments raised during their public enquiry and approval phases are delivered to the appropriate TSG.

top

SECTION I: REPORTING

Article 48: Chair’s reporting obligations

A report shall be prepared by the Chair following all PCG and TSG meetings.

top

Article 49: Changes to structure and officials

The Chair of each TSG shall inform the PCG of all organizational changes concerning Working Groups and their officials. An up to date record of the 3GPP structure shall be maintained.

top

Article 50: Calendar of meetings

The PCG and TSGs shall maintain an up to date calendar of the dates and venues for future meetings.

top

SECTION J: EXTERNAL RELATIONS

Article 51: Relationship with the ITU

3GPP results should be submitted to the ITU as appropriate.

For working groups, the following handling of communications toward ITU shall apply:

1 Working groups shall send ITU submissions which are destined to become part of ITU deliverables to their parent TSG for review.

2 Working group communications towards the ITU which are NOT destined to become part of an ITU deliverable must be reviewed by the TSG Chair and the appropriate ITU sector convener (if one exists for the given ITU sector). The working group's TSG Chair and ITU sector convener will determine if such a communication should be sent to the parent TSG for review. If for some reason either the TSG Chair or ITU sector convener is not available, then it is sufficient for the remaining person to review the document and determine if it should be escalated to the TSG or not.

3 If the working group communication does not require TSG review, then it shall be conveyed to the ITU from the WG using one of the mechanisms described below.

For TSGs, the following handling of communications toward ITU shall apply:

1 TSGs shall send ITU submissions which are destined to become part of ITU deliverables to the PCG for review.

2 TSGs communications towards the ITU which are deemed sensitive by the TSG shall be sent to the PCG for review.

3 If the TSG does not judge the communication as sensitive, then it shall be conveyed to the ITU from the WG using one of the mechanisms described below.

To convey a communications towards the ITU, one of the following mechanisms shall be used based upon determination of the sending body (a body may determine a default mechanism).

a) The communication shall be sent from the OPs as a deliverable from their organizations (applicable to PCG reviewed communications only)

b) The communication shall be made by Individual Members who are also members of the ITU. In such a circumstance, the appropriate ITU sector convener will coordinate and handle the administrative matters for the submission. 3GPP Technical Specifications and Technical Reports may be taken as the technical content of such contributions (applicable to PCG reviewed communications or TSG reviewed communications).

c) The communication shall be sent directly from the 3GPP liaison coordinator to the appropriate ITU receiver in the ITU (applicable to TSG reviewed communications or WG reviewed communications).

Representatives of ITU-D, ITU-R and ITU-T are invited to participate in the Project Coordination Group for the efficient coordination and exchange of information.

top

Article 52: Relations with other groups

TSGs and WGs are encouraged to liaise directly with the relevant technical bodies within the 3GPP and Partners as appropriate.

A liaison statement shall clearly communicate what is expected from the receiver, i.e., which parts are for information, which questions are expected to be clarified and by whom (especially if there are multiple receivers), and also when an answer is needed, e.g., when is the next meeting of the group sending the liaison statement.

A TSG or any subtending Working Group may send individual liaisons to any external organization (other than ITU) without PCG approval, except if the statement is considered sensitive by the TSG Chair, in which case PCG clearance is needed.

It is not necessary to have all external liaisons copied to the PCG and/or TSG SA. The liaison originating TSG should decide, at its own discretion, which should be copied. External liaisons that may have management implications such as schedules, organization, process, procedures, and policy shall be copied to the PCG, or approved by the PCG if sensitive.

Relations with the ITU are described in article 51.

top

SECTION K: MISCELLANEOUS

Article 53: Resources

The resources for the operation of 3GPP shall be managed by the Organizational Partners. The resources are allocated to the TSGs by the PCG.

top

Article 54: Support Team

The Partners shall provide logistical support to, and assist in the operation of, 3GPP. The support shall be in the form of a Support Team which shall operate under the overall management of the PCG and the day to day management of TSGs.

top

Article 55: Intellectual Property Rights (IPR) Policy

Individual Members shall be bound by the IPR Policy of their respective Organizational Partner.

Individual Members should declare at the earliest opportunity, any IPRs which they believe to be essential, or potentially essential, to any work ongoing within 3GPP. Declarations should be made by Individual Members to their respective Organizational Partners.

Organizational Partners should encourage their respective members to grant licences on fair, reasonable terms and conditions and on a non-discriminatory basis.

top

Article 56: Working language

The working language for 3GPP shall be English.

Meetings of the PCG and TSGs shall be conducted in English.

3GPP Technical Specifications and Technical Reports shall be prepared in English (as defined by the Shorter Oxford English Dictionary).

top

Article 57: Duration

3GPP shall be task oriented and on completion of the tasks the future of 3GPP shall be re-considered. The continuation of 3GPP shall therefore be confirmed by the Organizational Partners on an annual basis.

top

Article 58: Review of activities

An evaluation of the activities of 3GPP should be made by the Organizational Partners at regular intervals.

top

Article 59: Dissolution, winding up

In the event of a voluntary dissolution of 3GPP, the Partners shall determine the terms of liquidation by consensus. All issues shall be documented and distributed at least 30 days prior to decisions being made.

top

Article 59A: Exhaustion of appeal procedures

In connection with any claim or dispute of an Individual Member arising from or relating to any activity of any 3GPP meeting or action, including in connection with a TSG or WG meeting, such Individual Member shall, prior to commencing any such legal proceeding against 3GPP, its leadership, support staff, or one or more Organizational Partners in a court, an arbitral panel or other adjudicatory body, exhaust all appeal procedures provided in the 3GPP Working Procedures. Exhaustion of appeal procedures shall be diligently expedited by both the appealing party and the appeal body.

top

Article 60: Amendments to 3GPP Working Procedures

These Partnership Project Working Procedures may only be amended by decision taken by the PCG.

top

Annex A: Definitions

Consensus:	General agreement, characterized by the absence of sustained opposition to substantial issues by any important part of the concerned interest and by a process that involves seeking to take into account the views of all parties concerned and to reconcile any conflicting arguments. (Note: consensus need not imply unanimity).
Conversion:	The transformation of a 3GPP output document into an Organizational Partners deliverable following the Organizational Partners' recognized processes.
Delegate:	An individual taking part in a TSG/WG meeting physically or by electronic means.
Drafting Rules:	A document approved by the Organizational Partners providing rules for the drafting of 3GPP Technical Specifications and Technical Reports.
Election:	The voting process used to identify an individual from a number of individuals.
Guest:	An entity fulfilling the criteria to become a future Individual Member, which has been granted temporary participation rights in the 3GPP
Individual Member:	A member of an Organizational Partner having participation rights within that Organizational Partner and which has registered to take part in 3GPP.
ITU Representative	Representatives of ITU-D, ITU-R and ITU-T invited to participate in the Project Coordination Group for the efficient coordination and exchange of information.
Leadership:	A Chair, Vice-Chair, or Convenor of an OP/PCG/TSG/WG/SWG/Ad-Hoc or any other 3GPP meeting.
Market Representation Partner:	A Partner invited by the Organizational Partners to participate in 3GPP to offer advice and to bring into 3GPP a consensus view of market requirements.
Observer:	An Organization fulfilling the criteria to become a future Partner which has been granted temporary participation rights in 3GPP.
Organizational Partner:	A recognized Standards Organization which has been accepted as a Partner in 3GPP.
Partner:	An Organizational Partner or a Market Representation Partner of 3GPP.
Partnership Project Agreement:	The document signed by 3GPP Partners defining their rights and obligations.
Partnership Project Description:	A document which describes the overall structure and operation of 3GPP.
Represent:	Attend on behalf of. A person who attends a meeting on behalf of an Individual Member represents that Individual Member. The person is not necessarily employed by that Individual Member, but may be, for example, employed by a subsidiary company in the same group as the represented Individual Member; or the person may be an independent consultant under contract to the Individual Member. "Representation" sometimes influences the eligibility to vote – see article 35 and annexes A and F.
Sub Working Group	A subordinate body of a Working Group.
Support Team:	A number of persons dedicated to support 3GPP.
Technical Report:	A 3GPP output document containing mainly informative elements approved by a Technical Specification Group.
Technical Specification:	A 3GPP output document containing normative provisions approved by a Technical Specification Group.
Voting Member	An Individual Member who has voting rights within a TSG/WG.
Work Item:	The documented record of a specific technical activity of 3GPP.
Work Programme:	The documented record of the all technical activities of 3GPP.
Working Group:	A subordinate body of a Technical Specification Group.

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Annex B: Abbreviations

3GPP	Third Generation Partnership Project
ARIB	Association of Radio Industries and Businesses
ATIS	Alliance for Telecommunications Industry Solutions (successor to T1)
CCSA	China Communications and Standards Association (successor to CWTS)
CDMA	Code Division Multiple Access
CWTS	China Wireless Telecommunications Standards Group (superseded by CCSA)
ETSI	European Telecommunications Standards Institute
FDD	Frequency Division Duplex
GSM	Global System for Mobile Communication
IM	Individual Member
IMT-2000	International Mobile Telecommunication
ITU	International Telecommunication Union
MRP	Market Representation Partner
PCG	Project Co-ordination Group
SWG	Sub Working Group
T1	Standards Committee T1 (superseded by ATIS)
TDD	Time Division Duplex
TSDSI	Telecommunications Standards Development Society, India
TSG	Technical Specification Group
TTA	Telecommunications Technology Association
TTC	Telecommunication Technology Committee
UIM	User Identity Module
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network
WG	Working Group

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Annex C: Individual member application form

APPLICATION FORM
for INDIVIDUAL MEMBERSHIP
of the THIRD GENERATION PARTNERSHIP PROJECT
Please complete this form and return it to your Organizational Partner

COMPANY NAME .....

Please indicate below which ORGANIZATIONAL PARTNER you are a member of

ARIB	
CCSA	
ETSI	
ATIS	
TSDSI	
TTA	
TTC	

Please indicate below which Technical Specification Groups you wish to participate in:

Radio Access Network	
Core Network and Terminals	
Service and System Aspects	
GSM EDGE Radio Access Network (GERAN)	

Upon your approval as an Individual Member of the Third Generation Partnership Project you agree that you will be bound by the Working Procedures of the Third Generation Partnership Project then in effect and as they may be amended from time to time.

Signed by (Authorized Representative) (See Note 1)	
Print name	
Position	
Date	
Telephone	
Fax	
Email	
Company Website URL	

Contact person's family name (See Note 2)	
Contact person's given name	
Job title	
Mailing address	
Telephone	
Fax	

Email	

Note 1: Is either the official contact person or voting contact of a company.

Note 2: People attending meetings and who can also have signing authority.

top

Annex D: (Void)

top

Annex E: Guidance for MRP applicants

E.1 Introduction

The conditions for the acceptance of Market Representation Partners (MRPs) in 3GPP are given in article 7 of these Working Procedures. This annex provides additional guidance to MRP Applicants.

top

E.2 Guidance

During the application process, the Organizational Partners will need to be assured that an Applicant:

(a) Has a field of interest directly or indirectly related to the work being undertaken by 3GPP;

(b) Has attained a demonstrable level of recognition within this field of interest;

(c) Has an understanding of the market requirements relevant to 3GPP;

(d) Is willing to actively contribute to the work of 3GPP and has sufficient resources for this purpose;

(e) Fully supports the goals and objectives of 3GPP and does not take part in activities that conflict with these goals and objectives.

In processing an application, the Organizational Partners will peruse openly available documentation published by an Applicant, including material posted on its Website, in order to confirm that the points listed above have been satisfied.

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Annex F: Guidance on meeting organization

F.1 Meeting classification

TSG and WG Meetings are classified either:

- ordinary; or
- ad hoc.

top

F.2 Ordinary meetings

Ordinary meetings are ones where the regular business of the TSG or WG is conducted. Such meetings are normally chaired by the Group's Chair or, if unavailable, a Vice Chair. Ordinary meeting should be announced at least six months prior to the opening day of the meeting.

TSG and WG ordinary meetings shall follow an incrementing number sequence. If an additional ordinary meeting is required between two ordinary meetings, the sequence may be preserved, even though this means renumbering subsequent meetings, or the additional meeting may be numbered using the 'bis' suffix as a numbering scheme.

Attendance at an ordinary meeting counts towards an Individual Member's eligibility to cast a vote in the Group (see articles 26 and 27). The Support Team shall record the participation in an ordinary meeting (each person and organization represented) and the attendance list shall be included in the meeting report.

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F.3 Ad hoc meetings

An ad hoc meeting of a WG or a TSG is one called to address one or more particular topics. The ad hoc meeting shall be called by decision of the WG (or its parent TSG) or TSG concerned; the decision to hold any subsequent ad hoc meetings on the same topic may be made by the ad hoc meeting participants themselves without reference to the parent WG or TSG, although the parent WG or TSG shall review any ad hoc activity at every Ordinary meeting and determine to either continue or to close the ad hoc activity, even if the previous ad hoc meeting suggested a further meeting. The scope of each subsequent ad hoc meeting shall be indicated by the Chair at least 21 days before the meeting. The ad hoc meeting shall not expand or change the scope originally determined by the parent group. An ad hoc meeting is allowed to make decisions only within its pre-defined remit, and any such decisions shall be ratified by the parent WG or TSG unless, in the case of a WG, a decision was previously explicitly delegated by the WG to the ad hoc meeting.

An ad hoc meeting may be chaired as described for an ordinary meeting above, or, with the agreement of the WG or TSG concerned, by a Work Item rapporteur, or other appropriate person. Although open to all 3GPP Individual Members, ad hoc meetings may attract only a subset of Individual Member representatives who would normally participate in ordinary meetings.

Ad hoc meetings shall not be considered when calculating voting rights. That is, attendance at (or absence from) an ad hoc meeting shall not influence voting rights, which are determined solely by attendance at "ordinary" meetings.

No voting shall occur at ad hoc meetings.

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F.4 Attendance register

F.4.1 Face to face meetings

A delegate is deemed to have attended a given meeting if the individual confirms their participation by signing the attendance list made available by the group's secretary during the meeting. If a delegate does not sign the attendance sheet during the meeting, the secretary shall assume that the individual did not attend.

A delegate, having registered and begun to participate in a meeting, is not allowed to change their represented organization during the course of that meeting. An individual delegate is not allowed to simultaneously represent two or more Individual Members at a meeting.

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F.4.2 Electronic meetings

Electronic meetings such as audio / video conferences, email exchanges considered as meetings, etc, are encouraged where appropriate. For such events, the Secretary will establish the attendance list on the basis of those actually participating in the meeting (those dialling in to the conference bridge, those issuing and responding to emails, etc.) Nevertheless, advance registration is strongly encouraged.

Fully electronic meetings are to be considered as "ad hoc" as defined above.

Participation by Individual Member in fully electronic meetings, or electronic participation in a face to face meeting (eg by phoning in) is not considered for the accrual or loss of voting rights.

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Annex G: Working agreements

"Working agreements" are tentative decisions reached by 3GPP groups in order to make progress on matters where consensus (as defined in annex A) cannot be reached. It is intended to be used in situations where there is a clear majority in favour of one approach, but a small minority has sustained opposition to that approach.

The working agreement process has the following steps:

- Consensus cannot be reached on an issue. A substantial majority of individual members prefer a given approach, but there is sustained opposition by a small minority of individual members, preventing consensus.
- The Chair declares a working agreement. The working agreement is documented in the meeting report
- The approach agreed to by the majority and documented in the working agreement can continue unimpeded.
- The working agreement is entered into the 3GPP working agreements page on the 3GPP web site. The window for challenging the working agreement is now open.
- Working agreements may be challenged, resulting in a formal vote. This potential vote would be held at the next meeting of the WG or parent TSG (whichever comes first). If the next meeting is less than 14 days after the establishment of the working agreement, then that meeting is skipped in determining the next meeting. The meeting for potential voting is documented on the 3GPP working agreements page of the 3GPP web site (http://www.3gpp.org/TSG-Working-Agreements).
- The challenge cut-off date is established. This is 7 days before the start of the meeting for potential voting. The cut-off date is documented on the 3GPP working agreements page of the 3GPP web site.
- Organizations wishing to challenge the working agreement may do so until the challenge window closes. A challenge may be made by informing the Chair of the group which will do the voting. Any received challenge is documented on 3GPP working agreements page of the 3GPP web site.
- The group which will be voting is informed of the intention to have a working agreement challenge vote and the specific voting question.
- If no challenge is received by the challenge cut-off date, then the working agreement is confirmed. The confirmation of the working agreement is documented on the 3GPP working agreements page of the 3GPP web site. The issue is closed.
- If a challenge is received, then a formal vote on the working agreement will occur at the designated meeting. If the draft agenda for the designated meeting has already been issued, then it will be updated to include the potential for voting on the working agreement. Voting is as described in articles 25, 26 and 32 of the working procedures with the exception that the requirement for quorum is waived.
- If the challenge fails (at least 71% in favour of the working agreement), then the working agreement is confirmed. The confirmation of the working agreement is documented on the 3GPP working agreements page of the 3GPP web site. The issue is closed.
- If the challenge succeeds (less than 71% in favour of the working agreement), then the working agreement fails. All changes which were made based on the working agreement shall be reversed and the group must continue to search for consensus. The overturning of the working agreement is documented on the 3GPP working agreements page of the 3GPP web site.
- Organizations may withdraw a challenge at any time in the process. If the last challenge is withdrawn after the challenge cut-off, then the working agreement is confirmed. The confirmation of the working agreement is documented on the 3GPP working agreements page of the 3GPP web site. The issue is closed.

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Annex H: Calculation of quorum in TSGs and WGs

Where calculation of a quorum is required in the context of a vote conducted in a TSG or a WG, the quorum shall be deemed to have been met if:
(B – P) / V >= Q
Where:

B is the number of ballot papers issued;

P is the number of proxy votes exercised (i.e. the number of ballot papers issued to delegates bearing authorization to cast votes by proxy);

V is the number of Individual Members having the right to vote at the meeting (including those with only the right to vote “in person” and not by proxy);

Q is the required quorum value given in article 26.

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Annex I: Special procedures for exceptional situations restricting travel

3GPP working procedures are designed around the concept of periodic face to face meetings. This is not always possible. This annex implements modifications to the working procedures intended to allow 3GPP to function in the absence of face to face meetings. The PCG has the responsibility of activating and deactivating this annex.

The following changes in the working procedures are in effect when this annex is activated:

Article 14: PCG tasks

The following item shall be added to the list of PCG tasks:

- *maintenance of the voting and voting rights process integrity, to include disciplinary action if required.*

Article 22: TSG and WG election of Chair and Vice Chairs

The following paragraph is removed from section 22.2

If a WG does not meet physically with enough frequency to maintain an up to date voting list, the working group may elect to escalate the voting for officers to the parent TSG.

Article 26: TSG and WG voting during a meeting

The following additions to article 26 are in effect:

If voting occurs in the context of an Electronic Meeting, then:

- *Proxies are not allowed.*
- *Quorum does not apply.*
- *The voting period shall be a minimum of 18 consecutive hours excluding the period 12:00 UTC Friday to 11:59 UTC Monday which excludes Saturday and Sunday in every time zone. The use of 18:00 UTC to 12:00 UTC the next day is recommended for the voting period.*
- *The voting period shall commence no earlier than the start of the Electronic meeting and complete before the closure of the meeting. Voting for elections may exceptionally extend past the scheduled end of the meeting if additional rounds are required to complete the election of all open positions. Such elections are considered to be part of the meeting in which the elections started.*
- *The starting and closing times of the vote shall be clearly announced and disseminated to all on the principal TSG or WG membership mail exploder lists.*
- *The list of Voting Members (IMs that are eligible to vote) is as defined in article 35. Delegates vote on behalf of the IM under which they have registered, and only delegates checked in to the meeting may vote.*
- *If, in accordance with Article 25, the TSG or WG decides that a secret ballot is required, voting shall preserve the secrecy of the votes cast.*
- *A secure voting tool provided by the MCC shall be used for elections, and is also encouraged for other matters where voting is required.*

Article 28: TSG or WG voting for the election of TSG or WG Chair and Vice Chair

The following new paragraph is added to the end of article 28:

If an election is held during an electronic meeting, the voting shall use the voting procedures described in Article 26 as amended by this Annex.

Article 30: TSG and WG meetings

The following new paragraph is added after the 2nd paragraph of this article:

Electronic meetings are encouraged where appropriate.

Article 30A: TSG and WG participation

The text in article 30A shall be replaced with:

IMs wishing to progress work on topics in 3GPP are expected to participate in both face to face meetings and electronic meetings.

If a 3GPP IM is materially interested in a specific topic but is unable to participate in a meeting by sending a delegate, the IM is urged to engage the support of other IMs whose delegates will be present at the meeting to present its views. If this is not possible for any reason, the IM may advise the Chair of the situation and may provide documents supporting their position. The Chair may facilitate the introduction of these documents during the meeting and the record of the meeting can include the discussion and outcome. The option to engage the Chair is intended for exceptional situations. The Chair has the right to decline the request.

Article 32: TSG and WG meeting agenda

The following paragraph is added:

The draft agenda shall indicate the start and end dates and times of the meeting. The draft agenda shall indicate if the meeting counts toward maintenance of voting rights.

Article 35: TSG and WG Voting Membership List

35.3 Established TSGs and WGs

The text in section 35.3 shall be replaced with:

To qualify for the voting list it is necessary for at least one delegate of an Individual Member to fulfill the voting rights establishment provisions of article 35.4 for the group concerned, without being removed according to the provisions of article 35.4.

An individual member having attained voting rights according to clause 35.4 has the right to cast a vote by proxy (see article 26). Thus, an Individual Member may not cast a vote by proxy during a meeting at which it is not represented unless it had already attained voting rights as described in clause 35.4.

35.4 Removal from and instatement to voting list

The word *reinstatement* in the title of section 35.4 shall be replaced by *instatement*

The text in section 35.4 shall be replaced with:

An Individual Member shall be removed from the voting list when either of the following happens:

1. *The Individual Member is not represented at three consecutive face to face ordinary meetings of the group (TSG or WG),*
2. *The Individual Member is not represented in two consecutive ordinary meetings of the group (TSG or WG) of which at least one is electronic*

The right to vote shall be instated or reinstated for an Individual Member at either of the following events:

1. *the second face to face ordinary meeting which a delegate of the Individual Member attends without missing the number of consecutive face to face ordinary meetings mentioned in the previous paragraph,*
2. *the third consecutive ordinary meeting which a delegate of the Individual Member attends*

Note: See article 35.3 for eligibility to cast a proxy vote.

EXAMPLE 1: *If Individual Member Z is represented at face to face ordinary meeting K and K+3 (and is thus eligible to vote) but is not represented at face to face ordinary meetings K+4, K+5 and K+6, it is removed from the voting list.*

EXAMPLE 2: *If Individual Member X, not previously having been represented at an face to face ordinary meeting of the group, is represented at face to face ordinary meetings N and N+3, it may cast a vote at face to face ordinary meeting N+3.*

NOTE: *Individual Member X might choose to cast a vote by proxy at face to face ordinary meeting N+3, even though its delegate is physically present. This is sometimes useful for coordinating company positions where one large company has several Individual Memberships, possibly via several different Organizational Partners.*

EXAMPLE 3: *If Individual Member Y, not previously having been represented at a meeting of the group, is represented at ordinary meeting N only, it may not cast a vote by proxy at ordinary meeting N+2.*

EXAMPLE 4: *If Individual Member A is represented at electronic ordinary meetings N, N+1, and N+2 (and is thus eligible to vote) but is not represented at electronic ordinary meetings N+3 and N+4, it is removed from the voting list.*

EXAMPLE 5: *If Individual Member B, not previously having been represented at an ordinary meetings of the group, is represented at electronic ordinary meetings N, N+1, and N+2, it may cast a vote at electronic ordinary meeting N+2.*

35.5 (Void)

The contents of this section shall be struck and the heading replaced with VOID.

The following subclause is added to Article 35:

35.6 OP Voting Rights Hardship Exemption

For an IM belonging to an OP that has a voting rights hardship exemption for a given meeting, then missing the meeting is not counted in the voting rights algorithm. (In other words, for that IM, it is treated as though the meeting did not occur). If an IM covered by a voting rights hardship exemption for voting rights does attend the meeting, then it is counted as normal attendance.

If an IM covered by voting rights hardship exemption misses a meeting, there will be a permanent record (e.g., in the relevant meeting report) to note the list of IMs who have the voting rights hardship exemption for that meeting, and the voting rights list will also indicate the voting rights hardship exemption for the relevant meeting.

Voting rights hardship exemptions are granted on a per OP, per meeting basis.

Annex A: Definitions

The following 4 definitions are added:

Ad hoc Meeting	*A meeting called to address one or more particular topics that is not an ordinary meeting (see F.3)*
Electronic meeting:	*A electronic meeting is one where all the participants connect to the meeting using electronic means such as audio/video conference, email, etc.*
Face to face meeting:	*A face to face meeting, also referred to as a physical meeting, is one held at a designated physical location where participants are invited to attend in person.*
Ordinary Meeting	*A meeting where the ordinary business of a group is conducted (see F.2).*

Annex F: Guidance on meeting organization

The title of Annex F shall be changed to Guidance on TSG and WG meeting Organization

F.2 Ordinary meetings

The contents of clause F.2 shall be replaced with the following:

Ordinary meetings are ones where the regular business of the TSG or WG is conducted. Such meetings are normally chaired by the Group's Chair or, if unavailable, a Vice Chair. Ordinary meetings should be announced at least six months prior to the opening day of the meeting. An ordinary meeting may be held as a face to face meeting or as an electronic meeting.

TSG and WG ordinary meetings shall follow an incrementing number sequence. If an additional ordinary meeting is required between two ordinary meetings, the sequence may be preserved, even though this means renumbering subsequent meetings, or the additional meeting may be numbered using the 'bis' suffix as a numbering scheme. Ordinary meetings that are held electronically shall be designated with an 'e' suffix.

Attendance at an ordinary meeting counts towards an Individual Member's eligibility to cast a vote in the Group (see articles 26 and 27). The Support Team shall record the participation in an ordinary meeting (each person and organization represented) and the attendance list shall be included in the meeting report.

If a meeting is designated as face to face, provisions to support remote participation (e.g. by using additional audio/video capabilities) would be at the discretion of the host and leadership. In a meeting designated as face to face, those participating remotely are not to be counted toward quorum or attendance, and are not allowed to vote.

Following each ordinary meeting, the Support Team shall publish a list of IMs that have gained or lost voting rights at that meeting.

F.3 Ad hoc meetings

The contents of clause F.3 shall be replaced with the following:

An ad hoc meeting of a WG or a TSG is one called to address one or more particular topics. An ad hoc meeting may be held as a face to face or as an electronic meeting. The ad hoc meeting shall be called by decision of the WG (or its parent TSG) or TSG concerned; the decision to hold any subsequent ad hoc meetings on the same topic may be made by the ad hoc meeting participants themselves without reference to the parent WG or TSG, although the parent WG or TSG shall review any ad hoc activity at every Ordinary meeting and determine to either continue or to close the ad hoc activity, even if the previous ad hoc meeting suggested a further meeting. The scope of each subsequent ad hoc meeting shall be indicated by the Chair at least 21 days before the meeting. The ad hoc meeting shall not expand or change the scope originally determined by the parent group. An ad hoc meeting is allowed to make decisions only within its pre-defined remit, and any such decisions shall be ratified by the parent WG or TSG unless, in the case of a WG, a decision was previously explicitly delegated by the WG to the ad hoc meeting.

An ad hoc meeting may be chaired as described for an ordinary meeting above, or, with the agreement of the WG or TSG concerned, by a Work Item rapporteur, or other appropriate person. Although open to all 3GPP Individual Members, ad hoc meetings may attract only a subset of Individual Member representatives who would normally participate in ordinary meetings.

Ad hoc meetings shall not be considered when calculating voting rights. That is, attendance at (or absence from) an ad hoc meeting shall not influence voting rights, which are determined solely by attendance at "ordinary" meetings.

No voting shall occur at ad hoc meetings.

F.4 Attendance Register

The contents of clause F.4 (and subclauses) shall be replaced with the following:

A delegate is deemed to have attended a given meeting if the individual confirms their participation by checking in. If a delegate does not check in during the meeting, the secretary shall assume that the individual did not attend. Checking in must be performed between the start and end of the meeting. In addition, the check in process shall clearly inform the delegate that 'Checking in carries the responsibility for participating in relevant parts of the meeting'.

A delegate, having registered and checked in to a meeting, is not allowed to change their represented organization during the course of that meeting. An individual delegate is not allowed to simultaneously represent two or more Individual Members at a meeting.

F.4.1 (void)

F.4.2 (void)

Annex G: Working agreements

The following changes to Annex G are in effect:

Challenge votes may be conducted at Electronic meetings provided they are Ordinary meetings.

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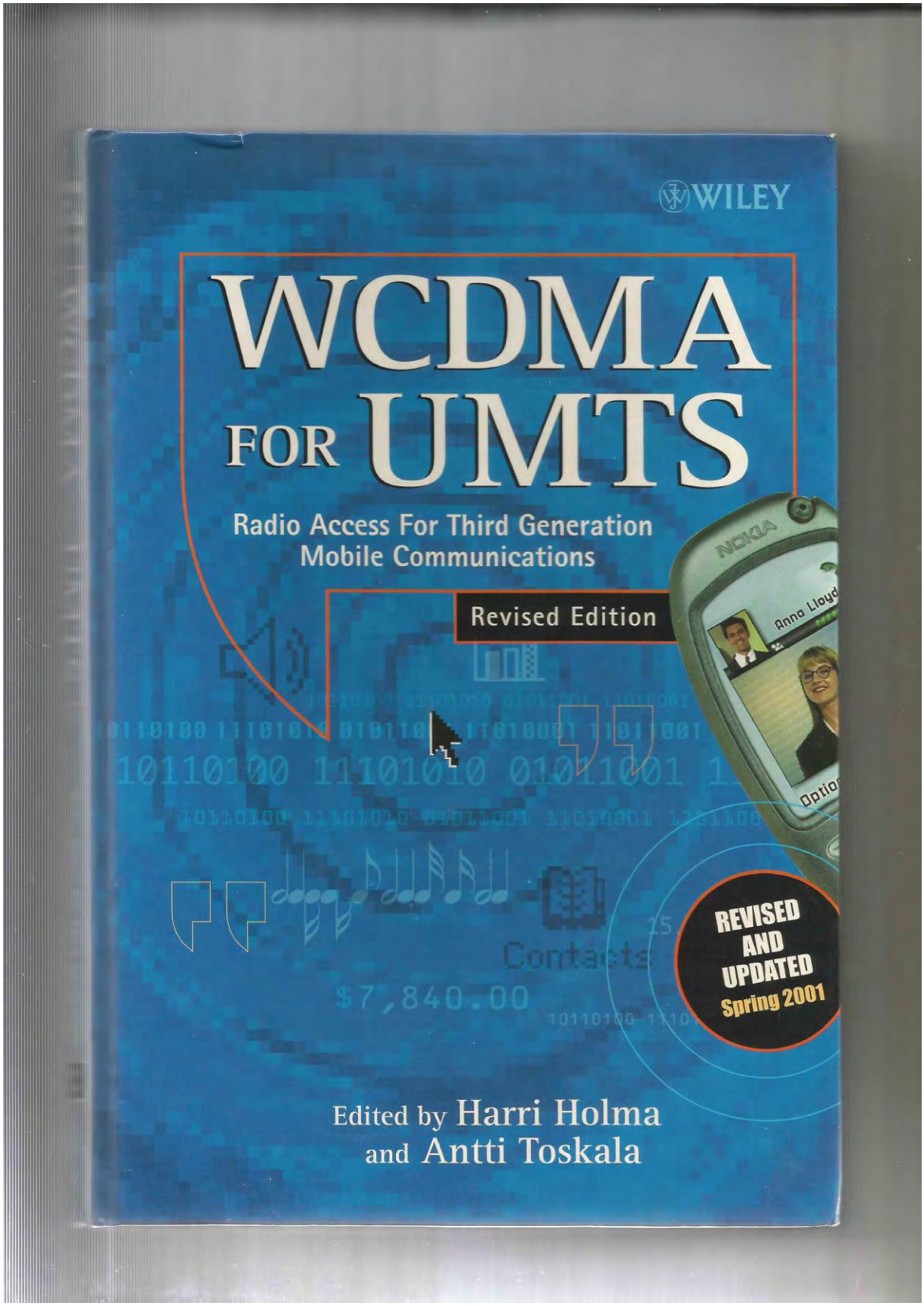
Annex J: Change history

Date	PCG #	PCG Doc.	CR	Rev	Subject/Comment
2002-04-25	6				
2005-03-01	13				Changes agreed at PCG meeting incorporated. [No formal change control system yet in place]
2006-04-24	16	PCG16_07	2		ETSI proposal: Article 10 Clarify the rights of observers and guests
			3		ETSI proposal: Article 15 To allow leeway in the number of delegates representing each OP at PCG (To reflect the decision already taken by PCG#14 on PCG participation)
			9		ETSI proposal: Article 34 To cater for current TSG structure and to reflect common practice of Tdoc numbering
			1	1	Article 3 Reflect decision on regional options (To incorporate PCG#7 decision)
			4	1	Article 22 Clarification and codification of the rights to stand for elected positions in TSGs and WGs
			8		Article 30 & annex F Inclusion of an annex giving guidance on meeting organization
2006-10-27	17	PCG17_15 r1	10		Article 35 Clarification of voting rights
2009-05-18	22	PCG22_18	11	5	Changes resulting from the OP ad hoc group on improvements report and conclusions of OP#20. Articles affected: 22 23 31 35 41 52 Annex D plus sundry spelling corrections.
		PCG22_19	12	2	Rules on eligibility to cast votes at TSG and WG level.
		PCG22_20	13		Bring statement of purpose of 3GPP up to date
		PCG22_23	14		Adding Working Agreements to working procedures
		PCG22_30 r3	15	3	Change of ITU liaison process Note: PCG meeting #22 approved contribution PCG22_30r1 but this was subsequently revised to r3 after the meeting with the apparent approval of the PCG.
					Decision PCG22/11: clause 22.1 changed wording from "in the March time frame in" to "in the first semester of".
2009-08-12					Editorial correction to implementation of CR15r3. (article 52).
2010-04-23	24	PCG24_11	16		TSG vs WG election
		PCG24_12	17		Quorum
		PCG24_13	18		Communication with ITU
		PCG24_25	19		Attendance register for meetings
2012-10-24		PCG29_17	20		Update to 3GPP Working Procedures article 22
2014-07-22	33	PCG33_10	21		Anti-trust / competition law requirements articles 12, 17, 22.1, 23, 29, 59A, annex C
2014-12-31	34	PCG34_14	22		Anti-trust recommendations v1.1.
					Addition of TSDSI to list of OPs in annexes B and C. Minor formatting and spelling corrections, consistent capitalization.

2016-11-15	35	PCG37_14	23		Article 22.1 Modification to clarify obligation on elected officials regarding antitrust/competition law training.
2019-08-22	42	(none)	24		Article 55 Correction of text to reflect actual practice. Note: Decision taken by email in response to Action PCG42/7.
2019-08-23	42	PCG42_18	25		Article 22.2 Adds text allowing WGs which meet infrequently to escalate elections of their officials to the parent TSG. Article 25 Adds text allowing WGs which meet infrequently to escalate technical votes to the parent TSG. Article 30A (new) Introduces procedures for situations where an IM is unable to send a delegate in person to a meeting but nevertheless wishes to contribute to the proceedings. Secretary's note 1: Annex B Added abbreviation 'IM', though this was not included in PCG42_18. Secretary's note 2: Corrected the CR numbers in the previous two change history entries.
2020-02-07	43	PCG43_14			Annex G: Removal of the statement that voting on working agreements was to be a standard element of every meeting agenda. Addition of a reference to article 32. Removal of the requirement for a quorum during voting on working agreements.
2020-05-15	44				Addition of "crisis annex"
2020-09-30	45	PCG45_11			Update to 3GPP Working Procedures Annex I ("crisis annex")
2021-04-29	46	PCG46_20			Decision PCG46/09: Gender Neutrality Changes Annex I Change minimum voting window from 24 to 18 hours
2022-03-07	48	PCG48_12			Voting Rights pCR to Annex I
2022-03-07	48	PCG48_13			Hardship Exemption pCR to Annex I
2022-09-01	49	-			Working Procedures P-CR for Registration

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Appendix 6


WILEY
WCDMA
FOR UMTS
Radio Access For Third Generation
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Spring 2001
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and Antti Toskala

WCDMA FOR UMTS

Radio Access For Third Generation Mobile Communications

Revised edition

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4.5.3 *cdma2000*

The cdma2000 air interface proposal to ITU is the result of work in TR45.5 on the evolution of IS-95 towards the third generation. The cdma2000 proposal is based partly on IS-95 principles with respect to synchronous network operation, common pilot channels, and so on, but it is a wideband version with three times the bandwidth of IS-95. The ITU proposal contains further bandwidth options as well as the multi-carrier option for downlink. The cdma2000 proposal has a high degree of commonality with the Global CDMA 1 ITU proposal from TTA, Korea.

The cdma2000 multi-carrier option is covered in more detail in Chapter 13, as being currently standardised by 3GPP2.

4.5.4 *TR46.1*

The WIMS W-CDMA was not based on work derived from an existing second generation technology but was a new third generation technology proposal with no direct link to any second generation standardisation. It was based on the constant processing gain principle with a high number of multicodes in use, thus showing some fundamental differences but also a level of commonality with WCDMA technology in other forums.

4.5.5 *WP-CDMA*

WP-CDMA (Wideband Packet CDMA) resulted from the convergence between W-CDMA N/A of T1P1 and WIMS W-CDMA of TR46.1 in the US. The main features of the WIMS W-CDMA proposal were merged with the principles of W-CDMA N/A. The merged proposal was submitted to the ITU-R IMT-2000 process towards the end of 1998, and to the 3GPP process at the beginning of 1999. Its the most characteristic feature, compared with the other WCDMA-based proposals, was a common packet mode channel operation for the uplink direction, but there were also a few smaller differences.

4.6 Creation of 3GPP

As similar technologies were being standardised in several regions around the world, it became evident that achieving identical specifications to ensure equipment compatibility globally would be very difficult with work going on in parallel. Also, having to discuss similar issues in several places was naturally a waste of resources for the participating companies. Therefore initiatives were made to create a single forum for WCDMA standardisation for a common WCDMA specification.

The standardisation organisations involved in the creation of the 3rd Generation Partnership Project (3GPP) [9] were ARIB (Japan), ETSI (Europe), TTA (Korea), TTC (Japan) and T1P1 (USA) as shown in Figure 4.2. The partners agreed on joint efforts for the standardisation of UTRA, now standing for Universal Terrestrial Radio Access, as distinct from UTRA (UMTS Terrestrial Radio Access) from ETSI, also submitted to 3GPP. Companies such as manufacturers and operators are members of 3GPP through the respective standardisation organisation to which they belong.

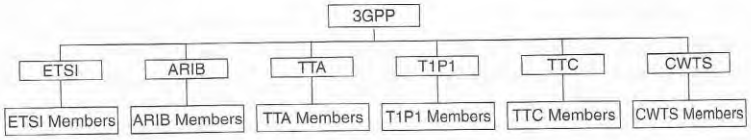


Figure 4.2. 3GPP organisational partners

Later during 1999, CWTS (the China Wireless Telecommunication Standard Group) also joined 3GPP and contributed technology from TD/SCDMA, a TDD-based CDMA third generation technology already submitted to ITU-R earlier.

3GPP also includes market representation partners: GSM Association, UMTS Forum, Global Mobile Suppliers Association, IPv6 Forum and Universal Wireless Communications Consortium (UWCC). In [9] there are up-to-date links to all participating organisations.

The work was initiated formally at the end of 1998 and the detailed technical work was started in early 1999, with the aim of having the first version of the common specification, called Release-99, ready by the end of 1999.

Within 3GPP, four different technical specification groups (TSG) were set up as follows:

- Radio Access Network TSG
- Core Network TSG
- Service and System Aspects TSG
- Terminals TSG

Within these groups the one most relevant to the WCDMA technology is the Radio Access Network TSG (RAN TSG), which has been divided into four different working groups as illustrated in Figure 4.3.

The RAN TSG will produce Release-99 of the UTRA air interface specification. The work done within the 3GPP RAN TSG working groups has been the basis of the technical description of the UTRA air interface covered in this book. Without such a global initiative, this book would have been forced to focus on a single regional specification, though with many similarities to those of other regions. Thus the references throughout this book are to the specification volumes from 3GPP.

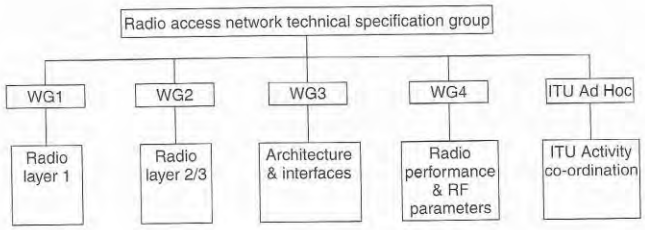


Figure 4.3. 3GPP RAN TSG working groups

During the first half of 1999 the inputs from the various participating organisations were merged in a single standard, leaving the rest of the year to finalise the detailed parameters for the first full release, Release-99, of UTRA from 3GPP. The member organisations have undertaken individually to produce standard publications based on the 3GPP specification. Thus, for example, the Release-99 UMTS specifications from ETSI are identical to the Release-99 specifications produced by 3GPP. The latest specifications can be obtained from 3GPP [9].

During 2000, further work on GSM evolution was moved from ETSI and other forums to 3GPP, including work on GPRS and EDGE. A new TSG, TSG GERAN was set up for this purpose.

4.7 Creation of 3GPP2

Work done in TR45.5 and TTA was merged to form 3GPP2, focused on the development of cdma2000 Direct-Sequence (DS) and Multi-Carrier (MC) mode for the cdma2000 third generation component. This activity has been running in parallel with the 3GPP project, with participation from ARIB, TTC and CWTS as member organisations. Recently the main concentration has been on the MC mode work, due to decisions resulting from the global harmonisation efforts.

4.8 Harmonisation Phase

During the spring of 1999 several operators and manufacturers held series of meetings to seek further harmonisation and convergence between the CDMA-based third generation solutions, WCDMA and cdma2000. For the 3GPP framework the ETSI, ARIB, TTA and T1P1 concepts had already been merged to a single specification, while cdma2000 was still on its own in TR45.5. As a result of several meetings and telephone conferences, the manufacturers and operators agreed to adopt a harmonised global third generation CDMA standard consisting of three modes: Multi-Carrier (MC), Direct Spread (DS) and Time Division Duplex (TDD). The MC mode was based on the cdma2000 multi-carrier option, the DS mode on WCDMA (UTRA FDD), and the TDD mode on UTRA TDD. The agreement was to phase in a modular approach in which both core networks could be used with all air interface alternatives, as described in Figure 1.4 in Chapter 1.

The main technical impacts of these harmonisation activities were the change of UTRA FDD and TDD mode chip rate from 4.096 Mcps to 3.84 Mcps and the inclusion of a common pilot for UTRA FDD. The work in 3GPP2 focused on the MC mode, and the DS mode from cdma2000 was abandoned. The result is that globally there is only one Direct Spread (DS) wideband CDMA standard, WCDMA.

4.9 IMT2000 Process in ITU

In the ITU, recommendations have been developed for third generation mobile communications systems, the ITU terminology being called IMT-2000 [10], formerly FPLMTS. In the ITU-R, ITU-R TG8/1 has worked on the radio-dependent aspects, while the radio-independent aspects have been covered in ITU-T SG11.

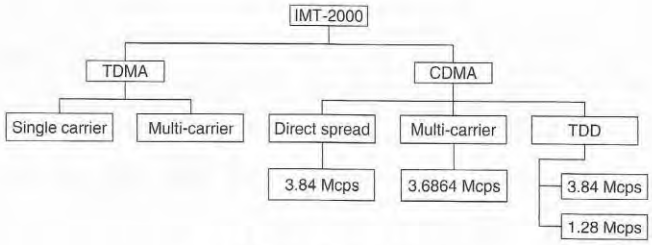


Figure 4.4. ITU-R IMT-2000 grouping

In the radio aspects, ITU-R TG8/1 received a number of different proposals during the IMT-2000 candidate submission process. In the second phase of the process, evaluation results were received from the proponent organisations as well as from the other evaluation groups that studied the technologies. During the first half of 1999 recommendation IMT.RKEY was created which describes the IMT-2000 multimode concept.

The ITU-R IMT-2000 process was finalised at the end of 1999, when the detailed specification (IMT-RSCP) was created and the radio interface specifications were approved by ITU-R [11]. The detailed implementation of IMT-2000 will continue in the regional standards bodies. The ITU-R process has been an important external motivation and timing source for IMT-2000 activities in regional standards bodies. The requirements set by ITU for an IMT-2000 technology have been reflected in the requirements in the regional standards bodies, for example in ETSI UMTS 21.01 [5], in order for the ETSI submission to fulfil the IMT-2000 requirements. The ITU-R interaction between regional standardisation bodies in the IMT-2000 process is reflected in Figure 4.5.

The ITU-R IMT-2000 grouping, with TDMA- and CDMA-based groups, is illustrated in Figure 4.4. The UTRA FDD (WCDMA) and cdma2000 are part of the CDMA interface, as CDMA Direct Spread and CDMA Multi-Carrier respectively. UWC-136 and DECT are part of the TDMA-based interface in the concept, as TDMA Single Carrier and TDMA Multi-Carrier respectively. The TDD part in CDMA consists of UTRA TDD from 3GPP and TD-SCDMA from CWTS. For the FDD part in the CDMA interface, harmonisation has been completed, and the harmonisation process is expected to continue for the CDMA TDD mode within 3GPP during 2000 and 2001.

4.10 Beyond 3GPP Release-99

Upon completion of the Release-99 specifications, work will concentrate on specifying new features as well as making the necessary corrections to Release-99. Typically such corrections arise as implementation proceeds and test systems are updated to include the latest changes in the specifications. As experience in various forums has shown, a major step forward in system capabilities with many new features requires a phasing-in period for the specifications. Fortunately, the main functions have been verified in the various test systems in operation since 1995, but only the actual implementation will reveal any errors and inconsistencies in the fine detail of the specifications.

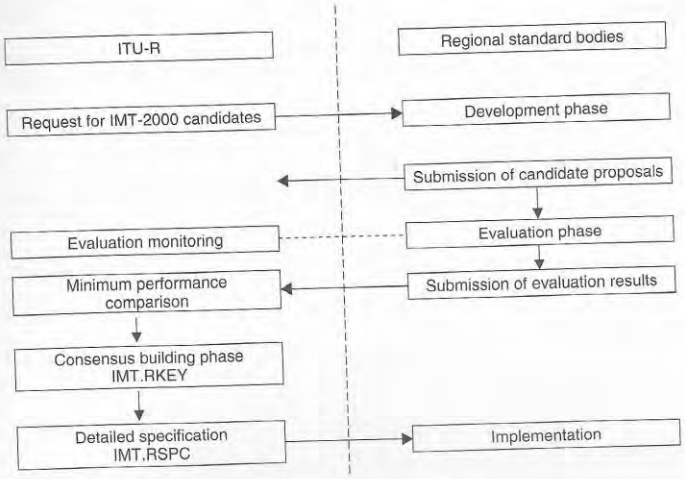


Figure 4.5. Relationship of ITU-R to the regional standards bodies

In 3GPP the next version of the specifications was originally considered as Release 2000, but since that the Release naming was adjusted so that next release is called Release 4 due to the 03/2001. Release 4 will contain only minor adjustment with respect to the Release'99. Bigger items are foreseen for inclusions in Release 5, including reaching for the data rates even up to the 10 Mbps in the downlink direction. Release 5 is due for the end of 2001. Release'99 specifications have a version number starting with 3 while Release 4 and 5 specifications have version number starting logically with 4 and 5 respectively.

During coming years, part of the process is to specify the extensions for connecting UTRA FDD to IS-41 based core networks. Work will be carried out on cdma2000 to allow connection to GSM-based core networks. This development will offer operators some degree of flexibility in selecting their third generation technology, assuming they are not aiming to launch such a service immediately, since Release-99 does not yet contain these options.

On the TDD side, further alignment is expected between the TDD mode in UTRA and the TDD mode from CWTS (China). This process is expected to continue after Release-99 is completed in 3GPP. 3GPP Release-4 is also planned to cover the lower chip rate (1.28 Mcps) TDD.

Other interesting developments are expected in the area of using IP based technology in UTRA. First step is going to be the IP based transport option in Release 4 and further releases are likely to see IP technology shaping the internal architecture of the UTRA Network (UTRAN). Also some of the protocols developed by the Internet Engineering Task Force (IETF) [12], such as robust IP header compression suitable for cellular transmission, are foreseen to be adopted as part the UTRA Rel'4 specifications.

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[12] http://www.ietf.org

Appendix 7

MCC Activity Report

Source

Adrian Scrase

Contents

- Departures and Arrivals
- Resource Allocation
- Workload
- 3GPP Membership
- 3G Ultimate Project
- Summary and Outlook

Departures and Arrivals

Adrian Zoicas retired from ETSI as of February 2015

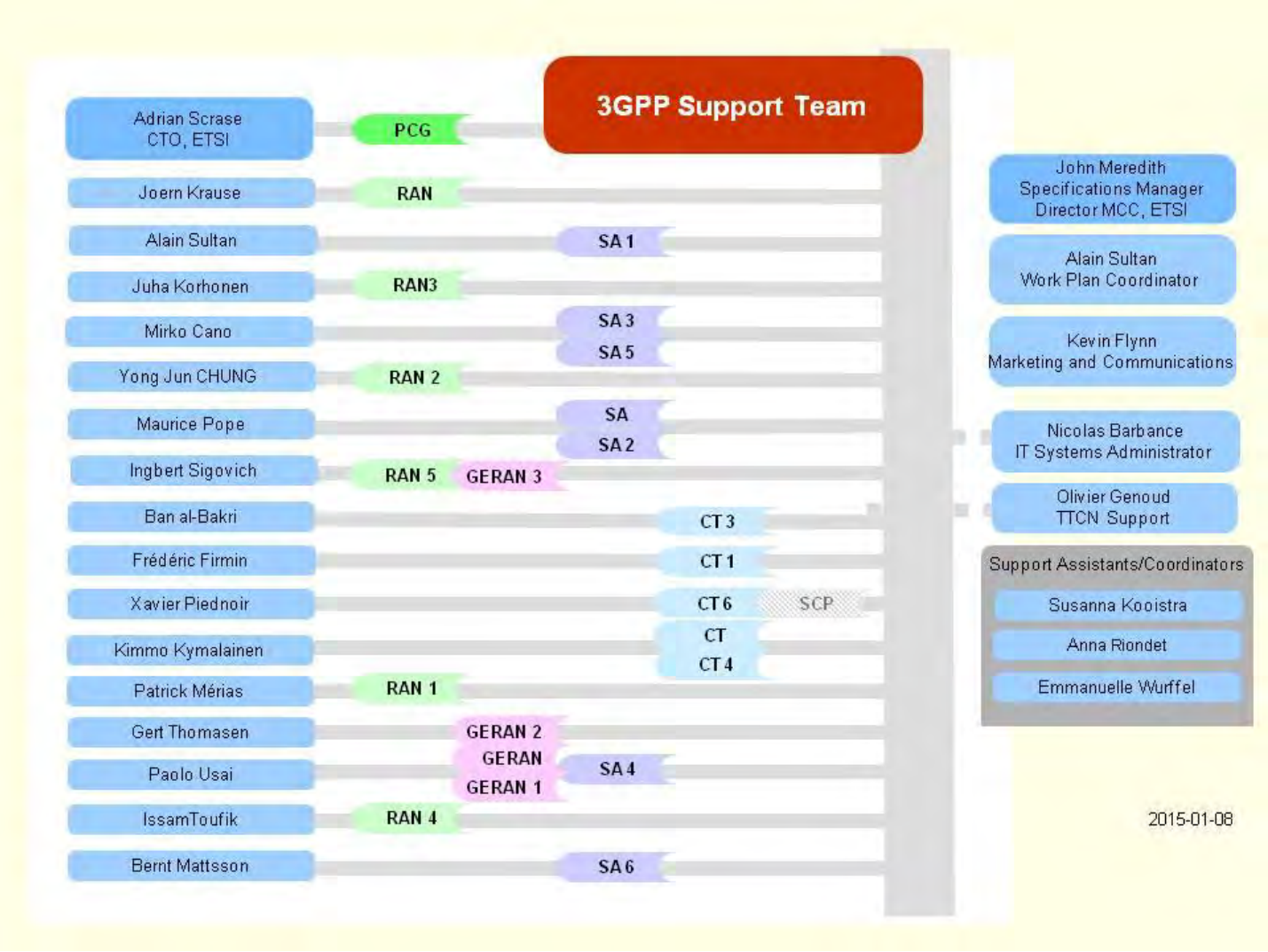


He has been temporarily replaced by Ban Al Bakri who will support CT3 until end April 2015



A more permanent solution for CT3 support is being pursued

Current Resource Allocation



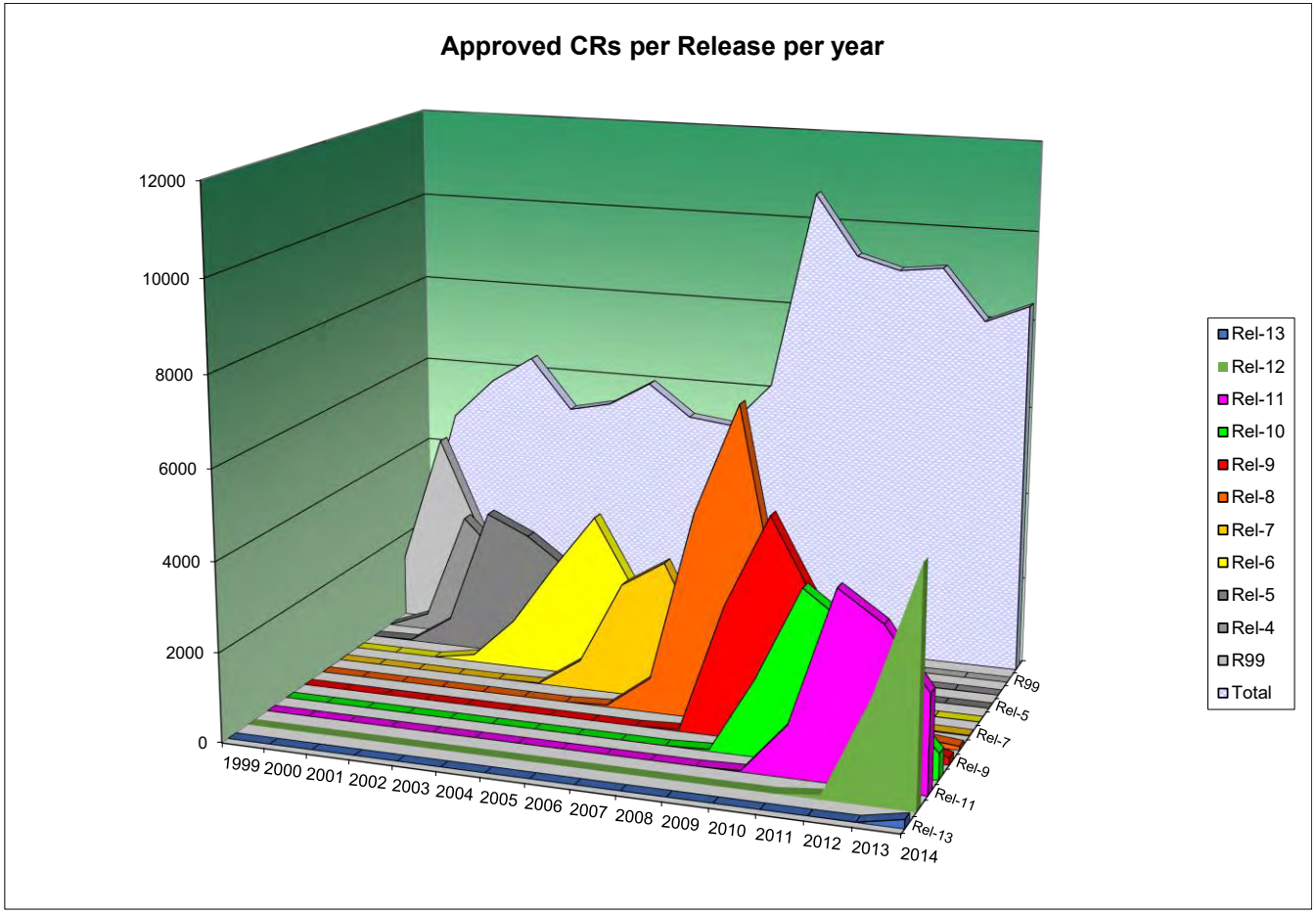
Workload

Approved CRs per Release per Year

Release	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
R99	1408	4398	2266	1004	581	512	111	42	23	5	5	1	0				**10356**
Rel-4		376	2828	1900	690	257	122	63	48	22	20	13	11	8	7	2	**6367**
Rel-5		27	644	3274	2842	2162	1357	509	94	25	22	7	7	5	3	2	**10980**
Rel-6				172	1088	2458	3721	2074	1078	212	74	19	17	10	4	4	**10931**
Rel-7					1	20	663	2529	3132	1262	492	176	91	43	25	15	**8449**
Rel-8								49	777	4609	7073	2347	706	347	184	91	**16183**
Rel-9										49	2918	4991	3252	1366	376	165	**13117**
Rel-10											47	1722	3800	3103	1636	584	**10892**
Rel-11												32	1152	4178	3525	2186	**11073**
Rel-12													6	102	2254	5181	**7543**
Rel-13															8	200	**208**
Total	**1408**	**4801**	**5738**	**6350**	**5202**	**5409**	**5974**	**5266**	**5152**	**6184**	**10651**	**9308**	**9042**	**9162**	**8022**	**8430**	**106099**

Workload

Approved CRs per Release per Year

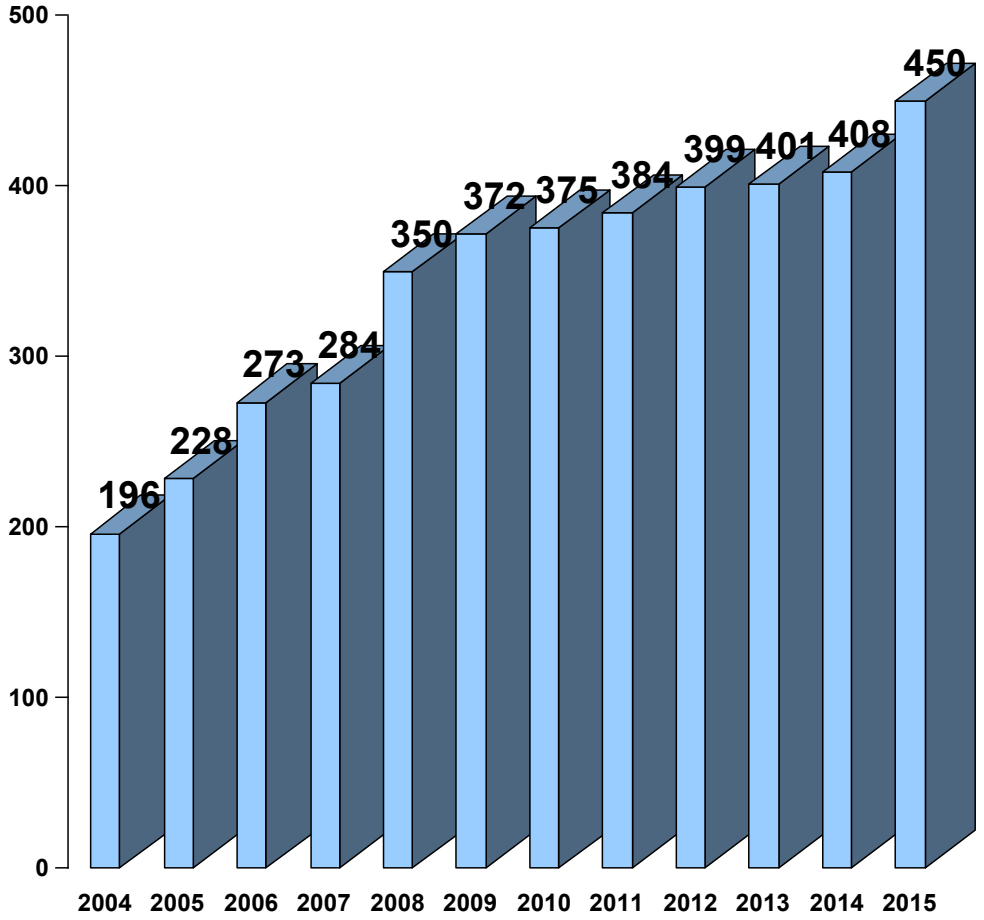


3GPP Membership

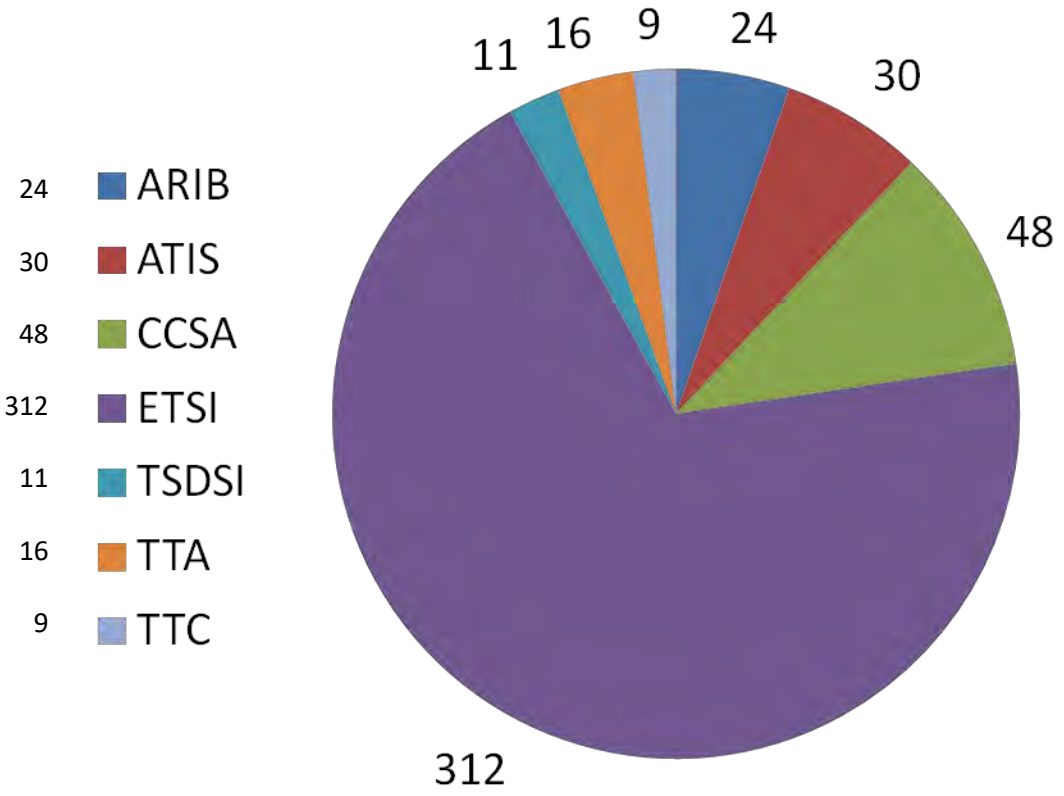
3GPP Membership has peaked in 2015 with *450* Individual Members. In addition, there are 23 companies having Guest Status, which are potential IMs

Number of Individual Members in 3GPP

3GPP Individual Members come from 41 Countries worldwide



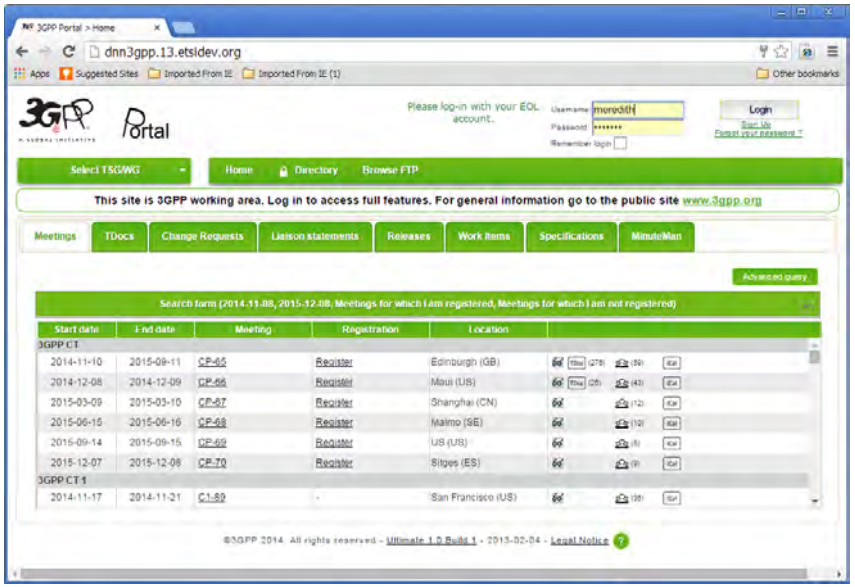
Individual Members in 3GPP



3GPP Ultimate Project (3GU)

Data import from the old databases to the 3GPP Ultimate portal occurred in early January 2015. The 3GU database is now the master source for specs and releases. Over the coming months, 3GU will be the prime source of progressively more data. At present, the 3GPP web site http://www.3gpp.org and the 3GU portal http://portal.3gpp.org both offer information on meetings, specifications, tdocs, CRs, etc, and both should be aligned.

Several WGs (e.g., RAN1, SA1, SA6, CT3, CT4, CT6) plus CT plenary have used 3GU for TDoc number allocation, and though some bugs have been reported, the feedback from MCC secretaries and delegates alike has been generally very positive. We expect all groups to be using 3GU by 2015 Q3,



" Our experience of using 3GU tool for allocating and uploading the tdocs has been very impressive. Even dozens of tdocs were uploaded all together in just few seconds. This has saved many hours of our effort that in the past was needed for uploading tdocs via the old ADN! So this is really a big improvement in efficiency. "

Summary and Outlook

The number of IMs within 3GPP continues to grow and the advent of 5G work is likely to add to that increase. This will change the dynamics within the project over time.

The workload within 3GPP is relatively constant although there is a slight increase in the number of physical meetings.

Discussions on the organizational structure within 3GPP continue (*cf* RAN/GERAN) and this will be monitored to ensure that support resources are always commensurate with the project structure.

Improvements in 3GPP tooling are well underway and the effectiveness of these tools will become more apparent towards the end of 2015.

Appendix 8

The 3G IP Multimedia Subsystem (IMS)

Merging the Internet and the Cellular Worlds

Gonzalo Camarillo and Miguel A. García-Martín

Both of
Ericsson, Finland



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Chapter 2

The History of the IMS Standardization

In Chapter 1 we mentioned that the IMS uses Internet protocols. When the IMS needs a protocol to perform a particular task (e.g., to establish a multimedia session), the standardization bodies standardizing the IMS take the Internet protocol intended for that task and specify its use in the IMS. Still, no matter how simple this may sound the process of choosing protocols to be used in the IMS can sometimes get tricky. Sometimes, the Internet protocol that is chosen lacks some essential functionality, or does not even exist at all. When this happens the IMS standardization bodies contact the standardization body developing Internet protocols to work together on a solution. We will cover this collaboration in Section 2.5. Nevertheless, before jumping into that we will introduce in Section 2.1 all the standardization bodies involved in IMS development. We need to know who is who and which functions of the IMS each of them performs.

2.1 Relations between IMS-related Standardization Bodies

The ITU (International Telecommunication Union) IMT-2000 (International Mobile Telecommunications-2000) is the global standard for 3G (third generation) networks. IMT-2000 is the result of the collaboration between different standards bodies and aims at providing access to telecommunication services using radio links, which include satellite and terrestrial networks.

We will focus on two of the standard bodies involved in IMT-2000: 3GPP (Third Generation Partnership Project) and 3GPP2 (Third Generation Partnership Project 2). Still, they are not the only ones working within IMT-2000. Other bodies, such as the ITU-R (ITU-Radiocommunication Sector), for instance, are also involved in IMT-2000 but on different areas than the IMS.

Both 3GPP and 3GPP2 have standardized their own IMS (IP Multimedia Subsystem). The 3GPP IMS and the 3GPP2 IMS are fairly similar, but, nevertheless, have a few differences (Appendix A lists the most important differences).

An important similarity between the 3GPP IMS and the 3GPP2 IMS is that both use Internet protocols, which have been traditionally standardized by the IETF (Internet Engineering Task Force). Consequently, both 3GPP and 3GPP2 collaborate with the IETF in developing protocols that fulfill their requirements. The following sections introduce the IETF, 3GPP, and 3GPP2 and provide a brief history of the IETF-3GPP/3GPP2 collaboration.

In addition to the standard bodies we have just mentioned, OMA (Open Mobile Alliance [144]) will play an important role in developing IMS services in the near future. While 3GPP and 3GPP have standardized (or are standardizing) a few IMS services, such as basic video calls or conferencing, from now on OMA will focus on service standardization for the IMS (of course, other standard bodies and third parties besides OMA may also develop services for the IMS).

2.2 Internet Engineering Task Force (IETF)

The Internet Engineering Task Force (IETF) is a loosely self-organized collection of network designers, operators, vendors, and research institutions that work together to develop the architecture, protocols, and operation of the public Internet. The IETF is body that is open to any interested individual. The IETF is not a corporation and, therefore, does not have a board of directors, members, nor dues.

The IETF is the standardization body that has developed most of the protocols that are currently used on the Internet. The IETF does not standardize networks, architectures combining different protocols, the internal behaviour of nodes, nor APIs (Application Programming Interface). The IETF is the protocol factory for IP-related protocols.

2.2.1 Structure of IETF

Work in the IETF is organized in working groups. Each working group is chartered to perform specific tasks, such as the delivery of a precise set of documents. Each working group has from one to three chairs, who take care that the working group completes its chartered tasks in time. Working groups have a temporary lifetime; so, once they have delivered their documents, either they are rechartered or they cease to exist. Figure 2.1 shows a few, but not all, of the working groups in the IETF; there are more than 100 active working groups in the IETF. The complete up-to-date list of active working groups is available at:

`http://www.ietf.org/html.charters/wg-dir.html`

Working groups get an acronym name that identifies the chartered task. For instance, SIPPING is the acronym of "Session Initiation Protocol Investigation", SIMPLE is the acronym of "SIP for Instant Messaging and Presence Leveraging Extensions" or AAA for "Authentication, Authorization and Accounting".

A collection of working groups form an Area Directorate. There are currently eight areas, as illustrated in Figure 2.1.

Each area has one or two area directors who, together with the IETF chairman, form the IESG (Internet Engineering Steering Group). The IESG is the technical

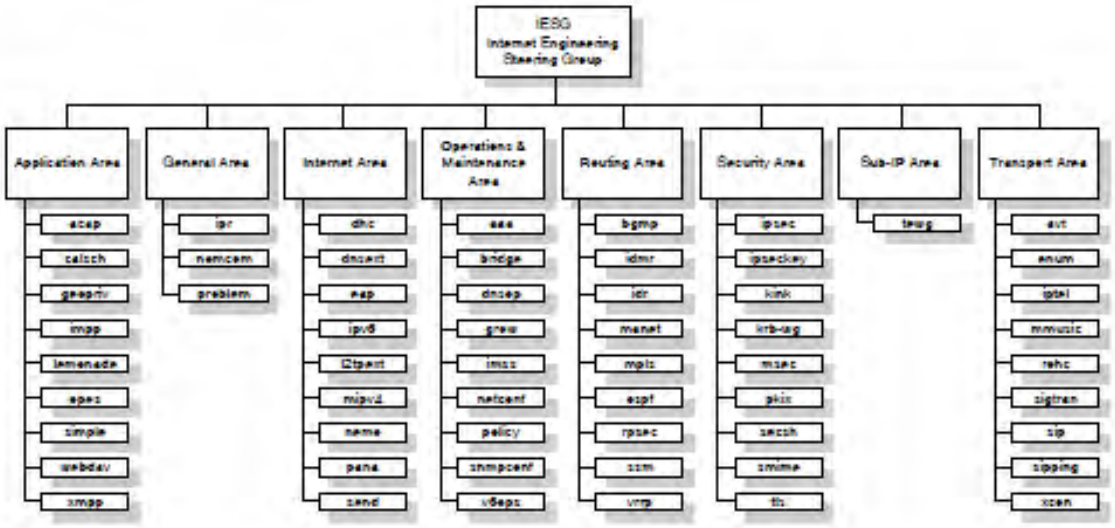


Figure 2.1: The structure of the IETF

management team of the IETF. They decide on which areas the IETF should work and review all the specifications that are produced.

The following web pages contain the complete list of the working groups of all areas and the charter of the SIPPING working group respectively.

```
http://www.ietf.org/html.charters/wg-dir.html
http://www.ietf.org/html.charters/sipping-charter.html
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The IAB (Internet Architecture Board) is the body that provides technical leadership and handles appeals. Its web page is:

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http://www.iab.org/
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2.2.2 Working Group Operations

The technical work in the IETF is done within the working groups. Working groups do not have any kind of membership; they are formed by a number of volunteers that work as individuals. That is, they do not represent their companies when working for the IETF.

Most of the technical discussions within a working group take place in its mailing list. Even the decisions made at face-to-face meetings (held three times a year) have to be confirmed in the mailing list.

The technical documents used within the working groups are called Internet-Drafts. There are two types of them: individual submissions and working group items. Individual submissions are technical proposals submitted by an individual or individuals. If the working group decides that an individual submission is a good starting point to work on a particular topic, it becomes a working group item.