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Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network
NR
Radio Resource Control (RRC) protocol specification
(Release 15)

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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.

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1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and NG-RAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source gNB and target gNB upon inter gNB handover;
- the radio related information transported in a transparent container between a source or target gNB and another system upon inter RAT handover.
- the radio related information transported in a transparent container between a source eNB and target gNB during E-UTRA-NR Dual Connectivity.

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 TS 38.300: "NR; Overall description; Stage 2".

[3] 3GPP TS 38.321: "NR; Medium Access Control (MAC); Protocol specification".

[4] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[5] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".

[6] 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).

[7] 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).

[8] 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).

[9] 3GPP TS 38.215: "NR; Physical layer measurements".

[10] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol Specification".

[11] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[12] 3GPP TS 38.104: “NR; Base Station (BS) radio transmission and reception”.

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3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP 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 3GPP TR 21.905 [1].

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.

RLC bearer configuration: The lower layer part of the radio bearer configuration comprising the RLC and logical channel configurations.

Special Cell: For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise the term Special Cell refers to the PCell.

SRB1S: The SCG part of MCG split SRB1 for EN-DC.

SRB2S: The SCG part of MCG split SRB2 for EN-DC.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

ACK	Acknowledgement
AM	Acknowledged Mode
ARQ	Automatic Repeat Request
AS	Access Stratum
ASN.1	Abstract Syntax Notation One
BLER	Block Error Rate
CCCH	Common Control Channel
CMAS	Commercial Mobile Alert Service
CP	Control Plane
C-RNTI	Cell RNTI
DCCH	Dedicated Control Channel
DL	Downlink
DRB	(user) Data Radio Bearer
DRX	Discontinuous Reception
EHPLMN	Equivalent Home Public Land Mobile Network
EPC	Evolved Packet Core
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
IE	Information element
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
kB	Kilobyte (1000 bytes)

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L1	Layer 1
L2	Layer 2
L3	Layer 3
MAC	Medium Access Control
MCG	Master Cell Group
MIB	Master Information Block
N/A	Not Applicable
PCell	Primary Cell
PDCP	Packet Data Convergence Protocol
PDU	Protocol Data Unit
PLMN	Public Land Mobile Network
PTAG	Primary Timing Advance Group
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RLC	Radio Link Control
RNTI	Radio Network Temporary Identifier
ROHC	RObust Header Compression
RPLMN	Registered Public Land Mobile Network
RRC	Radio Resource Control
SCell	Secondary Cell
SCG	Secondary Cell Group
SI	System Information
SIB	System Information Block
SpCell	Special Cell
SRB	Signalling Radio Bearer
STAG	Secondary Timing Advance Group
S-TMSI	SAE Temporary Mobile Station Identifier
TM	Transparent Mode
UE	User Equipment
UICC	Universal Integrated Circuit Card
UL	Uplink
UM	Unacknowledged Mode
UP	User Plane
UTC	Coordinated Universal Time
UTRAN	Universal Terrestrial Radio Access 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

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 messages in ASN.1;
- 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;

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- clause 10 specifies generic error handling;
- clause 11 specifies the RRC messages transferred across network nodes;
- clause 12 specifies the UE capability related constraints and performance requirements.

4.2 Architecture

Editor's note The state model is still a subject for discussion.FFS

4.2.1 UE states and state transitions including inter RAT

Editor's Note: For EN_DC, only RRC_CONNECTED is applicable.

A UE is either in RRC_CONNECTED state or in RRC_INACTIVE state 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 based on network configuration;
  - The UE:
  - Monitors a Paging channel;
  - Performs neighbouring cell measurements and cell (re-)selection;
  - Acquires system information.
- **RRC_INACTIVE**:
  - A UE specific DRX may be configured by upper layers or by RRC layer;
  - UE controlled mobility based on network configuration;
  - The UE stores the AS context;
  - The UE:
    - Monitors a Paging channel;
    - Performs neighbouring cell measurements and cell (re-)selection;
    - Performs RAN-based notification area updates when moving outside the RAN-based notification area;

Editor's Note: FFS Whether a RAN-based notification area is always configured or not.

Editor's Note: FFS UE behavior if it is decided that a RAN-based notification area is not always configured.

    - Acquires system information.
- **RRC_CONNECTED:**
  - The UE stores the AS context.
  - 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 SpCell, for increased bandwidth;
  - For UEs supporting DC, use of one SCG, aggregated with the MCG, for increased bandwidth;

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- Network controlled mobility, i.e. handover within NR and to/from E-UTRAN.
- The UE:
  - Monitors a Paging channel;
  - 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.

Figure 4.2.1-1 illustrates an overview of UE RRC state machine and state transitions in NR. A UE has only one RRC state in NR at one time.

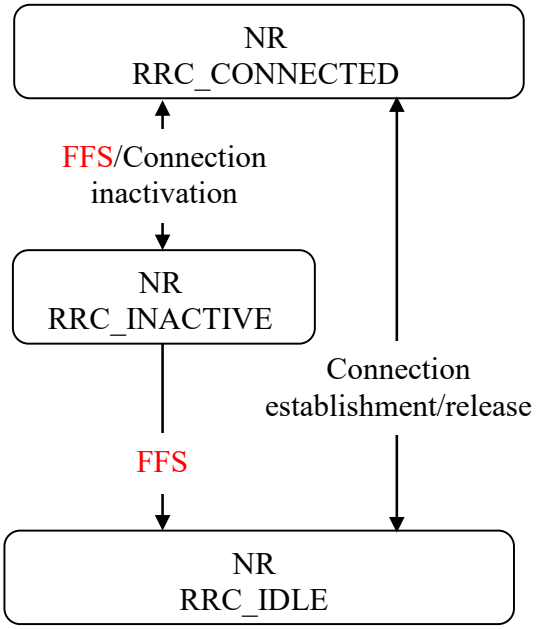

Figure 4.2.1-1: UE state machine and state transitions in NR

Figure 4.2.1-2 illustrates an overview of UE state machine and state transitions in NR as well as the mobility procedures supported between NR/NGC and E-UTRAN/EPC.

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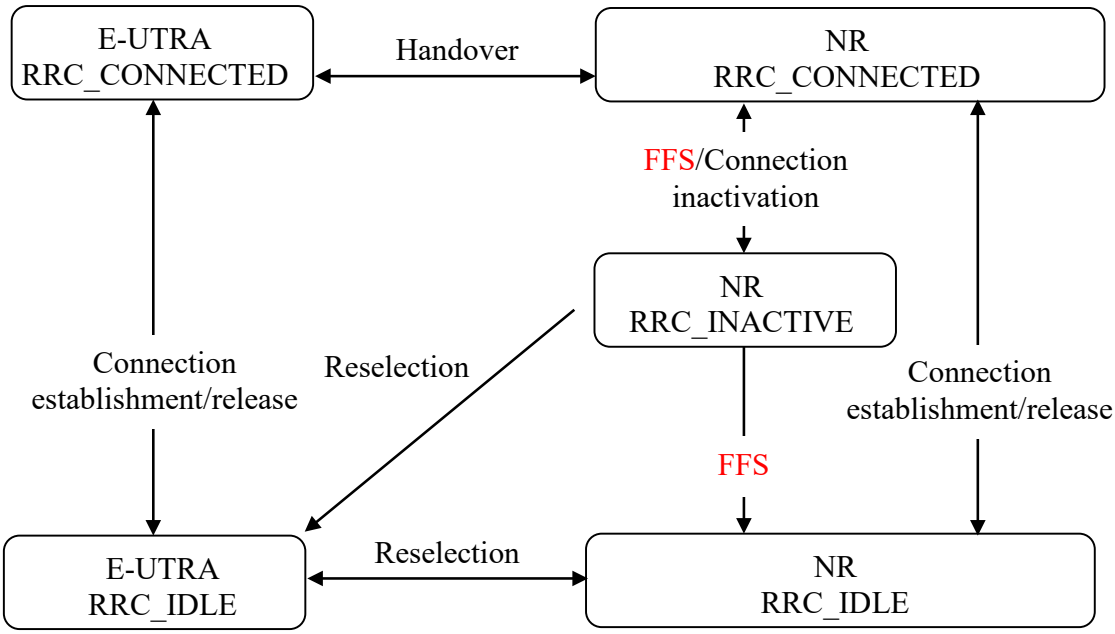

Figure 4.2.1-2: UE state machine and state transitions between NR/NGC and E-UTRAN/EPC

The UE state machine, state transition and mobility procedures between NR/NGC and E-UTRA/NGC is FFS.

4.2.2 Signalling radio bearers

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 [FFS, 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, ciphering and in-sequence delivery of information without duplication [FFS if duplication need to be listed];
- RLC: reliable transfer of information, without introducing duplicates and with support for segmentation.

4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:
  - Including NAS common information;

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  - Information applicable for UEs in RRC_IDLE and RRC_INACTIVE, e.g. cell (re-)selection parameters, neighbouring cell information and information (also) applicable for UEs in RRC_CONNECTED, e.g. common channel configuration information;
  - [FFS Including ETWS notification, CMAS notification].
- RRC connection control:
  - Paging;
  - Establishment/ modification/ suspension / resumption / release of RRC connection, including e.g. assignment/ modification of UE identity (C-RNTI), establishment/ modification/ release of SRBs, access class barring;

Editor's note: The terminology for establishment/modification/suspension/resumption is FFS.

  - Initial security activation, i.e. initial configuration of AS integrity protection (SRBs) and AS ciphering (SRBs, 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;
  - In case of DC, cell management including e.g. change of PSCell, addition/ modification/ release of SCG cell(s)[FFS, and addition/modification/release of SCG TAG(s)];
  - 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 [FFS support for RAN sharing (multiple PLMN identities)].

5 Procedures

5.1 General

5.1.1 Introduction

This section covers the general requirements.

The procedural requirements are structured according to the main functional areas: system information (5.2), connection control (5.3), inter-RAT mobility (5.4), measurements (5.5) and UE capability transfer (5.8). In addition, sub-clause 5.7 covers other aspects e.g. NAS dedicated information transfer.

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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: A subsequent procedure may be initiated 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 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 NR 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 receiving an extension field comprising the entries in addition to the ones carried by the original field (regardless of whether NR signals 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.

5.2 System information

Editor's Note: Targeted for completion in June 2018. For EN_DC, only MIB is applicable.

Editor's Note: Discuss whether to keep or temporarily remove this section for the December version. FFS

5.2.1 Introduction

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

- the *MasterInformationBlock* (MIB) is always transmitted on the BCH (refer Figure 5.2.2.X.X FFS_Ref) with a periodicity of 80 ms and repetitions made within 80 ms [X] and it includes parameters that are needed to acquire *SystemInformationBlockType1* (SIB1) from the cell [FFS TBD-RAN1];
- the *SystemInformationBlockType1* (SIB1) is transmitted on the DL-SCH with a periodicity of [X] and repetitions made within [X]. SIB1 includes information regarding the availability and scheduling (e.g. periodcity, SI-window size) of other SIBs. It also indicates whether they (i.e. other SIBs) are provided via periodic broadcast basis or only on-demand basis (refer Figure 5.2.2.X.X FFS_Ref). If other SIBs are provided on-demand then SIB1 includes information for the UE to perform SI request;
- SIBs other than *SystemInformationBlockType1* are carried in SystemInformation (SI) messages, which are transmitted on the DL-SCH. Each SI message is transmitted within periodically occurring time domain windows (referred to as SI-windows);

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- For SCells, RAN provides the required SI by dedicated signaling. Nevertheless, the UE shall acquire MIB of the PSCell to get SFN timing of the SCG (which may be different from MCG). Upon change of relevant SI, RAN releases and adds the concerned SCell.

Editor's Note: Reference to RAN1 specification may be used for the MIB/SIB1 periodicities [X].FFS

5.2.2 System information acquisition

5.2.2.1 General UE requirements

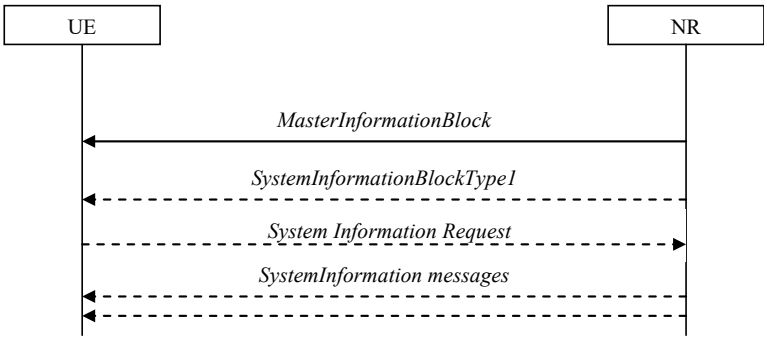

Figure 5.2.2.1-1: System information acquisition

The UE applies the SI acquisition procedure to acquire the AS- and NAS information. The procedure applies to UEs in RRC_IDLE, in RRC_INACTIVE and in RRC_CONNECTED.

The UE in RRC_IDLE and RRC_INACTIVE shall ensure having a valid version of (at least) the *MasterInformationBlock*, *SystemInformationBlockType1* as well as *SystemInformationBlockTypeX* through *SystemInformationBlockTypeY* (depending on support of the concerned RATs for UE controlled mobility).

The UE in RRC_CONNECTED shall ensure having a valid version of (at least) the *MasterInformationBlock*, *SystemInformationBlockType1* as well as *SystemInformationBlockTypeX* (depending on support of mobility towards the concerned RATs).

The UE shall store relevant SI acquired from the currently camped/serving cell. A version of the SI that the UE acquires and stores remains valid only for a certain time. The UE may use such a stored version of the SI e.g. after cell re-selection, upon return from out of coverage or after SI change indication.

Editor's Note: [FFS if the UE is required to store SI other than for the currently camped/serving cell]. FFS_Standalone

Editor's Note: [FFS if different versions of SIBs are provided]. FFS_Standalone

Editor's Note: [FFS UE may or shall store several versions of SI]. FFS_Standalone

Editor's Note: To be updated when above FFS is resolved. Another sub-clause under 5.2.2.2 can be considered depending on the resolution of above FFSs. FFS_Standalone

5.2.2.2 SI validity and need to (re)-acquire SI

The UE shall apply the SI acquisition procedure as defined in clause 5.2.2.3 upon cell selection (e.g. upon power on), cell-reselection, return from out of coverage, after handover completion, after entering RAN from another RAT; whenever the UE does not have a valid version in the stored SI.

Editor's Note: [FFS_Standalone if upon receiving HO command the SI acquisition depend on stored SI]

When the UE acquires a *MasterInformationBlock* or a *SystemInformationBlockType1* or a SI message in a currently camped/serving cell as described in clause 5.2.2.3, the UE shall store the acquired SI.

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5.2.2.2.1 SI validity

The UE shall:

1> delete any stored version of SI after [FFS] hours from the moment it was successfully confirmed as valid;

1> if the UE does not have in the stored SI a valid version for the required SI corresponding to the *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex* of that SI in the currently camped/serving cell:

2> (re)acquire the SI as specified in clause 5.2.2.3 .

NOTE: At the SI acquisition procedure, the UE may assume the acquired SI in the currently camped/serving cell to be valid in other cells than the currently camped/serving cell based on *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex*.

Editor's Note: [FFS_Standalone terminology to be used is systemInfoValueTag or systemInfoConfigurationIndex]

Editor's Note: [FFS_Standalone terminology to be used for area ID is systemInfoAreaIdentifier]

Editor's Note: [FFS_Standalone whether the area ID and valuetag is separately signalled or as a single identifier]

Editor's Note: [FFS_Standalone whether the area ID is associated to each SIB/ SI message or associated to a group of SIBs/ SI messages or all SIBs/ SI messages]

5.2.2.2.2 SI change indication and PWS notification

A modification period is used, i.e. updated SI is provided in the modification period following the one where SI change indication is transmitted. RAN transmits SI change indication and PWS notification through paging. Repetitions of SI change indication may occur within preceding modification period.

Editor's Note : The above descriptive text can remain in this sub-clause or moved under 5.2.1. FFS_Standalone

If the UE is in RRC_CONNECTED or is configured to use a DRX cycle smaller than the modification period in RRC_IDLE or in RRC_INACTIVE and receives a Paging message:

1> if the received Paging message includes the *etws*/*cmasNotification*;

2> the UE shall immediately re-acquire the SIB1 and apply the SI acquisition procedure as defined in sub-clause [X.X.X.X FFS_Ref].

1> else, if the received Paging message includes the *systemInfoModification*;

2> the UE shall apply the SI acquisition procedure as defined in sub-clause [X.X.X.X FFS_Ref] from the start of the next modification period.

NOTE: For PWS notification the SIB1 is re-acquired to know the scheduling information for the PWS messages.

Editor's Note: [FFS_Standalone if upon receiving a SI change indication the SI acquisition depend on stored SI]

Editor's Note: [FFS_Standalone if value tags and area identifier included in paging message to reacquire SIB1]

Editor's Note: [FFS_Standalone the update mechanism for access control notifications and other non-access control configuration updates]

5.2.2.3 Acquisition of System Information

5.2.2.3.1 Acquisition of MIB and SIB1

The UE shall:

1> acquire the *MIB* as defined in [X];

1> if the UE is unable to acquire the *MIB*;

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2> follow the actions as defined in clause 5.2.2.5;

1> else:

2> perform the actions defined in section 5.2.2.4.1;

1> acquire the SystemInformationBlockType1 as defined in [X];

1> if the UE is unable to acquire the SystemInformationBlockType1:

2> follow the actions as defined in clause 5.2.2.5;

1> else perform the actions defined in section 5.2.2.4.2;

Editor's Note: Reference to RAN1 [X] specification may be used for the scheduling of MIB and SIB1.FFS_Standalone

5.2.2.3.2 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:

Editor's Note: [FFS_Standalone the details of the mapping to subframes/slots where the SI messages are scheduled]

Editor's Note: [FFS_Standalone if there are any exceptions on e.g. subframes where SI messages cannot be transmitted]

Editor's Note: [FFS_Standalone if the SI-windows of different SI messages do not overlap].

Editor's Note: [FFS_Standalone if multiple SI messages can be mapped to same SI window]

Editor's Note: [FFS_Standalone if the length of SI-window is common for all SI messages or if it is configured per SI message]

Editor's Note: [FFS_Standalone if the UE may accumulate the SI-Message transmissions across several SI-Windows within the Modification Period]

1> if SI message acquisition not triggered due to UE request:

2> 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;

2> 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.

1> if SI message acquisition triggered due to UE request:

2> [FFS_Standalone 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];

2> [FFS_Standalone 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].

Editor's Note: [FFS_Standalone on the details of from which SI-window the UE shall receive the DL-SCH upon triggering the SI request.

Editor's Note: [FFS_Standalone on the details of how many SI-windows the UE should monitor for SI message reception if transmission triggered by UE request]

Editor's Note: [FFS_Standalone if UE need to monitor all the TTIs in SI window for receiving SI message]

1> store the acquired SI message as specified in clause 5.2.2.2.

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Editor's Note: FFS_Standalone The procedural text for SI message acquisition triggered by UE request will be updated upon finalizing the details.

5.2.2.3.3 Request for on demand system information

When acquiring an SI message, which according to the SystemInformationBlockType1 is indicated to be provided upon UE request, the UE shall:

1> if in RRC_IDLE or in RRC_INACTIVE:

2> if the [FFS_Standalone] field is received in *SIB1*:

3> the UE shall trigger the lower layer to initiate the preamble transmission procedure in accordance with TS 38.321 [3] using the [indicated PRACH preamble] and [indicated PRACH resource];

3> if acknowledgement for SI request is received from lower layer;

4> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2.

Editor's Note: To be updated with details of the Msg1 request procedure.FFS_Standalone

2> else

3> the UE shall trigger the lower layer to initiate the random access procedure in accordance with TS 38.321 [3];

3> if acknowledgement for SI request is received;

4> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2.

Editor's Note: To be updated with details of the Msg3 request procedure. FFS_Standalone

1> else (in RRC_CONNECTED):

2> [details FFS_Standalone]

Editor's Note: To be updated with details of the on-demand request procedure in RRC_CONNECTED. FFS_Standalone

Editor's Note: [FFS_Standalone if there is a need for a separate sub-clause to describe case where on demand SI is not successfully received by the UE and where it should initiate a new request]

5.2.2.4 Actions upon receipt of SI message

5.2.2.4.1 Actions upon reception of the MasterInformationBlock

Upon receiving the MasterInformationBlock the UE shall:

1> store the acquired *MIB*;

1> if the UE is in RRC_IDLE or if the UE is in RRC_INACTIVE or if the UE is in RRC_CONNECTED while *T311* is running: [FFS]

2> if the *cellBarred* in the acquired MIB is set to *barred*;

3> consider the cell as barred in accordance with TS 38.304 [FFS].

2> else,

3> apply the received parameter(s) [FFS] to acquire *SIB1*.

Editor's Note: To be updated when content of the MasterInformationBlock has been agreed.FFS.

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5.2.2.4.2 Actions upon reception of the SystemInformationBlockType1

Upon receiving the SystemInformationBlockType1 the UE shall:

1> store the acquired *SIB1*;

1> if the UE has a stored valid version of the required SIB(s) associated with the *systemInfoAreaIdentifier* and *systemInfoValueTag*/*systemInfoConfigurationIndex* in the acquired *SIB1*:

2> use that stored version of the SIB.

1> else if the *SIB1* message indicates that the SI message(s) is only provided on request:

2> trigger a request to acquire the SI message(s) (if needed) as defined in sub-clause 5.2.2.3.

1> else:

2> acquire the SI message(s) (if needed) as defined in sub-clause 5.2.2.3.2, which are provided according to the schedulingInfoList in the SystemInformationBlockType1.

Editor's Note: [FFS_Standalone Whether there is an additional indication that an on-demand SI is actually being broadcast at this instant in time]

Editor's Note: To be updated when content of the SystemInformationBlockType1 has been agreed. FFS_Standalone.

Editor's Note: To be updated how to capture the UE behaviour when some required SIBs are from broadcast and other required SIBs through SI request.

5.2.2.4.3 Actions upon reception of SystemInformationBlockTypeX

Editor's Note: To be extended with further sub-clauses as more SIBs are defined. FFS_Standalone

5.2.2.5 Essential system information missing

The UE shall:

1> if in RRC_IDLE or in RRC_INACTIVE:

2> if the UE is unable to acquire the *MIB*; or

2> if the UE is unable to acquire the *SIB1* and UE does not have a stored valid version of SIB1; or

2> [FFS_Standalone if the UE is unable to acquire the [FFS essential SystemInformationBlockTypeX] and UE does not have a stored valid version of SystemInformationBlockTypeX];

3> consider the cell as barred in accordance with TS 38.304 [X]; and

3> perform barring as if intraFreqReselection is set to allowed;

Editor's Note: [FFS_Standalone on details of RRC connection re-establishment procedure and corresponding reading of SI in RRC_CONNECTED].

Editor's Note: [FFS_Standalone whether all the information needed to access the cell is included in SIB1 or if both SIB1 and SIB2 are essential in NR].

5.3 Connection control

Editor's note: FFS The structure and content of this subclause is a subject for discussion, e.g. potential merging of connection establishment and re-establishment messages, mobility aspects etc.

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5.3.1 Introduction

5.3.2 Paging

Editor's Note: Targeted for completion in June 2018.

5.3.3 RRC connection establishment

Editor's Note: Targeted for completion in June 2018.

5.3.4 Initial security activation

Editor's Note: Targeted for completion in June 2018.

5.3.5 RRC reconfiguration

Editor's Note: FFS Check terminology ("RAN may …" or "Network may …"). Update figures accordingly.

5.3.5.1 General

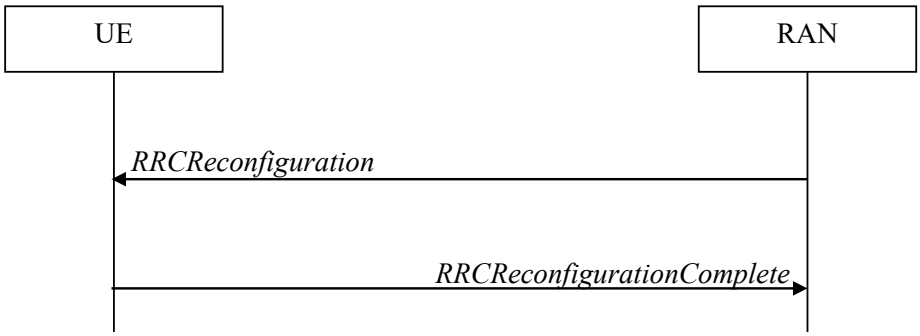

Figure 5.3.5.1-1: RRC reconfiguration, successful

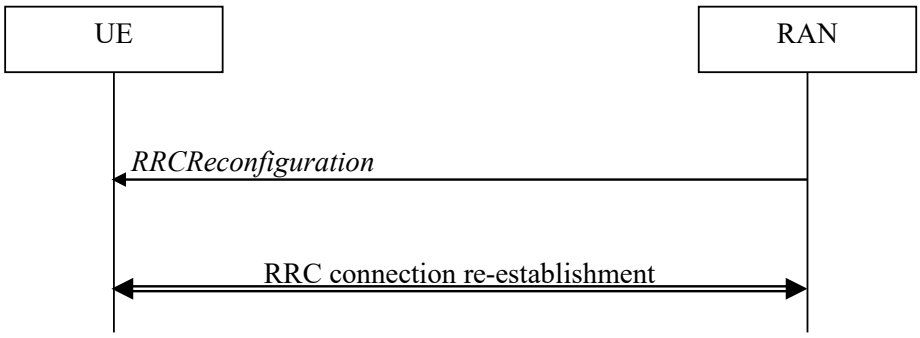

Figure 5.3.5.1-2: RRC reconfiguration, failure

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 and cell groups. As part of the procedure, NAS dedicated information may be transferred from RAN to the UE.

In EN-DC, SRB3 can be used to perform measurement, MAC, RLC, PDCP, physical layer and RLF timers and constants (re-)configurations.

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5.3.5.2 Initiation

RAN may initiate the RRC reconfiguration procedure to a UE in RRC_CONNECTED. RAN applies the procedure as follows:

- the *reconfigurationWithSync* 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 Secondary Cell Groups and SCells is performed only when AS security has been activated.

5.3.5.3 Reception of an *RRCReconfiguration* by the UE

Editor's note: FFS / TODOs:

- Handling of first reconfiguration after re-establishment
- clarify that/whether SCG(s) must perform a reconfiguration with sync when the MCG performs a synchronous reconfiguration

The UE shall perform the following actions upon reception of the *RRCReconfiguration*:

Editor's Note: For EN-DC, MCG configuration is not supported.

1> if the received *RRCReconfiguration* includes the *masterCellGroupConfig*:

2> perform the cell group configuration for the MCG according to 5.3.5.5.

Editor's Note: For EN-DC, SCG release is not supported by *SecondaryCellGroupToReleaseList* (instead by field in 36.331). FFS how to capture

1> if the received *RRCReconfiguration* includes the *SecondaryCellGroupToReleaseList*:

2> perform the SCG release according to 5.3.5.4.

1> if the received *RRCReconfiguration* includes the secondaryCellGroup:

2> perform the cell group configuration for the SCG according to 5.3.5.5.

1> if the *RRCReconfiguration* message contains the *radioBearerConfig*:

2> perform the radio bearer configuration according to 5.3.5.6.

Editor's Note: *dedicatedInfoNASList* is not supported for EN-DC. FFS how to capture

1> if the *RRCReconfiguration* message includes the *dedicatedInfoNASList*:

2> forward each element of the *dedicatedInfoNASList* to upper layers in the same order as listed.

1> if the *RRCReconfiguration* message includes the *measConfig*:

2> perform the measurement configuration procedure as specified in 5.5.2.

Editor's Note: *otherConfig* is not supported for EN-DC. FFS how to capture

1> if the *RRCReconfiguration* message includes the *otherConfig*:

2> perform the other configuration procedure as specified in 5.3.10.9.

1> if the UE is operating in EN-DC mode (MCG is EUTRA):

2> if *RRCReconfiguration* was received via SRB1:

3> construct *RRCReconfigurationComplete* message and submit it via the EUTRA MCG as specified in TS 36.331 [10];

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3> if *reconfigurationWithSync* was included in *spCellConfig* of an SCG:

4> initiate the random access procedure on the SpCell, as specified in TS 38.321 [3].

2> else (*RRCReconfiguration* was received via SRB3):

3> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration.

1> else (NR SA or NE-DC):

2> submit the *RRCReconfigurationComplete* message via SRB1 to lower layers for transmission using the new configuration;

2> if *reconfigurationWithSync* was included in *spCellConfig* of an SCG:

3> initiate the random access procedure on the SpCell, as specified in TS 38.321 [3].

1> if MAC of an NR cell group successfully completes a random access procedure triggered above;

2> stop timer T304 for that cell group;

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 respective target SpCell, if any;

2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the respective target SPCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of that target SpCell;

2> the procedure ends.

5.3.5.4 Secondary cell group release

The UE shall:

1> for each CellGroupId in the *SecondaryCellGroupToReleaseList* or as a result of SCG release triggered by E-UTRA:

2> reset SCG MAC, if configured;

2> for each RLC bearer that is part of the SCG configuration:

3> perform RLC bearer release procedure as specified in 5.3.5.5.3;

2> release the entire SCG configuration;

2> stop timer T313, if running;

2> stop timer T304, if running;

NOTE: Release of cell group means only release of the lower layer configuration of the cell group but the RadioBearerConfig may not be released.

5.3.5.5 Cell Group configuration

5.3.5.5.1 General

The network configures the UE with a Master Cell Groups (MCG) and zero or one Secondary Cell Groups (SCG). For EN-DC, the MCG is configured as specified in TS 36.331 [10]. The network provides the configuration parameters for a cell group in the *CellGroupsConfig* IE. *CellGroupConfig* with *cellGroupId* 0 is used for the MCG.

The UE performs the following actions based on a received *CellGroupConfig* IE:

1> if the received CellGroupConfig contains the *spCellConfig* with *reconfigurationWithSync*:

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2> perform Reconfiguration with sync according to 5.3.5.5.2;

2> resume all suspended radio bearers and resume SCG transmission for all radio bearers, if suspended;

1> if the CellGroupConfig contains the *rlc-BearerToReleaseList*:

2> perform RLC bearer release as specified in 5.3.5.5.3;

1> for each element in *RLC-BeaererToAddModList*:

2> configure the RLC bearer as specified in 5.3.5.5.4;

1> if the *CellGroupConfig* contains the *mac-CellGroupConfig*:

2> configure the MAC entity of this cell group as specified in 5.3.5.5.5;

1> if the *CellGroupConfig* contains the *rlf-TimersAndConstants*

2> configure the RLF timers for this cell group as specified in 5.3.5.5.6;

1> if the *CellGroupConfig* contains the *sCellToReleaseList*:

2> for each entry in the *sCellToReleaseList*:

3> release the SCell as specified in 5.3.5.5.8;

1> if the *CellGroupConfig* contains the spCellConfig:

2> configure the SpCell as specified in 5.3.5.5.7;

1> if the *CellGroupConfig* contains the *sCellToAddModList*:

2> for each entry in the *sCellToAddModList*:

3> add or modify the SCell as specified in 5.3.5.5.9;

5.3.5.5.2 Reconfiguration with sync

The UE shall perform the following actions to execute a reconfiguration with sync.

Editor's Note: Master cell group config is not supported for EN-DC. FFS how to capture

1> if the *cellGroupId* of the *CellGroupConfig* triggering the reconfiguration with sync is 0 (master cell group):

2> stop timer T310, if running;

2> stop timer T312, if running;

2> start timer T304 with the timer value set to *t304*, as included in the *reconfigurationWithSync*;

1> else (secondary cell group):

2> stop timer T313, if running;

2> start timer T304 with the timer value set to *t304*, as included in the *reconfigurationWithSync*;

Editor's Note: FFS_TODO: update below after L1 parameter email discussion

1> if the *carrierFreq* is included:

2> consider the target SpCell 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 SpCell to be one on the frequency of the source SpCell with a physical cell identity indicated by the *targetPhysCellId*;

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1> start synchronising to the DL of the target SpCell;

NOTE 1: The UE should perform the reconfiguration with sync as soon as possible following the reception of the RRC message triggering the reconfiguration with sync, which could be before confirming successful reception (HARQ and ARQ) of this message.

1> reset the MAC entity of this cell group;

1> consider the SCell(s) of this cell group, if configured, to be in deactivated state;

1> apply the value of the *newUE-Identity* as the C-RNTI for this cell group;

Editor's Note: *fullConfig* is not supported in EN-DC.

1> if the *RRCReconfiguration* message includes the *fullConfig*:

2> perform the radio configuration procedure as specified in 5.3.5.7;

Editor's Note: Verify that this does not configure some common parameters which are later discarded due to e.g. SCell release or due to LCH release.

1> configure lower layers in accordance with the received *spCellConfigCommon*;

1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *reconfigurationWithSync*;

1> perform the measurement related actions as specified in 5.5.6.1;

5.3.5.5.3 RLC bearer release

The UE shall:

1> for each *LogicalChannelIdentity* value included in the *lrlc-BearerToReleaseList* that is part of the current UE configuration (LCH release), or

1> for each *LogicalChannelIdentity* value that is to be released as the result of full configuration option according to 5.3.5.7 or as the result of an SCG release according to 5.3.5.4:

2> release the RLC entity or entities (includes discarding all pending RLC PDUs and RLC SDUs);

2> release the DTCH logical channel.

5.3.5.5.4 RLC bearer addition/modification

For each *LCH-Config* received in a *rlc-BearerToAddModList* IE the UE shall:

1> if the UE's current configuration contains a RLC bearer with the received *logicalChannelIdentity*:

2> if *reestablishRLC* is received, re-establish the RLC entity as specified in 38.322:

2> reconfigure the RLC entity or entities in accordance with the received *rlc-Config;*

2> reconfigure the logical channel in accordance with the received *mac-LogicalChannelConfig*;

NOTE: The network does not re-associate an already configured LCH with another radio bearer. Hence *servedRadioBearer* is not be present in this case.

1> else (a logical channel with the given ID was not configured before):

2> if the logical channel ID corresponds to an SRB (i.e. ID less than or equal to 3) and *rlc-Config* is not included:

3> establish an RLC entity in accordance with the default configuration defined in 9.2 for the corresponding SRB;

2> else:

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3> establish an RLC entity in accordance with the received *rlc-Config;*

2> if the logical channel ID corresponds to an SRB (i.e. ID less than or equal to 3) and if *mac-LogicalChannelConfig* is not included:

3> configure this MAC entity with a logical channel in accordance to the default configuration defined in 9.2 for the corresponding SRB;

2> else:

3> configure this MAC entity with a logical channel in accordance to the received mac-LogicalChannelConfig;

2> configure this MAC entity with a logical channel in accordance to the received *mac-LogicalChannelConfig;*

2> associate this logical channel with the PDCP entity identified by *servedRadioBearer;*

5.3.5.5.5 MAC entity configuration

5.3.5.5.6 RLF Timers & Constants configuration

5.3.5.5.7 SpCell Configuration

Editor's Note: May contain procedures similar to the one in 36.331, section 5.3.10.6 (Physical channel reconfiguration), i.e., applying L1 parameters for the SpCell

5.3.5.5.8 SCell Release

The UE shall:

1> if the release is triggered by reception of the *sCellToReleaseList*:

2> for each *sCellIndex* value included in the *sCellToReleaseList*:

3> if the current UE configuration includes an SCell with value *sCellIndex*:

4> release the SCell;

Editor's Note: Need to be updated for EN-DC.FFS.

1> if the release is triggered by RRC connection re-establishment:

2> release all SCells that are part of the current UE configuration.

5.3.5.5.9 SCell Addition/Modification

The UE shall:

1> for each *sCellIndex* value included in the *sCellToAddModList* that is not part of the current UE configuration (SCell addition):

2> add the SCell, corresponding to the *sCellIndex*, in accordance with the *sCellConfigCommon* and *sCellConfigDedicated*;

2> configure lower layers to consider the SCell to be in deactivated state;

Editor's Note: FFS Check automatic measurement handling for SCells.

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*:

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4> remove the concerned SCell from *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

1> for each *sCellIndex* value included in the *sCellToAddModList* that is part of the current UE configuration (SCell modification):

2> modify the SCell configuration in accordance with the *sCellConfigDedicated*;

5.3.5.6 Radio Bearer configuration

5.3.5.6.1 General

The UE shall perform the following actions based on a received *RadioBearerConfig* IE:

1> if the RadioBearerConfig includes the srb-ToReleaseList:

2> perform the SRB release as specified in 5.3.5.6.2;

1> if the *RadioBearerConfig* includes the srb-ToAddModList:

2> perform the SRB addition or reconfiguration as specified in 5.3.5.6.3;

1> if the *RadioBearerConfig* includes the drb-ToReleaseList:

2> perform DRB release as specified in 5.3.5.6.4;

1> if the *RadioBearerConfig* includes the drb-ToAddModList:

2> perform DRB addition or reconfiguration as specified in 5.3.5.6.5;

5.3.5.6.2 SRB release

Editor's note: FFS / TODO: check handling during full configuration

The UE shall for the SRB with SRB Identity corresponding to *srb-ToRelease*:

1> release the PDCP entity.

5.3.5.6.3 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 or configured with *pdcp-Config* (SRB establishment or reconfiguration from E-UTRA PDCP to NR PDCP):

2> establish a PDCP entity and configure it with the security algorithms according to *securityConfig* and apply the keys (KUPenc) associated with the KeNB/S-KgNB as indicated in *keyToUse*, if applicable;

2> if the current UE configuration as specified in TS 36.331 includes an SRB identified with the same *srb-Identity* value:

3> associate the E-UTRA RLC and DCCH entities of this SRB with the NR PDCP entity;

3> release the E-UTRA PDCP entity of this SRB;

2> if the *pdcp-Config* is included:

3> configure the PDCP entity in accordance with the received *pdcp-Config*.

2> else:

3> configure the PDCP entity in accordance with the specified configuration defined in 9.1 for the corresponding SRB;

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is part of the current UE configuration:

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2> if *reestablishPDCP* is set:

3> configure the PDCP entity to apply the integrity protection algorithm and KRRCint key associated with the KeNB/S-KgNB as indicated in *keyToUse* , 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;

3> configure the PDCP entity to apply the ciphering algorithm and KRRCenc key associated with the KeNB/S-KgNB as indicated in *keyToUse*, 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;

3> re-establish the PDCP entity of this SRB as specified in 38.323;

3> resume the SRB, if suspended;

2> if the *pdcp-Config* is included:

3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.

5.3.5.6.4 DRB release

Editor's Note: FFS / TODO: Add handling for the new QoS concept (mapping of flows; configuration of QFI-to-DRB mapping; reflective QoS…) but keep also EPS-Bearer handling for the EN-DC case

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 5.3.5.7:

2> release the PDCP entity;

Editor's Note: FFS / TODO: handling of indication to higher layers in EN-DC

1> if new bearer is not added with same *eps-BearerIdentity*:

2> if the procedure was triggered due to handover:

3> indicate the release of the DRB(s) and the *eps-BearerIdentity* of the released DRB(s) to upper layers after successful handover;

2> else:

3> indicate the release of the DRB(s) and the *eps-BearerIdentity* of the released DRB(s) to upper layers immediately.

NOTE 1: 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.

NOTE 2: Whether or not the RLC- and MAC entities associated with this PDCP entity are reset or released is determined by the CellGroupConfig.

5.3.5.6.5 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> establish a PDCP entity and configure it in accordance with the received pdcp-Config;

2> configure the PDCP entity with the security algorithms according to securityConfig and apply the keys (KUPenc) associated with the KeNB/S-KgNB as indicated in *keyToUse*;

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Editor's Note: Full configuration is not applicable for EN-DC. For EN-DC, NR *RRCReconfiguration* message does not include the *fullConfig* IE.

2> if the *RRCReconfiguration* message includes the *fullConfig* IE:

3> associate the established DRB with corresponding included *eps-BearerIdentity*;

2> else if no DRB was configured with the same *eps-BearerIdentity* prior to receiving this reconfiguration:

Editor's Note: FFS_CHECK

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:

2> if *reestablishPDCP* is set

3> configure the PDCP entities of this *RadioBearerConfig* to apply the ciphering algorithm and KUPenc key associated with the KeNB/S-KgNB as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE;

3> re-establish the PDCP entity of this DRB as specified in 38.323, [REF], section 5.1.2;

3> resume the DRB, if suspended;

2> else, if *recoverPDCP* is set:

3> trigger the PDCP entity of this DRB to perform data recovery as specified in 38.323;

2> if the *pdcp-Config* is included:

3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*;

Editor's Note: verify that TS 38.323 covers case when more than one RLC entity is associated with the PDCP entity.

NOTE 1: Removal and addition of the same *drb-Identity* in a single *radioResourceConfig* is not supported. In case *drb-Identity* is removed and added due to handover or re-establishment with the full configuration option, the eNB can use the same value of *drb-Identity*.

NOTE 2: When determining whether a drb-Identity value is part of the current UE configuration, the UE does not distinguish which *RadioBearerConfig* and *DRB-ToAddModList* that DRB was originally configured in. To re-associate a DRB with a different key (KeNB to S-KeNB or vice versa), the network provides the *drb-Identity* value in the (target) *drb-ToAddModList* and sets the *reestablish* flag. The network does not list the *drb-Identity* in the (source) *drb-ToReleaseList*.

NOTE 3: When setting the *reestablishPDCP* flag for a radio bearer, the network ensures that the RLC receiver entities do not deliver old PDCP PDUs to the re-established PDCP entity. It does that e.g. by triggering a reconfiguration with sync of the cell group hosting the old RLC entity or by releasing the old RLC entity.

5.3.5.7 Full configuration

Editor's Note: This subclause is not applicable for EN-DC, but is targeted for completion in June 2018. For EN-DC,NR *RRCReconfiguration* message does not include the *fullConfig* IE.

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 sp*CellConfig* in the *masterCellGroupConfig* includes the *reconfigurationWithSync*:

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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 (full configuration after re-establishment):

2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SystemInformationBlockType2* (or *SystemInformationBlockType2-NB* in NB-IoT);

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 re-establishment) to a known state from which the reconfiguration message can do further configuration.

Editor's Note: FFS_Standalone: Replace the following by corresponding handling of "PDU Sessions" and/or "Flows". Remember: Current UE configuration refers to the current MCG and SCG configuration, i.e., it handles also DRBs associated with the S-KeNB prior to the HO/Re-establishment.

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 5.3.10.35.x.x FFS_Ref using the new configuration. The *eps-bearerIdentity* acts as the anchor for associating the released and re-setup DRB. In the AS the DRB re-setup is equivalent with a new DRB setup (including new PDCP and logical channel configurations).

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;5.3.5.8 Security key update

Upon reception of *sk-Counter* the UE shall:

Editor's Note: FFS: Consider mentioning that this corresponds to SCG-counter in 33.401.

Editor's Note: FFS reference to 33.401 correct?

1> update the S-KgNB key based on the KeNB key and using the received *sk-Counter* value, as specified in TS 33.401 [32];

1> derive the the KRRCenc and KUPenc key as specified in TS 33.401 [32];

1> derive the KRRCint key as specified in TS 33.401 [32];

1> for all radio bearers configured with S-KgNB:

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2> configure lower layers to apply the KRRCint key, i.e. the 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;

2> configure lower layers to apply the ciphering algorithm, the KRRCenc key and the KUPenc key, i.e. the 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.

5.3.5.9 Reconfiguration failure

Editor's Note: Added sub-sections for the different failure cases that may occur during the RRCReconfiguration procedure.

5.3.5.9.1 Integrity check failure

Editor's Note: Removed "SIB3" from heading so that this sub-section can easily be expanded to stand-alone case (if considered necessary). FFS_Standalone

The UE shall:

1> upon integrity check failure indication from NR lower layers for SRB3:

2> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SRB3 integrity check failure;

5.3.5.9.2 Inability to comply with RRCReconfiguration

The UE shall:

1> if the UE is operating in EN-DC:

2> if the UE is unable to comply with (part of) the configuration included in the RRCReconfiguration message received over SRB3;

3> continue using the configuration used prior to the reception of RRCReconfiguration message;

3> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;

2> else, if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over MCG SRB1;

3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> initiate the connection re-establishment procedure as specified in TS 36.331 [10, 5.3.7], upon which the connection reconfiguration procedure ends;

NOTE 1: The UE may apply above failure handling also in case the RRCReconfiguration message causes a protocol error for which the generic error handling as defined in 10 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.

5.3.5.9.3 T304 expiry (Reconfiguration with sync Failure)

The UE shall:

1> if T304 of the master cell group expires:

Editor's Note: FFS_Standalone Add the actions similarly to the ones in 36.331 section 5.3.5.6 (handover failure)

1> else, if T304 of a secondary cell group expires:

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NOTE 1: Following T304 expiry any dedicated preamble, if provided within the rach-ConfigDedicated, is not available for use by the UE anymore.

2> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG change failure;

5.3.6 Counter check

FFS

5.3.7 RRC connection re-establishment

Editor's Note: Targeted for completion in June 2018.

5.3.8 RRC connection release

Editor's Note: Targeted for completion in June 2018.

5.3.9 RRC connection release requested by upper layers

Editor's Note: Targeted for completion in June 2018.

5.3.10 Radio resource configuration

Editor's Note: Targeted for completion in June 2018.

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 SpPCell from lower layers while T311 is not running:

2> start timer T310;

Editor's Note: FFS: The following is wrong since according to other agreed TPs there is no T307 and no N313/T313. Rewrite the previous statement so that it applies to the PCell of any cell group. Remove the following. Update also PCell/PScell to SpCell

1> upon receiving N313 consecutive "out-of-sync" indications for the PSCell from lower layers while T304 is not running:

2> start T313;

Editor's Note: FFS: Under which condition physical layer problems detection is performed, e.g. neither T300, T301, T304 nor T311 is running. It's subject to the harmonization of the RRC procedures for RRC Connection establishment/resume/ re-establishment and RRC connection reconfiguration.

Editor's Note: FFS: The naming of the timers.

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;

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Editor's Note: FFS: whether to support T312 for early RLF declaration in NR. Consider whether T310 and T313 can be combined into one timer, since only one is active at a time. If combined, procedure text need to be modified.

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 random access problem indication from MCG MAC while T311 is not running, or

Editor's Note: FFS: Under which condition physical layer problems detection is performed, e.g. neither T300, T301, T304 nor T311 is running. It's subject to the harmonization of the RRC procedures for RRC Connection establishment/resume/ re-establishment and RRC connection reconfiguration.

1> upon indication from MCG RLC that the maximum number of retransmissions has been reached:

Editor's Note: FFS whether maximum ARQ retransmission is only criteria for RLC failure.

2> consider radio link failure to be detected for the MCG i.e. RLF;

Editor's Note: FFS Whether indications related to beam failure recovery may affect the declaration of RLF.

Editor's Note: FFS: How to handle RLC failure in CA duplication for MCG DRB and SRB.

Editor's Note: FFS: RLF related measurement reports e.g. *VarRLF-Report* is supported in NR.

2> if AS security has not been activated:

3> perform the actions upon leaving RRC_CONNECTED as specified in x.x.x FFS_Ref, with release cause 'other';

2> else:

3> initiate the connection re-establishment procedure as specified in x.x.x FFS_Ref.

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:

2> consider radio link failure to be detected for the SCG i.e. SCG-RLF;

Editor's Note: FFS: How to handle RLC failure in CA duplication for SCG DRB and SRB.

2> initiate the SCG failure information procedure as specified in 5.7.34 to report SCG radio link failure;

5.3.12 UE actions upon leaving RRC_CONNECTED

Editor's Note: Targeted for completion in June 2018.

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5.3.13 UE actions upon PUCCH/SRS release request

Editor's Note: Targeted for completion in June 2018.

5.4 Inter-RAT mobility

Editor's Note: Targeted for completion in June 2018.

5.5 Measurements

5.5.1 Introduction

Editor's Note: FFS In the context of subclause 5.5., the term "beam" will be later aligned with the RAN1 terminology when stabilized. For the current version, the term "beam" refers to the reference signals SS/PBCH Blocks and/or CSI-RS resources. Beam level measurements refer to the output of the L1 filters as defined in 38.215, i.e., SS-RSRP, SS-RSRQ, SS-SINR, CSI-RSRP, CSI-RSRQ and CSI-SINR.

The network may configure an RRC_CONNECTED UE to perform measurements and report them in accordance with the measurement configuration. The measurement configuration is provided by means of dedicated signalling i.e. using the *RRCReconfiguration.*

The network may configure the UE to perform the following types of measurements:

- NR measurements;
- Inter-RAT measurements of E-UTRA frequencies.

The network may configure the UE to perform the following NR measurements, based on different RS types SS/PBCH Block or CSI-RS:

- SS/PBCH Block based intra-frequency measurements: measurements at SSB(s) of neighbour cell(s) where both the center frequency(ies) and subcarrier spacing are the same as each serving cell defining SSB.
- SS/PBCH Block based inter-frequency measurements: measurements at SSB(s) of neighbour cell(s) that have different center frequency(ies) or different subcarrier spacing compared to each serving cell defining SSB.
- CSI-RS based intra-frequency measurements: measurements at CSI-RS(s) resource(s) of configured neighbour cell(s) whose bandwidth(s) are within the bandwidth(s) of the CSI-RS resource(s) on the serving cell(s) configured for measurements and having the same subcarrier spacing of the CSI-RS resource(s) on the serving cell(s) configured for measurements.
- CSI-RS based inter-frequency measurements: measurements at CSI-RS(s) resource(s) of configured neighbour cell(s) whose bandwidth(s) are not within the bandwidth(s) or having different subcarrier spacing compared to the CSI-RS resource(s) on the serving cell(s) configured for measurements.

Editor's Note: FFS Whether the definition of inter-frequency and intra-frequency measurements provided by RAN4 should be removed from 38.331.

The network may configure the UE to report the following measurement information based on SS/PBCH block(s):

- Measurement results per SS/PBCH block;
- Measurement results per cell based on SS/PBCH block(s);
- SS/PBCH block(s) indexes.

The network may configure the UE to report the following measurement information based on CSI-RS resources:

- Measurement results per CSI-RS resource;
- Measurement results per cell based on CSI-RS resource(s);
- CSI-RS resource measurement identifiers.

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The measurement configuration includes the following parameters:

1. **Measurement objects:** A list of objects on which the UE shall perform the measurements.

   - For intra-frequency and inter-frequency measurements a measurement object is associated to an NR carrier frequency. Associated with this NR carrier frequency, the network may configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.

Editor's Note: Revisit the formulation below, and as well as how to capture the following additional agreements:

2 More than one MO with CSI-RS resources for measurement can be associated to the same SSB location in frequency. The SSB is at least used for timing reference.

3 In case that more than one MO with CSI-RS resources for measurement is associated to the same SSB location in frequency the UE is indicated which MO corresponds to the serving carrier.

FFS whether the indication is in MO or serving cell configuration.

   - UE determines which MO corresponds to the serving cell frequency from the frequency location of the CD-SSB that is contained within the serving cell configuration.

Editor's Note: FFS Detailed definition of a measurement object based on RAN1/RAN4 input e.g. concerning SS Blocks transmissions. Revisit the procedures describing neighbouring cells on associated frequency and the concept of serving frequency. Consider summarizing the description if becomes lengthy.

   - For inter-RAT E-UTRA measurements a measurement object is a single EUTRA carrier frequency. Associated with this E-UTRA carrier frequency, the network can configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.

2. **Reporting configurations:** A list of reporting configurations where there can be one or multiple reporting configurations per measurement object. 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.

   - RS type: The RS that the UE uses for cell measurement results (SS/PBCH block or CSI-RS).

   - Reporting format: The quantities per cell and/or per beam that the UE includes in the measurement report (e.g. RSRP) and other associated information such as the maximum number of cells and the maximum number beams per cell 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 also included in the measurement report that triggered the reporting, serving as a reference to the network.

4. **Quantity configurations:** The quantity configuration defines the measurement quantities and associated filtering used for all event evaluation and related reporting of that measurement type. For NR measurements, the network may configure up to 2 quantity configurations with a reference in the NR measurement object to the configuration that is to be used.

5. **Measurement gaps:** Periods that the UE may use to perform measurements, i.e. no (UL, DL) transmissions are scheduled.

An RRC_CONNECTED UE maintains a single measurement object list, a single reporting configuration list, and a single measurement identities list. The measurement object list possibly includes NR intra-frequency object(s), NR inter-frequency object(s) and inter-RAT objects. Similarly, the reporting configuration list includes NR and inter-RAT

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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 NR measurement object(s), the UE measures and reports on the serving cell(s), listed cells and/or detected cells.

Editor's Note: FFS Whether the definitions of serving cells, listed cells and detected cells in 38.331 are also applicable for E-UTRAN measurement object(s).

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

The network applies the procedure as follows:

- to ensure that, whenever the UE has a *measConfig*, it includes a *measObject* for each serving frequency;

Editor's Note: FFS How the procedure is used for CGI reporting.

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 *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-MeasureConfig*:

2> if *s-MeasureConfig* is set to *ssb-rsrp*, set parameter *ssb-rsrp* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig;*

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2> else, set parameter *csi-rsrp* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*;

Editor's Note: FFS Whether we can simplify the procedural text and avoid using *VarMeasConfig*.

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 if 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.

5.5.2.3 Measurement identity addition/ modification

The network 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 and reset the associated information (e.g. *timeToTrigger*) 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 *measObjectList* 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 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.

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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*, *whiteCellsToAddModList*, *cellsToRemoveList, blackCellsToRemoveList*, *whiteCellsToRemoveList, absThreshSS-BlocksConsolidation, absThreshCSI-RS-Consolidation, nroSS-BlocksToAverage, nroCSI-RS-ResourcesToAverage*;

Editor's Note: FFS: Exceptions in handling *measObject* modification for other fields e.g. cells to add/remove from current cell list, measurement configuration for NR-SS and/or CSI-RS.

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*;

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 *whiteCellsToRemoveList*:

4> for each *cellIndex* included in the *whiteCellsToRemoveList*:

5> remove the entry with the matching *cellIndex* from the *whiteCellsToAddModList*;

3> if the received *measObject* includes the *whiteCellsToAddModList*:

4> for each *cellIndex* included in the *whiteCellsToAddModList*:

5> if an entry with the matching *cellIndex* is included in the *whiteCellsToAddModList*:

6> replace the entry with the value received for this *cellIndex*;

5> else:

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6> add a new entry for the received *cellIndex* to the *whiteCellsToAddModList*;

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 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*.

Editor's Note: FFS How cell indexes are encoded e.g. cell index range.

Editor's Note: FFS Whether the UE should delete a measurement reporting entry based on one RS type (e.g. SS/PBCH block), stop timers and reset variables (e.g. *timeToTrigger*) when parameters associated to another RS type are modified in *measObject*.

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 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 the *VarMeasReportList*, if included;

4> stop the periodical reporting timer 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*;

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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 and reset the associated information (e.g. *timeToTrigger*) for this *measId*;

5.5.2.9 Measurement gap configuration

Editor's Note: FFS How measurement gaps are configured.

Editor's Note: FFS how to capture the e.g. following agreement:

For the independent gap case where UE is able to apply a different gap pattern for LTE/FR1 and FR2:

a NR RRC configures a measurement gap configuration for FR2.

5.5.2.10 Reference signal measurement timing configuration

Editor's Note: FFS How SS/PBCH block measurement timing is configured.

5.5.3 Performing measurements

5.5.3.1 General

An RRC_CONNECTED UE shall derive cell measurement results by measuring one or multiple beams associated per cell as configured by the network, as described in 5.5.3.3. For all cell measurement results in RRC_CONNECTED the UE applies the layer 3 filtering as specified in 5.5.3.2, before using the measured results for evaluation of reporting criteria and measurement reporting. For cell measurements, the network can configure RSRP, RSRQ or SINR as trigger quantity. Reporting quantities can be the same as trigger quantity or combinations of quantities (i.e. RSRP and RSRQ; RSRP and SINR; RSRQ and SINR; RSRP, RSRQ and SINR).

Editor's Note: FFS Whether multiple quantities and be configured as trigger quantities, e.g. RSRP and RSRQ; RSRP and SINR; RSRQ and SINR; RSRP, RSRQ and SINR.

The network may also configure the UE to report measurement information per beam (which can either be measurement results per beam with respective beam identifier(s) or only beam identifier(s)), derived as described in 5.5.3.3. If beam measurement information is configured to be included in measurement reports, the UE applies the layer 3 beam filtering as specified in 5.5.3.2. On the other hand, the exact layer 1 filtering of beam measurements used to derive cell measurement results is implementation dependent.

The UE shall:

1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell as follows:

2> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *ss*:

3> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains a *reportQuantityRsIndexes*:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3;

3> derive serving cell measurement results based on SS/PBCH block, as described in 5.5.3.3;

2> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *csi-rs*:

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3> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains a *reportQuantityRsIndexes*:

4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on CSI-RS, as described in 5.5.3.3;

3> derive serving cell measurement results based on CSI-RS, as described in 5.5.3.3;

1> if at least one *measId* included in the *measIdList* within *VarMeasConfig* contains SINR as trigger quantity and/or reporting quantity:

2> if the associated *reportConfig* contains *rsType* set to *ss*:

3> if the *measId* contains a *reportQuantityRsIndexes*:

4> derive layer 3 filtered SINR per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3;

3> derive serving cell SINR based on SS/PBCH block, as described in 5.5.3.3;

2> if the associated *reportConfig* contains *rsType* set to *csi-rs*:

3> if the *measId* contains a *reportQuantityRsIndexes*:

4> derive layer 3 filtered SINR per beam for the serving cell based on CSI-RS, as described in 5.5.3.3;

3> derive serving cell SINR based on CSI-RS, as described in 5.5.3.3;

1> for each *measId* included in the *measIdList* within *VarMeasConfig*:

2> if the *reportType* for the associated *reportConfig* is not set to *reportCGI*:

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-MeasureConfig* is not configured, or

4> if *s-MeasureConfig* is set to *ssb-rsrp* and the PCell RSRP based on SS/PBCH block, after layer 3 filtering, is lower than *ssb-rsrp* or,

4> if *s-MeasureConfig* is set to *csi-rsrp* and the PCell RSRP based on CSI-RS, after layer 3 filtering, is lower than *csi-rsrp* or,

5> if the *measObject* is associated to NR and the *rsType* is set to *csi-rs*:

6> if *reportQuantityRsIndexes* for the associated *reportConfig* is configured:

7> derive layer 3 filtered beam measurements only based on CSI-RS for each measurement quantity indicated in *reportQuantityRsIndexes*, as described in 5.5.3.3;

6> derive cell measurement results based on CSI-RS for each trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;

5> if the *measObject* is associated to NR and the *rsType* is set to *ss*:

6> if *reportQuantityRsIndexes* for the associated *reportConfig* is configured:

7> derive layer 3 beam measurements only based on SS/PBCH block for each measurement quantity indicated in *reportQuantityRsIndexes*, as described in 5.5.3.3;

6> derive cell measurement results based on SS/PBCH block for each trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;

5> if the *measObject* is associated to E-UTRA:

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6> perform the corresponding measurements associated to neighbouring cells on the frequencies indicated in the concerned *measObject*;

2> perform the evaluation of reporting criteria as specified in 5.5.4.

5.5.3.2 Layer 3 filtering

The UE shall:

1> for each cell measurement quantity and for each beam measurement quantity that the UE performs measurements according to 5.5.3.1:

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 X ms;

Editor's Note: FFS Exact value of the sampling rate (i.e. X) for layer 3 filtering.

NOTE 1: If k is set to 0, no layer 3 filtering is applicable.

NOTE 2: 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 3: The filter input rate is implementation dependent, to fulfil the performance requirements set in [FFS]. For further details about the physical layer measurements, see TS 38.133 [FFS].

5.5.3.3 Derivation of measurement results

The network may configure the UE to perform RSRP, RSRQ and SINR measurement results per cell associated to NR carrier frequencies based on parameters configured in the *measObject* (e.g. maximum number of beams to be averaged and beam consolidation thresholds) and in the *reportConfig* (*rsType* to be measured, SS/PBCH block and CSI-RS).

The UE shall:

1> for each cell measurement quantity to be derived based on SS/PBCH block;

2> if *nroSS-BlocksToAverage* in the associated *measObject* is not configured; or

2> if *absThreshSS-BlocksConsolidation* in the associated *measObject* is not configured; or

2> if the highest beam measurement quantity value is below *absThreshSS-BlocksConsolidation*:

3> derive each cell measurement quantity based on SS/PBCH block as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];

2> else:

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3> derive each cell measurement quantity based on SS/PBCH block as the linear average of the power values of the highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* where the total number of averaged beams shall not exceed *nroSS-BlocksToAverage*;

1> for each cell measurement quantity to be derived based on CSI-RS;

2> consider a CSI-RS resource on the associated frequency to be applicable for deriving RSRP when the concerned CSI-RS resource is included in the *csi-rs-ResourceConfig-Mobility* with the corresponding *cellId* and *CSI-RS-ResourceId-RRM* within the *VarMeasConfig* for this *measId*;

2> if *nroCSI-RS-ResourcesToAverage* in the associated *measObject* is not configured;

2> if *absThreshCSI-RS-Consolidation* in the associated *measObject* is not configured; or

2> if the highest beam measurement quantity value is below *absThreshCSI-RS-Consolidation*:

3> derive each cell measurement quantity based on CSI-RS as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];

2> else:

3> derive each cell measurement quantity based on CSI-RS as the linear average of the power values of the highest beam measurement quantity values above *absThreshCSI-RS-Consolidation* where the total number of averaged beams shall not exceed *nroCSI-RS-ResourcesToAverage*;

The network can configure the UE to perform RSRP, RSRQ and SINR measurement results per beam based on parameters configured in the *measObject* and in the *reportConfig*. If beam measurement information is configured to the reported, beam measurement should be derived as follows.

The UE shall:

1> for each layer 3 beam filtered measurement quantity to be derived based on SS/PBCH block;

2> derive each configured beam measurement quantity based on SS/PBCH block as described in TS 38.215[9], and apply layer 3 beam filtering as described in 5.5.3.2.

1> for each layer 3 beam filtered measurement quantity to be derived based on CSI-RS;

2> derive each configured beam measurement quantity based on CSI-RS as described in TS 38.215 [9], and apply layer 3 beam filtering as described in 5.5.3.2.

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* does not include a *reportType* set to *reportCGI*:

3> if the corresponding *measObject* concerns NR;

4> if the eventA1 or eventA2 is configured in the corresponding *reportConfig*:

5> consider only the serving cell to be applicable;

4> else:

5> if *useWhiteCellList* is set to TRUE:

6> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is included in the *whiteCellsToAddModList* defined within the *VarMeasConfig* for this measId;

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5> else:

6> 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;

2> if the *reportType* is set to *eventTriggered* 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> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *reportType* is set to *eventTriggered* 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> initiate the measurement reporting procedure, as specified in 5.5.5;

2> if the *reportType* is set to *eventTriggered* 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 *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 *reportType* is set to *periodical* 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;

4> if the *reportAmount* exceeds 1:

5> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the PCell;

4> else (i.e. the *reportAmount* is equal to 1):

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5> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the PCell and for the strongest cell among the applicable cells;

2> upon expiry of the periodical reporting timer for this *measId*:

3> initiate the measurement reporting procedure, as specified in 5.5.5;

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 *measObjectNR* 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 and RS-SINR.

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 *measObjectNR* 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).

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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 and RS-SINR.

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 *measObjectNR* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* 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 *measObjectNR* corresponding to the frequency of the PCell/ PSCell).

Ocp is the cell specific offset of the PCell/ PSCell (i.e. *cellIndividualOffset* as defined within *measObjectNR* 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 *reportConfigNR* for this event).

Off is the offset parameter for this event (i.e. *a3-Offset* as defined within *reportConfigNR* for this event).

Mn, Mp are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ofn, ***Ocn***, ***Ofp***, ***Ocp***, ***Hys***, ***Off*** are expressed in dB.

5.5.4.5 Event A4 (Neighbour becomes better than threshold)

The UE shall:

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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 *measObjectNR* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* 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 *reportConfigNR* for this event).

Thresh is the threshold parameter for this event (i.e. *a4-Threshold* as defined within *reportConfigNR* for this event).

Mn is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

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)

$Mp - Hys > Thresh1$

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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 *measObjectNR* corresponding to the frequency of the neighbour cell).

Ocn is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* 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 *reportConfigNR* for this event).

Thresh1 is the threshold parameter for this event (i.e. *a5-Threshold1* as defined within *reportConfigNR* for this event).

Thresh2 is the threshold parameter for this event (i.e. *a5-Threshold2* as defined within *reportConfigNR* for this event).

Mn, Mp are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

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***.

5.5.4.7 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 *measObjectNR* 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 *measObjectNR* 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 *measObjectNR* corresponding to the serving frequency), and is set to zero if not configured for the serving cell.

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Hys is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

Off is the offset parameter for this event (i.e. *a6-Offset* as defined within *reportConfigNR* for this event).

Mn, Ms are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

Ocn, Ocs, Hys, Off are expressed in dB.

Editor's Note: FFS Whether multiple trigger quantities is supported in Rel-15.

Editor's Note: FFS Details of B1/B2 inter-RAT events and periodical reporting for LTE measurements.

5.5.5 Measurement reporting

5.5.5.1 General

Figure 5.5.5-1: Measurement reporting

The purpose of this procedure is to transfer measurement results from the UE to the network. 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 *measResultServingCell* within *measResultServingFreqList* to include RSRP, RSRQ and the available SINR for each configured serving cell derived based on the *rsType* indicated in the associated *reportConfig*;

1> set the *measResultServingCell* within *measResultServFreqList* to include for each SCell that is configured, if any, the *servFreqId*;

1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRsIndexes*:

2> for each configured serving cell, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2.

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 *measResultBestNeighCell* within *measResultServFreqList* to include the *physCellId* and the available measurement quantities and *rsType* indicated in *reportConfig* of the best non-serving cell on the concerned serving frequency;

3> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRsIndexes:*

4> for each best non-serving cell on the concerned serving frequency, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2.

1> if there is at least one applicable neighbouring cell to report:

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2> set the *measResultNeighCells* to include the best neighbouring cells up to *maxReportCells* in accordance with the following:

3> if the *reportType* is set to *eventTriggered*:

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;

4> if *reportQuantityRsIndexes* is configured, include beam measurement information as described in 5.5.5.2.

3> for each cell that is included in the *measResultNeighCells*, include the *physCellId*;

3> if the *reportType* is set to *eventTriggered*;

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 NR:

6> if *rsType* in the associated *reportConfig* is set to *ss*:

7> set *resultsSSBCell* within the *measResult* to include the SS/PBCH block based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in order of decreasing trigger quantity, i.e. the best cell is included first;

8> if *reportQuantityRsIndexes* is configured, include beam measurement information as described in 5.5.5.2.

6> else if *rsType* in the associated *reportConfig* is set to *csi-rs*:

7> set *resultsCSI-RSCell* within the *measResult* to include the CSI-RS based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in order of decreasing trigger quantity, i.e. the best cell is included first;

8> if *reportQuantityRsIndexes* is configured, include beam measurement information as described in 5.5.5.2.

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 *reportType* is set to *periodical*:

3> remove the entry within the *VarMeasReportList* for this *measId*;

3> remove this *measId* from the *measIdList* within *VarMeasConfig*.

1> submit the *MeasurementReport* message to lower layers for transmission, upon which the procedure ends.

Editor's Note: Capture that NR MeasurementReport is sent over SRB3 whenever SRB3 is available. FFS.

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5.5.5.2 Reporting of beam measurement information

For beam measurement information to be included in a measurement report the UE shall:

1> set *rsIndexResults* to include up to *maxNroRsIndexesToReport* beam indexes in order of decreasing quantity as follows:

2> if the measurement information to be included is based on SS/PBCH block:

3> include within *resultsSSBIndexes* the index associated to the best beam for that SS/PBCH block quantity and the remaining beams whose quantity is above *absThreshSS-BlocksConsolidation* defined in the *VarMeasConfig* for the corresponding *measObject*;

3> if *onlyReportBeamIds* is not configured, include the SS/PBCH based measurement results associated to each beam index.

2> else if the beam measurement information to be included is based on CSI-RS:

3> include within *resultsCSI-RSIndexes* the index associated to the best beam for that CSI-RS quantity and the remaining beams whose quantity is above *absThreshCSI-RS-Consolidation* defined in the *VarMeasConfig* for the corresponding *measObject*;

3> if *onlyReportBeamIds* is not configured, include the CSI-RS based measurement results associated to each beam index.

Editor's Note: FFS which quantity to use for ordering beam measurement results.

Editor's Note: FFS Measurement relation actions during procedures such as handover and re-establishment

5.6 UE capabilities

5.6.1 UE capability transfer

5.6.1.1 General

Editor's Note: Targeted for completion in June 2018.5.6.1.2 Initiation

Editor's Note: Targeted for completion in June 2018.

5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

Editor's Note: Targeted for completion in June 2018.

5.6.1.4 Compilation of band combinations supported by the UE

The UE shall:

1> if includes *requestedFreqBandList*:

2> compile a list of band combinations, candidate for inclusion in the *UECapabilityInformation* message, only consisting of bands included in *requestedFreqBandList*, and prioritized in the order of *requestedFreBandList*, (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);

2> for each band combination included in the candidate list:

3> if it is regarded as a fallback band combination with the same capabilities of another band combination included in the list of candidates as specified in TS 38.306 [xx]:

4> remove the band combination from the list of candidates.

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2> include all band combinations in the candidate list into *supportedBandCombination*.

1> else:

2> include all band combinations supported by the UE into *supportedBandCombination,* excluding fallback band combinations with the same capabilities of another band combination included in the list of band combinations supported by the UE.

5.6.1.5 Compilation of baseband processing combinations supported by the UE

The UE shall:

1> for each band combination included in *supportedBandCombination*:

2> include the baseband processing combination supported for the band combination into *supportedBasebandProcessingCombination*, unless it is already included;

2> if there are the fallback baseband processing combinations of this baseband processing combination as specified in TS 38.306 [xx] for which supported baseband capabilities are different from this baseband processing combination:

3> include the fallback baseband processing combinations into *supportedBasebandProcessingCombination*.

5.7 Other

5.7.1 DL information transfer

Editor's Note: Targeted for completion in June 2018.

5.7.2 UL information transfer

Editor's Note: Targeted for completion in June 2018.

5.7.3 SCG failure information

5.7.3.1 General

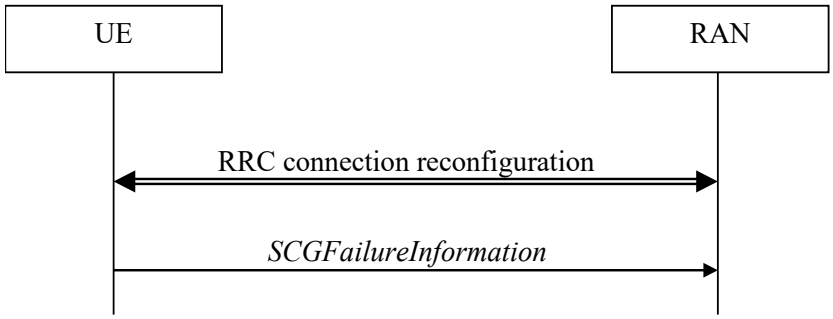

Figure 5.7.3.1-1: SCG failure information

The purpose of this procedure is to inform EUTRAN or NR MN about an SCG failure the UE has experienced i.e. SCG radio link failure, SCG change failure, SCG configuration failure for RRC message on SRB3, SCG integrity check failure and exceeding the maximum uplink transmission timing difference.

Editor's Note: SCG failure considers the case of exceeding the maximum uplink transmission timing difference if RAN1 decides that EN-DC supports the synchronised operation case. FFS how to capture

Editor's Note: FFS whether to include the handling of SCell Failure in CA duplication case in SCGfailureinformation procedure and whether to rename SCGfailureinformation.

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5.7.3.2 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 subclause 5.3.11.3,

1> upon reconfiguration with sync failure of the SCG, in accordance with subclause 5.3.5.9.3,

1> upon stopping uplink transmission towards the SCG's SpCell due to exceeding the maximum uplink transmission timing difference, in accordance with subclause x.x.x of TS 38.133 [xx]FFS_Ref.

Editor's Note: FFS on RAN1 decision on powerControlMode;

1> upon SCG configuration failure, in accordance with subclause 5.3.5.8.2;

1> upon integrity check failure indication from SCG lower layers, in accordance with subclause 5.3.5.9.3;

Upon initiating the procedure, the UE shall:

1> suspend SCG transmission for all SRBs and DRBs;

1> reset SCG-MAC;

1> stop T304;

1> if the UE is operating in EN-DC:

2> determine the failure type in accordance with subclause 5.7.3.3;

2> indicate the failure type information to the MCG RRC entity;

2> set the contents of *FailureReportSCG-ToOtherRAT* in accordance with subclause 5.7.3.4;

2> indicate the *FailureReportSCG-ToOtherRAT* to the MCG RRC entity;

2> initiate transmission of the SCGFailureInformation message as specified in TS 36.331 [10, 5.6.13.3];

Editor's Note: for EN-DC, transmission of SCGFailureInformation message is transmitted through LTE RRC entity. FFS how to capture.
The section for transmission of SCGFailureInformation in NR RRC entity for SA is FFS_Standalone.

5.7.3.3 Failure type determination

Editor's Note: FFS / TODO: Either use this section also for NR-DC or change section title (add "for EN-DC")

The UE shall determine the SCG failure type as follows:

1> if the UE initiates transmission of the SCGFailureInformation message to provide SCG radio link failure information:

2> determine the failure type as the trigger for detecting SCG radio link failure;

1> else if the UE initiates transmission of the SCGFailureInformation message to provide reconfiguration with sync failure information for an SCG:

2> determine the failure type as scg-ChangeFailure.

Editor's Note: FFS whether to change scg-ChangeFailure to synchronousReconfigurationFailure-SCG

1> else if the UE initiates transmission of the SCGFailureInformation message due to exceeding maximum uplink transmission timing difference:

2> determine the failure type as *maxUL-TimingDiff*;

1> else, if the UE initiates transmission of the SCGFailureInformation message due to SRB3 IP check failure:

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2> determine the failure type as *srb3IPCheckFailure*;

1> else, if the UE initiates transmission of the *SCGFailureInformation* message due to Reconfiguration failure of NR RRC reconfiguration message:

2> determine the failure type as *scg-reconfigFailure*;

Editor's Note: FFS: whether to include *rrc-TransactionIdentifier* information.

5.7.3.4 Setting the contents of *FailureReportSCG-ToOtherRAT*

The UE shall set the contents of the *FailureReportSCG-ToOtherRAT* as follows:

1> set the measResultServFreqList to include for each SCG cell that is configured by the SN to be measured, if any, within measResultSCell the quantities of the concerned SCell, if available, according to performance requirements in [FFS_Ref];

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 NR 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 by the SN for one or more non-serving NR frequencies and measurement results are available, include the measResultListNR;

2> for each neighbour cell included,

3> include the optional fields that are available.

NOTE: 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.

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6 Protocol data units, formats and parameters (ASN.1)

6.1 General

6.1.1 Introduction

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.

6.1.2 Need codes for optional downlink fields

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. For guidelines on the use of need codes, see Annex A.6.

Table 6.1.2-1: Meaning of abbreviations used to specify the need for fields to be present

Abbreviation	Meaning

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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).
S	*Specified* Used for (configuration) fields, whose field description or procedure **specifies** the UE behavior performed upon receiving a message with the field absent (and not if field description or procedure specifies the UE behavior when field is not configured).
M	*Maintain* Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE maintains the current value.
N	*No action* (one-shot configuration that is not maintained) Used for (configuration) fields that are not stored and whose presence causes a one-time action by the UE. Upon receiving message with the field absent, the UE takes no action.
R	*Release* Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE releases the current value.

6.2 RRC messages

6.2.1 General message structure

– *NR-RRC-Definitions*

This ASN.1 segment is the start of the NR RRC PDU definitions.

```
-- ASN1START
-- TAG-NR-RRC-DEFINITIONSSTART

NR-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- TAG-NR-RRC-DEFINITIONS-STOP
-- ASN1STOP
```


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– *BCCH-BCH-Message*

The *BCCH-BCH-Message* class is the set of RRC messages that may be sent from the network to the UE via BCH on the BCCH logical channel.

```
-- ASN1START
-- TAG-BCCH-BCH-MESSAGE-START

BCCH-BCH-Message ::= SEQUENCE {
    message                                         BCCH-BCH-MessageType
}

BCCH-BCH-MessageType ::= CHOICE {
    mib                                             MIB,
    messageClassExtension   SEQUENCE {}
}

-- TAG-BCCH-BCH-MESSAGE-STOP
-- ASN1STOP
```

– *DL-DCCH-Message*

The *DL-DCCH-Message* class is the set of RRC messages that may be sent from the network to the UE on the downlink DCCH logical channel.

```
-- ASN1START
-- TAG-DL-DCCH-MESSAGE-START

DL-DCCH-Message ::= SEQUENCE {
    message                                         DL-DCCH-MessageType
}

DL-DCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        rrcReconfiguration                          RRCReconfiguration,
        spare15 NULL, spare14 NULL, spare13 NULL,
        spare12 NULL, spare11 NULL, spare10 NULL,
        spare9 NULL, spare8 NULL, spare7 NULL,
        spare6 NULL, spare5 NULL, spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- TAG-DL-DCCH-MESSAGE-STOP
-- ASN1STOP
```


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– *UL-DCCH-Message*

The *UL-DCCH-Message* class is the set of RRC messages that may be sent from the UE to the network on the uplink DCCH logical channel.

```
-- ASN1START
-- TAG-UL-DCCH-MESSAGE-START

UL-DCCH-Message ::= SEQUENCE {
    message                                         UL-DCCH-MessageType
}

UL-DCCH-MessageType ::= CHOICE {
    c1                      CHOICE {
        measurementReport                           MeasurementReport,
        rrcReconfigurationComplete                  RRCReconfigurationComplete,
        spare14 NULL, spare13 NULL, spare12 NULL,
        spare11 NULL, spare10 NULL, spare9 NULL,
        spare8 NULL, spare7 NULL, spare6 NULL,
        spare5 NULL, spare4 NULL, spare3 NULL,
        spare2 NULL, spare1 NULL
    },
    messageClassExtension   SEQUENCE {}
}

-- TAG-UL-DCCH-MESSAGE-STOP
-- ASN1STOP
```

6.2.2 Message definitions

– *MIB*

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

MasterInformationBlock

```
-- ASN1START
```


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```
-- TAG-MIB-START

MIB ::= SEQUENCE {
    -- Part of the SSB index transmitted explicitly in the MasterInformationBlock (see 38.213, section 4.1).
    -- The SSB-Index identifies this SSB in the SS-Burst-Set.
    -- The field is only present for carrier frequencies >6 GHz. FFS whether to create a separate MIB for >6 GHz or move optional field to the end.
    ssb-IndexExplicit                   INTEGER (1..7)                                          OPTIONAL, -- Cond Above6Ghz

    -- Indication of whether the SS block is in the first or second 5 ms of a radio frame.
    -- Corresponds to L1 parameter 'half-frame-index' (see 38,211, section 4.3.1)
    halfFrameIndex                      ENUMERATED {firstHalf,secondHalf},

    systemFrameNumber                   BIT STRING (SIZE (10)),

    -- Subcarrier spacing for SIB1, Msg.2/4 for initial access and SI-messages.
    -- Values 15 and 30 kHz are applicable for carrier frequencies <6GHz; Values 60 and 120 kHz are applicable for carrier frequencies >6GHz
    subCarrierSpacingCommon             SubcarrierSpacing,

    -- The frequency domain offset between SSB and the overall resource block grid in number of subcarriers. See 38.211, section 7.4.3.1)
    ssb-subcarrierOffset                INTEGER (0..11),

    -- Position of (first) DL DM-RS (see 38.211, section 7.4.1.1.1)
    dmrs-TypeA-Position                 ENUMERATED {pos2, pos3},

    -- Determines a bandwidth for PDCCH/SIB, a common ControlResourceSet (CORESET) a common search space and necessary PDCCH parameters
    -- Corresponds to L1 parameter 'RMSI-PDCCH-Config' (see FFS_Specification, section FFS_Section)
    -- FFS: Make optional and omit e.g. in EN-DC or in other cells not broadcasting SIB1? Or make it mandatory to avoid optional fields in MIB?
    pdcchConfigSIB1                     INTEGER(0..255),

    -- Indicates that UE shall not campe on this cell
    cellBarred                          ENUMERATED {barred, notBarred},
    -- Indicates that intraFreqReselection is not allowed when cellBarred is set to barred.
    intraFreqReselection                ENUMERATED {allowed, notAllowed},

    -- FFS: How many spare values to keep in MIB?
    spare                               BIT STRING (SIZE (ffsValue))
}

-- TAG-MIB-STOP
-- ASN1STOP
```

MasterInformationBlock **field descriptions**

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– *MeasurementReport*

The *MeasurementReport* message is used for the indication of measurement results.

Signalling radio bearer: SRB1, SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to NG-RAN

MeasurementReport message

```
-- ASN1START
-- TAG-MEASUREMENTREPORT-START

MeasurementReport ::=               SEQUENCE {
    criticalExtensions                  CHOICE {
        measurementReport                           MeasurementReport-IEs,
        criticalExtensionsFuture                    SEQUENCE {}
    }
}

MeasurementReport-IEs ::=       SEQUENCE {
    measResults                     MeasResults
-- FFS
}

-- TAG-MEASUREMENTREPORT-STOP
-- ASN1STOP
```

– *RRCReconfiguration*

The *RRCReconfiguration* 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.

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Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

RRCReconfiguration message

```
-- ASN1START
-- TAG-RRCRECONFIGURATION-START

RRCReconfiguration ::=              SEQUENCE {
    rrc-TransactionIdentifier           RRC-TransactionIdentifier,
    criticalExtensions                  CHOICE {
        rrcReconfiguration                  RRCReconfiguration-IEs,
        criticalExtensionsFuture            SEQUENCE {}
    }
}

RRCReconfiguration-IEs ::=          SEQUENCE {
    -- Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP.
    -- In In EN-DC this field may only be present if the RRCReconfiguration
    -- is transmitted over SRB3.
    radioBearerConfig                   RadioBearerConfig                                       OPTIONAL, -- Need M

    -- Configuration of primary and secondary cell groups (Dual Connectivity):
    masterCellGroupConfig               CellGroupConfig                                         OPTIONAL, -- Need M
    secondaryCellGroupToAddModList      SEQUENCE (SIZE (1..maxSCellGroups)) OF CellGroupConfig      OPTIONAL, -- Need M
    secondaryCellGroupToReleaseList     SEQUENCE (SIZE (1..maxSCellGroups)) OF CellGroupId      OPTIONAL, -- Need M

    measConfig                          MeasConfig                                              OPTIONAL, -- Need M


    lateNonCriticalExtension            OCTET STRING                                            OPTIONAL,
    nonCriticalExtension                SEQUENCE{}                                              OPTIONAL
}

-- TAG-RRCRECONFIGURATION-STOP
-- ASN1STOP
```

***RRCReconfiguration* field descriptions**
FFS FFS.

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Conditional presence	Explanation
FFS	FFS

– *RRCReconfigurationComplete*

The *RRCReconfigurationComplete* message is used to confirm the successful completion of an RRC connection reconfiguration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to E-UTRAN

RRCReconfigurationComplete message

```
-- ASN1START
-- TAG-RRCRECONFIGURATIONCOMPLETE-START

RRCReconfigurationComplete ::=          SEQUENCE {
    rrc-TransactionIdentifier               RRC-TransactionIdentifier,
    criticalExtensions                      CHOICE {
        rrcReconfigurationComplete              RRCReconfigurationComplete-IEs,
        criticalExtensionsFuture                SEQUENCE {}
    }
}

RRCReconfigurationComplete-IEs ::= SEQUENCE {
    -- FFS
}

-- TAG-RRCRECONFIGURATIONCOMPLETE-STOP
-- ASN1STOP
```

***RRCReconfigurationComplete* field descriptions**
FFS FFS

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– *SIB1*

Editor's Note: Discuss whether to keep SIB1 for the December version. FFS

SIB1 contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information. It also contains radio resource configuration information that is common for all UEs.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH and BR-BCCH

Direction: Network to UE

SIB1 message

```
-- ASN1START
-- TAG-SIB1-START

SIB1 ::=        SEQUENCE {

    -- FFS / TODO: Add other parameters.

    -- Time domain positions of the transmitted SS-blocks in an SS-Burst-Set (see 38.213, section 4.1)
    ssb-PositionsInBurst                SEQUENCE {
        -- Indicates the presence of the up to 8 SSBs in one group
        inOneGroup                          BIT STRING (SIZE (8)),
        -- For above 6 GHz: indicates which groups of SSBs is present
        groupPresence                       BIT STRING (SIZE (8))                                   OPTIONAL, -- Cond above6GHzOnly
    },

    -- The SSB periodicity in msec for the rate matching purpose (see 38.211, section [7.4.3.1])
    ssb-periodicityServingCell          ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160, spare1, spare2 },

    -- TX power that the NW used for SSB transmission. The UE uses it to estimate the RA preamble TX power.
    -- (see 38.213, section 7.4)
    ss-PBCH-BlockPower                  INTEGER (-60..50),

    frequencyInfoUL                     FrequencyInfoUL                                             OPTIONAL -- Cond FDD

    -- FFS: How to indicate the FrequencyInfoUL for the SUL
    supplementaryUplink                 SEQUENCE {
        frequencyInfoUL                     FrequencyInfoUL
        -- FFS: Add additional (selection) criteria determining when/whether the UE shall use the SUL frequency
    }                                                                                               OPTIONAL, -- Cond SUL

    tdd-UL-DL-configuration             TYPE_FFS!                                                   OPTIONAL -- Cond TDD
```


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```
    -- Enables hopping of base sequence of PUCCH Format 0 when transmitted in different slots.
    -- Corresponds to L1 parameter 'PUCCH-F0-Base-sequence-hopping' (see 38.211, section 6.4.1.3)
    pucch-Format0-BaseSequenceHopping           ENUMERATED {true}       OPTIONAL,
    -- Enabling hopping of base sequence of PUCCH Format 1 when transmitted in different slots
    -- Corresponds to L1 parameter 'PUCCH-F1-Base-sequence-hopping' (see 38.211, section 6.4.1.3)
    PUCCH-Format1-BaseSequenceHopping           ENUMERATED {true}       OPTIONAL,
}

-- TAG-SIB1-STOP
-- ASN1STOP
```

6.3 RRC information elements

Editor's Note: FFS / FIXME: Move this hanging paragraph into one of the sub-sections

– *SetupRelease Information Element*

SetupRelease allows the *ElementTypeParam* to be used as the referenced data type for the setup and release entries. See A.3.8 for guidelines.

```
-- ASN1START
-- TAG-SETUP-RELEASE-START

SetupRelease { ElementTypeParam } ::= CHOICE {
    release         NULL,
    setup           ElementTypeParam
}

-- TAG-SETUP-RELEASE-STOP
-- ASN1STOP
```

6.3.1 System information blocks

6.3.2 Radio resource control information elements

– *DRB-Identity*

The IE *DRB-Identity* is used to identify a DRB used by a UE.

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DRB-Identity information elements

```
-- ASN1START
-- TAG-DRB-IDENTITY-START

DRB-Identity ::=                    INTEGER (4..32)

-- TAG-DRB-IDENTITY-STOP
-- ASN1STOP
```

– *BandwidthPart-Config*

The *BandwidthPart-Config* IE is used to configure a bandwidth part as defined in 38.211, section 4.2.2. Bandwidth parts are configured per serving cell for uplink (if the serving cell is configured with an uplink) and for downlink.

BandwidthPart.Config information element

```
-- ASN1START
-- TAG-BANDWIDTH-PART-START

BandwidthPart-Config ::=            SEQUENCE {

    -- FFS: Conditions! What to do when certain fields or the entire bandwidth part is omitted? Assume parameters of the carrier instead?
    --      Or use the initialBWP derived from SIB1 or ServingCellConfigCommon? Or make it mandatory to provide at least one BWP.
    -- FFS: How can a BandiwdthPart be changed? Only via synchronousReconfiguration or also without?

    -- NOTE: The changes in this section are based on RAN1 agreements (not from the official L1 parameter list):

    -- The bandwidth parts for downlink. (see 38.211, 38.213, section 12)
    downlinkBandwidthPartsToReleaseList         SEQUENCE (SIZE (1..maxNrofBandwidthParts)) OF BandiwdthPartId    OPTIONAL,
    downlinkBandwidthPartsToAddModList          SEQUENCE (SIZE (1..maxNrofBandwidthParts)) OF BandwidthPart        OPTIONAL,
    -- ID of the downlink bandwidth part to be used upon MAC-activation of an  SCell. If not provided, the UE uses the default BWP
    firstActiveDownlinkBwp-Id                   BandiwdthPartId                                                    OPTIONAL, -- Cond SCellOnly

    -- Corresponds to L1 parameter 'default-DL-BWP'.
    -- ID of the downlink bandwidth part to be used upon expiry of txxx.
    -- This field is UE specific. When the field is absent the UE the initial BWP as default BWP.
    -- (see 38.211, 38.213, section 12)
    -- FFS: May the NW change the default BWP with a regular RRC reconfiguration or only with Reconfiguration with sync?
    -- FFS: Whether to add a default uplink BWP
    defaultDownlinkBwp-Id                       BandiwdthPartId                                                    OPTIONAL,

    -- The bandwidth parts for uplink. In case of TDD uplink- and downlink BWP with the same bandwidthPartId are considered
    -- as a BWP pair and must have the same center frequency.
    uplinkBandwidthPartsToReleaseList           SEQUENCE (SIZE (1..maxNrofBandwidthParts)) OF BandiwdthPartId    OPTIONAL,
    uplinkBandwidthPartsToAddModList            SEQUENCE (SIZE (1..maxNrofBandwidthParts)) OF BandwidthPart        OPTIONAL,
    -- ID of the uplink bandwidth part to be used upon MAC-activation of an  SCell. If not provided, the UE uses the FFS: default BWP
```


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```
    firstActiveUplinkBwp-Id                     BandiwdthPartId                                                 OPTIONAL, -- Cond SCellOnly

    -- The duration in ms after which the UE falls back to the default Bandwidth Part. (see 38.321, section FFS_Section)
    -- The UE starts the timer when it switches its active downlink BWP to a downlink BWP other than the default downlink BWP.
    -- The UE restarts the timer to the initial value when it successfully decodes a DCI to schedule PDSCH(s) in its active downlink BWP.
    -- When the timer expires, the UE switches its active downlink BWP to the default downlink (FFS: and uplink?) BWP.
    -- FFS: For TDD the UE switches also the paired uplink BWP to the one with the defaultDownlinkBwp-Id.
    -- FFS: For FDD the UE switches the uplink BWP?????
    -- When the network releases the timer configuration, the UE stops the timer without swithching to the default (FFS: and uplink?) BWP.
    bandwidthPartInactivityTimer                SetupRelease { ENUMERATED {
                                                    FFS: Value range }}                                         OPTIONAL,   -- Need M
}

BandwidthPart ::=                   SEQUENCE {
        -- An identifier for this bandwidth part.
        -- Corresponds to L1 parameter 'UL-BWP-index'. (see 38.211, 38.213, section 12)
        bandwidthPartId                 BandiwdthPartId,
        -- Frequency domain location of this bandwidth part as a distance in number of PRBs in relation to the reference PRB (PRB 0)
        -- of the associated carrier. Corresponds to L1 parameter 'DL-BWP-loc'. (see 38.211, section FFS_Section).
        -- In case of TDD, a BWP-pair (UL BWP and DL BWP with the same bandwidthPartId) must have the same location (see 38.211, section REF)
        -- FFS Value: RAN1 seems to discuss the final range.
        location                        INTEGER (0.. maxNrofPhysicalResourceBlocksTimes4)                   OPTIONAL,
        -- Bandwidth of this bandwidth part (see 38.211, section REF)
        bandwidth                       INTEGER (1.. maxNrofPhysicalResourceBlocks)                         OPTIONAL,
        -- Subcarrier spacing to be used in this BWP. It is applied to at least PDCCH, PDSCH and corresponding DMRS.
        -- The values provided here are converted into a subcarrier spacing as indicated in 38.211, Table 4.1-2.
        subcarrierSpacing               ENUMERATED {n0, n1, n2, n3, n4}                                     OPTIONAL,
        -- Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix.
        -- Normal CP is supported for all numerologies and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing.
        -- (see 38.211, section 4.2.2)
        cyclicPrefix                    ENUMERATED { extended }                                             OPTIONAL,

        -- Frequency location of the uplink "direct current" frequency.
        -- Corresponds to L1 parameter 'UL-BWP-DC'. (see 38.211, section FFS_Section)
        directCurrentLocation           INTEGER (0..3299)                                                       OPTIONAL, -- Cond UplinkOnly
}

BandwidthPartId ::=                     INTEGER (0..maxNrofBandwidthParts-1)

-- TAG-BANDWIDTH-PART-STOP
-- ASN1STOP
```

– *CellGroupConfig*

The *CellGroupConfig* IE is used to configure a master cell group (MCG) or secondary cell group (SCG). A cell group comprises of one MAC entity, a set of logical channels with associated RLC entites and of a primary cell (SpCell) and one or more secondary cells (SCells).

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CellGroupConfig information element

```
-- ASN1START
-- TAG-CELL-GROUP-CONFIG-START

-- Configuration of one Cell-Group:
CellGroupConfig ::=                         SEQUENCE {
    cellGroupId                                 CellGroupId,

    -- Logical Channel configuration and association with radio bearers:
    rlc-BearerToAddModList              SEQUENCE (SIZE(1..maxLCH)) OF LCH-Config                    OPTIONAL,
    rlc-BearerToReleaseList             SEQUENCE (SIZE(1..maxLCH)) OF LogicalChannelIdentity        OPTIONAL,

    -- Parameters applicable for the entire cell group:
    mac-CellGroupConfig                         MAC-CellGroupConfig                                     OPTIONAL,   -- Need M
    rlf-TimersAndConstants                      RLF-TimersAndConstants                                  OPTIONAL,   -- Need M
    physical-CellGroupConfig                    PhysicalCellGroupConfig                                 OPTIONAL,   -- Need M

    -- Serving Cell specific parameters (PCell and SCells)
    spCellConfig                                SpCellConfig                                            OPTIONAL,   -- Need M
    sCellToAddModList                           SCellToAddModList                                       OPTIONAL,   -- Need M
    sCellToReleaseList                          SCellToReleaseList                                      OPTIONAL -- Need M
}

CellGroupId ::=                             INTEGER (1.. maxSCellGroups)


-- Configuration of one logical channel:
LCH-Config ::=                              SEQUENCE {
    logicalChannelIdentity                      LogicalChannelIdentity,

    -- Associate the logical channel with an SRB or a DRB:
    servedRadioBearer                       INTEGER (1..32)                                       OPTIONAL,   -- Cond LCH-SetupOnly

    reestablishRLC                              ENUMERATED {true}                                       OPTIONAL,   -- Need N
    rlc-Config                                  RLC-Config                                              OPTIONAL,   -- Cond LCH-Setup

    mac-LogicalChannelConfig                    LogicalChannelConfig                                    OPTIONAL -- Cond LCH-Setup
}

LogicalChannelIdentity ::=                  INTEGER (1..FFS)

-- Cell-Group specific L1 parameters
PhysicalCellGroupConfig ::=                 SEQUENCE {
    -- Enables spatial bundling of HARQ ACKs. It is configured per cell group, i.e. for all the cells within the cell group.
    -- It is only applicable when more than 4 layers are possible to schedule.
    -- Corresponds to L1 parameter 'HARQ-ACK-spatial-bundling' (see 38.213, section FFS_Section)
    -- Absence indicates that spatial bundling is disabled.
    harq-ACK-Spatial-Bundling                   ENUMERATED {true}                                       OPTIONAL -- Need R,
}
```


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```
-- Serving cell specific MAC and PHY parameters for a SpCell:
SpCellConfig ::=                        SEQUENCE {
    -- Parameters for the synchronous reconfiguration to the target SpCell:
    reconfigurationWithSync             SEQUENCE {
        spCellConfigCommon                  ServingCellConfigCommon,
        newUE-Identity                      C-RNTI,
        t304                                ENUMERATED {ms50, ms100, ms150, ms200, ms500, ms1000, ms2000, ms10000-v1310},
        rach-ConfigDedicated                RACH-ConfigDedicated                                    OPTIONAL,   -- Need M
    }                                                                                               OPTIONAL,   -- Cond SpCellChange

    spCellConfigDedicated               ServingCellConfigDedicated                                  OPTIONAL,   -- Need M
}

C-RNTI ::=                          BIT STRING (SIZE (16))
SCellToReleaseList ::=              SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellIndex
SCellToAddModList ::=               SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellConfig

SCellConfig ::=                     SEQUENCE {
    sCellIndex                          SCellIndex,
    sCellConfigCommon                   ServingCellConfigCommon                                     OPTIONAL,   -- Cond SCellAdd
    sCellConfigDedicated                ServingCellConfigDedicated                                  OPTIONAL,   -- Cond SCellAddMod
}

-- TAG-CELL-GROUP-CONFIG-STOP
-- ASN1STOP
```

***CellGroupConfig* field descriptions**
logicalChannelIdentity   The logical channel identity for both UL and DL.

Conditional Presence	Explanation
LCH-SetupOnly	The field is mandatory present if the corresponding LCH is being set up; otherwise it is not present.
LCH-Setup	The field is mandatory present if the corresponding LCH is being set up; otherwise it is optionally present, need M.
SpCellChange	The field is mandatory present in case of SpCell change and security key change; otherwise it is optionally present, need M.
SCellAdd	The field is optionally present, need M, upon SCell addition; otherwise it is not present
SCellAddMod	The field is mandatory present upon SCell addition; otherwise it is optionally present, need M.

– *CellIndexList*

The IE CellIndexList concerns a list of cell indices, which may be used for different purposes.

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***CellIndexList* information element**

```
-- ASN1START
-- TAG-CELL-INDEX-LIST-START

CellIndexList ::=                       SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CellIndex

CellIndex ::=                           INTEGER (1..maxNrofCellMeas)

-- TAG-CELL-INDEX-LIST-STOP
-- ASN1STOP
```

– *ControlResourceIndex*

The *ControlResourceIndex* IE concerns a short identity, used to identify a control resource set.

***ControlResourceIndex* information element**

```
-- ASN1START
-- TAG-CONTROL-RESOURCE-INDEX-START

ControlResourceIndex ::=                INTEGER (1..maxNrofControlResourceSets)

-- TAG-CONTROL-RESOURCE-INDEX-STOP
-- 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 ::=        SEQUENCE {

    -- FFS: Indicate this separately for UL and DL (as done in LTE for LAA)
    schedulingCellInfo                      CHOICE {
        own                                     SEQUENCE {                  -- No cross carrier scheduling
            cif-Presence                            BOOLEAN
        },
        other                                   SEQUENCE {                  -- Cross carrier scheduling
            schedulingCellId                        ServCellIndex,
            -- FFS: pdsch-start is probably not needed since RAN1 agreed that the scheduling DCI can provide (an index into a
```


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```
            -- UE-specific table giving) the OFDM symbols used for the PDSCH (or PUSCH)  transmission. But what does "can provide" mean?
            pdsch-Start                             INTEGER (1..4),
            -- FFS: cif-InSchedulingCell is probably still needed since RAN1 agreed that "If CIF is present in DCI, the bitwidth is fixed at 3 bit".
            cif-InSchedulingCell                    INTEGER (1..7)
        }
    }
}

-- 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 38.213 [REF, SECTION].
cif-InSchedulingCell The field indicates the CIF value used in the scheduling cell to indicate a grant or assignment applicable for this cell, see TS 38.213 [REF, SECTION]. If *cif-Presence* is set to true, the CIF value indicating a grant or assignment for this cell is 0.
pdsch-Start The starting OFDM symbol of PDSCH for the concerned SCell, see TS [REF]. 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 [REF].
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-MeasConfig*

The *CSI-MeasConfig* IE is used to configure the UE for measuring CSI-RS (reference signals) and for reporting those measurements on L1 (PUCCH, PUSCH) as channel state information. See also 38.214, section 5.2.

***CSI-MeasConfig* information element**

```
-- ASN1START
-- TAG-CSI-MEAS-CONFIG-START

-- Top level parameter for CSI/BM framework. Contains lists of  reporting, resource, and link configurations (see 38.214, section 5.2)
CSI-MeasConfig ::=                  SEQUENCE {
    csi-ResourceConfigs                 SEQUENCE (SIZE (1..maxNrofCSI-ResrouceConfigurations) OF CSI-ResourceConfig         OPTIONAL,
    csi-ReportConfigs                   SEQUENCE (SIZE (1..maxNrofCSI-Reports)) OF CSI-ReportConfig                      OPTIONAL,
    csi-MeasIdToAddModList              SEQUENCE (SIZE (1..maxNrofCSI-MeasId) OF CSI-MeasIdToAddMod                      OPTIONAL,

    -- Contains trigger states for dynamically selecting one or more aperiodic and semi-persistent reporting configurations
    -- and/or triggering one or more aperiodic CSI-RS resource sets for channel and/or interference measurement.
    -- FFS_CHECK: Is this the appropriate place for the IE or should it be inside the resource configuration or in a set?
    reportTrigger                   SEQUENCE {
        -- Size of CSI request field in DCI (bits). Corresponds to L1 parameter 'ReportTriggerSize' (see 38.214, section 5.2)
```


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```
        reportTriggerSize               INTEGER (0..FFS_Value)          OPTIONAL
    }
}


-- One CSI resource configuration comprising of one or more resource sets
CSI-ResourceConfig ::=              SEQUENCE {
    -- FFS: Where is the CSI-ResourceConfigId used?
    csi-ResourceConfigId                    CSI-ResourceConfigId,
    -- Contains up to maxNrofCSI-ResourceSets resource CSI-ReosurceSets if ResourceConfigType is 'aperiodic' and maxNrofCSI-ResourceSets otherwise.
    -- Corresponds to L1 parameter 'ResourceSetConfigList' (see 38.214, section 5.2.1.3.1)
    csi-ResourceSets                        SEQUENCE (SIZE (1..maxNrofCSI-ResourceSets) OF CSI-ResourceSet

    -- List of SSB resources used for beam measurement and reporting in a resource set
    -- Corresponds to L1 parameter 'SSBResourceMeasList' (see 38,214, section FFS_Section)
    ssb-Resources                           SEQUENCE (SIZE (1..maxNrofSSB-Resources-1)) OF  CSI-SSB-Resouce                 OPTIONAL,

    -- Time domain behavior of resource configuration. Corresponds to L1 parameter 'ResourceConfigType' (see 38.214, section 5.2.2.3.5)
    resourceType                            CHOICE {
        aperiodic                               NULL,
        semiPersistent,                         NULL,
        periodic                                NULL
    }}

CSI-ResourceConfigId ::= INTEGER (0..maxNrofCSI-ResourceConfigurations-1)

-- A set of CSI-RS resources (their IDs) for which DCI indicates whether or not these CSI-RS resources are currently present or not.
-- Corresponds to L1 parameter 'ResourceSetConfig' (see 38.214, section 5.2)
CSI-ResourceSet ::=                     SEQUENCE {
    -- FFS: Where is the CSI-ResourceSetId used?
    csi-ResourceSetId                       CSI-ResourceSetId,
    -- Contains up to maxNrofCSI-RS-ResourcesPerSet CSI-RS-Resource configurations.
    -- Corresponds to L1 parameter 'CSI-RS-ResourceConfigList' (see 38.214, section 5.2)
    -- FFS: Better make the csi-rs-Resources a common pool on CSI-MeasConfig level?
    csi-rs-Resources                        SEQUENCE (SIZE (1..maxNrofCSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-Resource,
    -- Indicates whether repetition is on/off. Repetition on (off), means that The UE can (cannot) assume that
    -- the network maintains a fixed TX beam over the resources in the set.
    -- Corresponds to L1 parameter 'ResourceRep' (see 38.214, section FFS_Section)
    repetition                              BOOLEAN
}

CSI-ResourceSetId ::= INTEGER (0..maxNrofCSI-ResourceSets-1)

-- A CSI-RS (reference signal) resource which the UE may be configured to measure on (see 38.214, section 5.2.1.3.1)
NZP-CSI-RS-Resource ::=                 SEQUENCE {
    nzp-csi-rs-ResourceId                   NZP-CSI-RS-ResourceId,
    -- Number of ports (see 38.214, section 5.2.1.2)
    nrofPorts                               ENUMERATED {p1,p2,p4,p8,p12,p16,p24,p32},
    -- OFDM symbol location(s) in a slot and subcarrier occupancy in a PRB of the CSI-RS resource
    -- FFS: how to configure CSI-RS in different slots for fine time/frequency tracking (see 38.214, section 5.2.1.3.1)
    resourceMapping                 TYPE_FFS!,
```


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```
    -- CDM value (1, 2, 4, or 8), CDM pattern (freq only, time and freq, time only) (see 38.214, section 5.2.1.3.1)
    cdm-Value                               ENUMERATED {n1, n2, n4, n8},
    cdm-Pattern                             ENUMERATED {freqOnly, timeAndFreq, timeOnly},
    -- Density of CSI-RS resource measured in RE/port/PRB (see 38.214, section 5.2.1.3.1)
    -- Values 0.5 (dot5), 1 (one) and 3 (three) are allowed for X=1,
    -- values 0.5 (dot5) and 1 (one) are allowed for X=2, 16, 24 and 32,
    -- value 1 (one) is allowed for X=4, 8, 12.
    csi-RS-Density                          ENUMERATED {dot5, one, three, spare},
    -- Wideband or partial band CSI-RS (see 38.214, section 5.2.1.3.1)
    csi-RS-FreqBand                         TYPE_FFS!,
    -- Power offset of NZP CSI-RS RE to PDSCH RE, corresponds to parameter Pc (see 38.214, section 5.2.1.3.1)
    powerControlOffset                      TYPE_FFS!,
    -- Power offset of NZP CSI-RS RE to SS RE. Corresponds to L1 parameter 'Pc_SS' (see 38.214, section FFS_Section)
    powerControlOffsetSS                    FFS_Value                                                   OPTIONAL,
    -- Scrambling ID (see 38.214, section 5.2.1.3.1)
    scramblingID                            TYPE_FFS!,
    -- Periodicity and slot offset
    csi-RS-timeConfig                       CHOICE {
        sl5                                     INTEGER (0..4),
        sl10                                    INTEGER (0..9),
        sl20                                    INTEGER (0..19),
        sl40                                    INTEGER (0..39),
        sl80                                    INTEGER (0..79),
        sl160                                   INTEGER (0..159),
        sl320                                   INTEGER (0..319),
        sl640                                   INTEGER (0..639)
    }
}

NZP-CSI-RS-ResourceId ::=                   INTEGER (0..maxNrofNZP-CSI-RS-Resources-1)

ZP-CSI-RS-Resource ::=                      SEQUENCE {
    zp-csi-rs-ResourceId                        ZP-CSI-RS-ResourceId,
    -- OFDM symbol and subcarrier occupancy of the CSI-RS resource within a slot (see 38.214, section REF)
    resourceMapping                             TYPE_FFS!

}

ZP-CSI-RS-ResourceId ::=                    INTEGER (0..maxNrofZP-CSI-RS-Resources-1)

CSI-IM-ResourceConfig ::=                   SEQUENCE {
    csi-IM-ResourceConfigId                     CSI-IM-ResourceConfigId,

    -- The resource element pattern for the CSI-IM resource
    -- Corresponds to L1 parameter 'CSI-IM-RE-pattern' (see 38.214, section 5.2.2.3.4)
    csi-IM-ResourceElementPattern               ENUMERATED {pattern2-2, pattern4-1),

    -- OFDM symbol and subcarrier occupancy of the CSI-IM resource within a slot
    -- Corresponds to L1 parameter 'CSI-IM-ResourceMapping' (see 38.214, section 5.2.2.3.4)
    -- FFS_Values: RAN1 indicated "symbol locations: [0..13] and subcarrier locations: [0..9]" ➔ Should this be a bitmap of 9x13? Or two separate?
    resourceMapping                             TYPE_FFS!       OPTIONAL,
```


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```
}

CSI-IM-ResourceConfigId ::=             INTEGER (0..maxNrofCSI-IM-Resources-1)

CSI-SSB-Resouce ::=                     SEQUENCE {
    FFS: Undefined what the IE CSI-SSB-Resource contains.
}

-- Configuration of a CSI-Report sent on L1 (e.g. PUCCH) (see 38.214, section 5.2.1)
CSI-ReportConfig ::=                    SEQUENCE {
    reportConfigId                          CSI-ReportConfigId,
    -- Time domain behavior of reporting configuration
    reportConfigType                        CHOICE {
        periodic                                SEQUENCE {
            -- Periodicity and slot offset . Corresponds to L1 parameter 'ReportPeriodicity'and 'ReportSlotOffset'
            -- (see 38.214, section section 5.2.1.4).
            reportSlotConfig                        CHOICE {
                sl5                                     INTEGER(0..4),
                sl10                                    INTEGER(0..9),
                sl20                                    INTEGER(0..19),
                sl40                                    INTEGER(0..39),
                sl80                                    INTEGER(0..79),
                sl160                                   INTEGER(0..159),
                sl320                                   INTEGER(0..319)
            },
            -- Indicates which PUCCH resource to use for reporting on PUCCH.
            pucch-CSI-ResourceIndex                 TYPE_FFS!
        },
        semiPersistent                          SEQUENCE {
            -- Periodicity and slot offset. Corresponds to L1 parameter 'ReportPeriodicity' and 'ReportSlotOffset'
            -- (see 38.214, section section 5.2.1.4).
            reportSlotConfig                        CHOICE {
                sl5                                     INTEGER(0..4),
                sl10                                    INTEGER(0..9),
                sl20                                    INTEGER(0..19),
                sl40                                    INTEGER(0..39),
                sl80                                    INTEGER(0..79),
                sl160                                   INTEGER(0..159),
                sl320                                   INTEGER(0..319)
            },
            -- Indicates which PUCCH resource to use for reporting on PUCCH.
            pucch-CSI-ResourceIndex                 TYPE_FFS!
        },
        aperiodic                               SEQUENCE {
            -- Timing offset Y for aperiodic reporting. A particular value is indicated in DCI. (see 38.214, section 5.2.1.1)
            aperiodicReportSlotOffset               TYPE_FFS!
        }
    },
    -- The CSI related quanities to report (see 38.214, section REF)
    reportQuantity                          CHOICE {
        cRI-RI-PMI-CQI                          NULL,
```


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```
        cRI-RI-i1                               NULL,
        cRI-RI-i1-CQI                           SEQUENCE {
            -- PRB bundling size to assume for CQI calcuation when reportQuantity is CRI/RI/i1/CQI
            -- Corresponds to L1 parameter 'PDSCH-bundle-size-for-CSI' (see 38.214, section FFS_Section)
            pdsch-BundleSizeForCSI                  ENUMERATED {n2, n4}     OPTIONAL,
        },
        cRI-RI-CQI                              NULL,
        cRI                                     NULL,
        cRI-RSRP                                NULL,
        spare1                                  NULL,
        spare0                                  NULL
    },
    -- Reporting configuration in the frequency domain. (see 38.214, section 5.2.1)
    reportFreqConfiguration                 SEQUENCE {
        -- Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI. (see 38.214, section 5.2.1.4)
        cqi-FormatIndicator                     ENUMERATED { widebandCQI, subbandCQI },
        -- Indicates whether the UE shall report a single (wideband) or multiple (subband) PMI. (see 38.214, section 5.2.1.4)
        pmi-FormatIndicator                     ENUMERATED { widebandPMI, subbandPMI },
        -- Indicates a contiguous or non-contigous subset of subbands in the bandwidth part which CSI shall be reported
        -- for. FFS: Each bit in the bit-string represents one subband. The right-most bit in the bit string represents the
        -- lowest subband in the BWP. (see 38.214, section 5.2.1.4)
        -- FFS: Size of the bitmap. Introduce a CHOICE with different bitmap lengths depening on number of subbands in carrier/BWP?
        csi-ReportingBand                       BIT STRING (SIZE (FFS))
    },
    -- Time domain measurement restriction for the channel (signal) measurements. (see 38.214, section 5.2.1.1)
    measRestrictionTimeForChannel               TYPE_FFS!,
    -- Time domain measurement restriction for interference measurements. (see 38.214, section 5.2.1.1)
    measRestrictionTimeForInterference          TYPE_FFS!,
    -- Codebook configuration for Type-1 or Type-II including codebook subset restriction
    codebookConfig                              CodebookConfig,
    -- Maximum number of CQIs per CSI report (cf. 1 for 1-CW, 2 for 2-CW)
    nrofCQIsPerReport                           ENUMERATED {n1, n2},
    -- Turning on/off group beam based reporting (see 38.214, section FFS_Section)
    groupBasedBeamReporting                     CHOICE {
        enabled                                     SEQUENCE {
            -- Number of beams to report for group based beam reporting (see 38.214, section REF)
            nrofBeamsToReport                       TYPE_FFS!
        },
        disabled                                SEQUENCE {
            -- The number (N) of measured RS resources to be reported per report setting in a non-group-based report.
            -- N <= N_max, where N_max is either 2 or 4 depending on UE capability.
            -- FFS: The signaling mechanism for the gNB to select a subset of N beams for the UE to measure and report.
            -- FFS: Note: this parameter may not be needed for certain resource and/or report settings
            -- FFS_ASN1: Change groupBasedBeamReporting into a CHOICE and include this field into the "no" option?
            -- (see 38.214, section FFS_Section)
            -- When the field is absent the UE applies the value 1
            nrofReportedRS                          ENUMERATED {n1, n2, n3, n4}                                 OPTIONAL
        }
    },

    -- Which CQI table to use for CQI calculation. Corresponds to L1 parameter 'CQI-Table' (see 38.214, section FFS_Section)
```


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```
    -- FFS: Whether URLLC2 should be added as one option
    cqi-Table                           ENUMERATED {64QAM, 256QAM, URLLC1, [URLLC2]}                    OPTIONAL,
    -- Indicates one out of two possible BWP-dependent values for the subband size
    -- Corresponds to L1 parameter 'SubbandSize' (see 38.214, section FFS_Section)
    -- FFS_Value: Clarify what value1 and value2 mean.
    subbandSize                         ENUMERATED {value1, value2},
    -- BLER target that the UE shall be assume in its CQI calculation.
    -- Corresponds to L1 parameter 'BLER-Target' (see 38.214, section FFS_Section)
    -- FFS_Values (now filled with spares)
    bler-Target                         ENUMERATED {0dot1, spare3, space2, spare1}                      OPTIONAL

}

CSI-ReportConfigId ::=                  INTEGER (0..maxNrofCSI-ReportConfig-1)

-- Codebook configuration for Type-I and Type-II (see 38.214, section 5.2.2.2)
CodebookConfig ::=                      SEQUENCE {
    -- Number of antenna ports in first dimension
    codebookConfig-N1                   ENUMERATED {n1,n2,n3,n4,n6,n8,n12,n16},
    -- Number of antenna ports in second dimension
    codebookConfig-N2                   ENUMERATED {n1,n2,n3,n4},
    -- Codebook subset restriction for the different codebooks

    -- CodebookType including possibly sub-types and the corresponding parameters for each. Corresponds to L1 parameter 'CodebookType'
    -- (see 38.214, section 5.2.2.2)
    codebookType                        CHOICE {
        type1                               SEQUENCE {
            subType                             ENUMERATED {typeI-SinglePanel, typeI-MultiPanel},
            -- Switch between Config 1 and Config 2
            codebookMode                        ENUMERATED {config1, config2},
            -- Number of panels, Ng, used in multi-panel codebook
            numberOfPanels                      ENUMERATED {2panels, 4panels}           OPTIONAL    -- Cond TypeI-MultiPanel
            codebookSubsetRestrictionType1      CHOICE {
                -- Codebook subset restriction for Type I Single-panel codebook
                -- Corresponds to L1 parameter 'TypeI-SinglePanel-CodebookSubsetRestriction' (see 38.214, section FFS_Section)
                -- FFS Value: RAN1 indicated Bitmap of size N1*N2*O1*O2
                singlePanel                         BIT STRING (SIZE (FFS)),

                -- Codebook subset restriction for 2TX codebook
                -- Corresponds to L1 parameter 'TypeI-SinglePanel-2Tx-CodebookSubsetRestriction' (see 38.214, section FFS_Section)
                singlePanel2TX                      BIT STRING (SIZE (6)),

                -- Codebook subset restriction for Type I Multi-panel codebook
                -- Corresponds to L1 parameter 'TypeI-MultiPanel-CodebookSubsetRestriction' (see 38.214, section FFS_Section)
                multiPanel                          BIT STRING (SIZE (FFS)),
                -- i2 codebook subset restriction for Type I Single-panel codebook used when reportQuantity is CRI/Ri/i1/CQI
                -- Corresponds to L1 parameter 'TypeI-SinglePanel-CodebookSubsetRestriction-i2' (see 38.214, section FFS_Section)
                singlePanelCodebookSubsetRestriction-i2 BIT STRING (SIZE (16))
            },
            ri-Restriction                      CHOICE {
                -- Restriction for RI for TypeI-SinglePanel-RI-Restriction
```


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```
                -- Corresponds to L1 parameter 'TypeI-SinglePanel-RI-Restriction' (see 38.214, section FFS_Section)
                typeI-SinglePanelRI-Restriction         BIT STRING (SIZE (8)),
                -- Restriction for RI for TypeI-MultiPanel-RI-Restriction
                -- Corresponds to L1 parameter 'TypeI-MultiPanel-RI-Restriction' (see 38.214, section FFS_Section)
                typeI-MultiPanelRI-Restriction          BIT STRING (SIZE (4))
            }
        },
        type2                                   SEQUENCE {
            subType                                 ENUMERATED {typeII, typeII-PortSelection},
            -- The size of the PSK alphabet, QPSK or 8-PSK
            phaseAlphabetSize                       ENUMERATED {n4, n8}
            -- If subband amplitude reporting is activated (true)
            subbandAmplitude                        BOOLEAN,
            -- Number of beams, L,  used for linear combination
            numberOfBeams                           ENUMERATED {2beams, 3beams, 4beams},
            -- The size of the port selection codebook (parameter d)
            portSelectionSamplingSize               ENUMERATED {n1, n2, n3, n4}                 OPTIONAL     -- Cond TypeII-PortSelection
            -- Codebook subset restriction for Type II codebook.
            -- FFS: Clarify the meaning of the bitmap
            -- FFS: The size of the bitmap is ceil(log2(nchoosek(O1*O2,4)))+8*N1*N2 ==> Clarify size. Present different bitmap sizes by CHOICE?
            codebookSubsetRestrictionType2          BIT STRING (SIZE (FFS)),
            ri-Restriction                          CHOICE {
                -- Restriction for RI for TypeII-RI-Restriction
                -- Corresponds to L1 parameter 'TypeII-RI-Restriction' (see 38.214, section FFS_Section)
                typeII-RI-Restriction                   BIT STRING (SIZE (2)),
                -- Restriction for RI for TypeII-PortSelection-RI-Restriction
                -- Corresponds to L1 parameter 'TypeII-PortSelection-RI-Restriction' (see 38.214, section FFS_Section)
                typeII-PortSelectionRI-Restriction      BIT STRING (SIZE (2))
            }
        }
    }
}


-- Linking a CSI-RS-ResourceConfig with a CSI-ReportConfig (see 38.214, section 5.2)
CSI-MeasIdToAddMod ::=                  SEQUENCE {
    csi-measId                              CSI-MeasId,
    csi-RS-resourceConfigId                 CSI-RS-ConfigurationId,
    csi-reportConfigId                      CSI-ReportConfigId,

    -- For CQI-Emulation, i.e., how to measure and compute the CQI.
    -- CHECK: Clarify further what the values mean.
    -- CHECK: Is there a need to inform the UE which resource to use for which measurement (signal, interference, ...)?
    measQuantity                            ENUMERATED {channel, interference}
}

CSI-MeasId ::=                          INTEGER (0..maxNrofCSI-MeasId-1)

-- CHECK: Do the BeamManagement parameters really belong into the CSI context? Or rather to RLF/RLM?
-- FFS_FIXME: BeamManagement IE is not used anywhere.
BeamManagement ::=                      SEQUENCE {
```


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```
    -- Use of PRACH or/and PUSCH for beam in some combination, details FFS
    linkReconfigurationRequest              FFS_Value                                           OPTIONAL,
    -- List of CSI-RS resouces used for beam failure detection
    -- Corresponds to L1 parameter 'Beam-Failure-Detection-RS-ResourceConfig' (see 38.213, section 6)
    failureDetectionResources               FFS_Value                                           OPTIONAL,

    -- Number of beam failure instances before the UE declares beam failure
    -- Corresponds to L1 parameter 'Beam-Failure-Instance-MaxCount' (see 38.321, section FFS_Section)
    beamFailureInstanceMaxCount             FFS_Value                                           OPTIONAL,

    -- Reference signal used to identify candidate beam
    -- Corresponds to L1 parameter 'Candidate-Beam-RS-Identification-Resource' (see 38.213, section 6)
    beamFailureCandidateBeamResource        FFS_Value                                           OPTIONAL,

    -- The candidate beam can be considered identified when metric X (FFS) of candidate beam is higher than a threshold"
    -- Corresponds to L1 parameter 'Beam-failure-candidate-beam-threshold' (see 38.213, section 6)
    beamFailureCandidateBeamThreshold       FFS_Value                                           OPTIONAL,

    -- RACH resource to send the beam failure recovery request
    -- Corresponds to L1 parameter 'Beam-failure-recovery-request-RACH-Resource' (see 38.213, section 6)
    beamFailureRecoveryRACH-Resource        FFS_Value                                           OPTIONAL,

    -- Window for beamfailure recovery
    -- Corresponds to L1 parameter 'Beam-failure-recovery-request-window' (see 38.213, section 6)
    beamFailureRecoveryRequestWindow        FFS_Value                                           OPTIONAL,

    -- CORESET configured to receive the Beam Failure Recovery Response. FFS: parameter name to be updated
    -- Corresponds to L1 parameter 'Beam-Failure-Recovery-Response-CORESET' (see 38.213, section 6)
    -- When the field is absent the UE applies the value FFS_DefaultValue
    -- FFS_Value: Is this the ID of a CORESET defined elsewhere? Or is it really a ControlResourceSet IE?
    recoveryControlResourceSet              FFS_Value                                           OPTIONAL,

}

-- TAG-CSI-MEAS-CONFIG-STOP
-- ASN1STOP
```

– *FailureReportSCG-ToOtherRAT*

The IE *FailureReportSCG-ToOtherRAT* is used to provide information regarding failures detected by the UE in case of EN-DC.

FailureReportSCG-ToOtherRAT information element

```
-- ASN1START
-- TAG-FAILURE-REPORT-SCG-TO-OTHER-RAT-START
-- FFS if failureType is needed

FailureReportSCG-ToOtherRAT ::=             SEQUENCE {
```


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```
    failureType                             ENUMERATED { t313-Expiry, randomAccessProblem,
                                                         rlc-MaxNumRetx, maxUL-TimingDiff,
                                                         scg-ChangeFailure, scg-reconfigFailure,
                                                         srb3-IntegrityFailure},
    measResultServingFreqList                   MeasResultServFreqList2NR,
    measResultNeighCells                        MeasResultList2NR,
    ...,
}

MeasResultServFreqList2NR ::=               SEQUENCE (SIZE (1..maxServCell)) OF MeasResultServFreq2NR

MeasResultServFreq2NR ::=               SEQUENCE {
    carrierFreq                             ARFCN-ValueNR,
    measResultServingCell                       MeasResultNR,
    measResultBestNeighServingCell              MeasResultNR        OPTIONAL
}

MeasResultList2NR ::=                   SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

MeasResult2NR ::=                       SEQUENCE {
    carrierFreq                             ARFCN-ValueNR,
    measResult                              MeasResultListNR
}

-- TAG-FAILURE-REPORT-SCG-TO-OTHER-RAT-STOP
-- ASN1STOP
```

– *FrequencyInfoUL*

The IE *FrequencyInfoUL* provides basic parameters of an uplink carrier and transmission thereon.

FrequencyInfoUL information element

```
-- ASN1START
-- TAG-FREQUENCY-INFO-UL-START

FrequencyInfoUL ::=                 SEQUENCE {
    -- FFS_FIXME: Frequency Information parameters need corrections (currently just inherited from LTE).
    carrierFreqUL                       ARFCN-ValueNR                                       OPTIONAL,   -- Need OP
    carrierBandwidthUL                  CarrierBandwidthNR                                  OPTIONAL,   -- Need OP
    additionalSpectrumEmission          AdditionalSpectrumEmission                          OPTIONAL,   -- Need OP
    p-Max                               P-Max                                               OPTIONAL,   -- Need OP
    -- Enable or disable the NR UL transmission with a 7.5KHz shift to the LTE raster
    frequencyShift7p5khz                ENUMERATED {true}                                   OPTIONAL,   -- Cond FDD

    -- The initial uplink BWP configuration for a SpCell. Corresponds to L1 parameter 'initial-UL-BWP'.
    -- (see 38.331, section FFS_Section).
    initialUplinkBandwidthPart          BandwidthPart                                       OPTIONAL,   -- Cond FDD-PCell
```


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```
}

-- TAG-FREQUENCY-INFO-UL-STOP
-- ASN1STOP
```

– *LogicalChannelConfig*

The IE *LogicalChannelConfig* is used to configure the logical channel parameters.

LogicalChannelConfig **information element**

```
-- ASN1START
-- TAG-LOGICAL-CHANNEL-CONFIG-START

LogicalChannelConfig ::=        SEQUENCE {
    ul-SpecificParameters           SEQUENCE {
        priority                        INTEGER (1..16),
        prioritisedBitRate              ENUMERATED {kBps0, kBps8, kBps16, kBps32, kBps64, kBps128, kBps256, kBps512,
                                            kBps1024, kBps2048, kBps4096, kBps8192, kBps16384, kBps32768, kBps65536, infinity},
        bucketSizeDuration              ENUMERATED {ms50, ms100, ms150, ms300, ms500, ms1000, spare2, spare1},

        -- FFS: Detailed handling of restrictions (UP email discussion)
        -- Defined in L1 parameters but the value range must be checked.
        allowedSubCarrierSpacing        SubcarrierSpacing                                               OPTIONAL,

        allowedTiming                   TYPE_FFS                                                        OPTIONAL,
        logicalChannelGroup             INTEGER (0..maxLCid)                                            OPTIONAL,

        logicalChannelSR-Mask           BOOLEAN,

        logicalChannelSR-DelayTimerApplied  BOOLEAN
    }                                                                                                   OPTIONAL,   -- Cond UL

    -- other parameters
}

-- TAG-LOGICAL-CHANNEL-CONFIG-STOP
-- ASN1STOP
```


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LogicalChannelConfig field descriptions
allowedTiming If present, UL MAC PDUs from this logical channel can only be transmittedin the indicated timing as specified in TS 38.321 [3].
allowedSubCarrierSpacing If present, UL MAC PDUs from this logical channel can only be mapped to the indicated numerology as specified in TS 38.321 [3].
bucketSizeDuration Value in ms. ms50 corresponds to 50ms, ms100 corresponds to 100ms, and so on.
logicalChannelGroup ID of the logical channel group, as specified in TS 38.321 [3], which the logical channel belongs to.
logicalChannelSR-Mask Indicates whether SR masking is configured for this logical channel.
logicalChannelSR-DelayTimerApplied Indicates whether to apply the delay timer for SR transmission for this logical channel. Set to FALSE if *logicalChannelSR-DelayTimer* is not included in *BSR-Config*.
priority Logical channel priority, as specified in TS 38.321 [3].
prioritisedBitRate Value in kiloBytes/s. 0kBps corresponds to 0, 8kBps corresponds to 8 kiloBytes/s,16 kBps corresponds to 16 kiloBytes/s, and so on.
schedulingRequestId *schedulingRequestId of the associated scheduling request configuration.*

Conditional Presence	Explanation
UL	The field is mandatory present for a logical channel with uplink, otherwise it is not present.

– *MAC-CellGroupConfig*

The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX.

MAC-CellGroupConfig information element

```
-- ASN1START
-- TAG-MAC-CELL-GROUP-CONFIG-START

MAC-CellGroupConfig ::=             SEQUENCE {
    drx-Config                          DRX-Config                                                          OPTIONAL, -- Need R

    schedulingRequestConfig             SchedulingRequestConfig                                             OPTIONAL,
    bsr-Config                          BSR-Configuration                                                   OPTIONAL,   -- Need N
    tag-Config                          TAG-Configuration                                                   OPTIONAL,   -- Need N
    phr-Config                          PHR-Config                                                          OPTIONAL,   -- Need N
    sCellDeactivationTimer              ENUMERATED {
                                            ms20, ms40, ms80, ms160, ms200, ms240, ms320, ms400, ms480, ms520, ms640, ms720, ms840, ms1280, spare2,
                                            spare1}                 OPTIONAL,   -- Cond ServingCellWithoutPUCCH
    -- FFS : configurable per SCell?
```


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```
    skipUplinkTxDynamic                 BOOLEAN
}

DRX-Config ::=                      CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        drx-onDurationTimer                 ENUMERATED {
                                                ms1-32, ms2-32, ms3-32, ms4-32, ms5-32, ms6-32, ms7-32, ms8-32, ms9-32, ms10-32, ms11-32,
                                                ms12-32, ms13-32, ms14-32, ms15-32, ms16-32, ms17-32, ms18-32, ms19-32, ms-20-32, ms21-32,
                                                ms22-32, ms23-32, ms24-32, ms25-32, ms26-32, ms27-32, ms28-32, ms29-32, ms30-32, ms31-32,
                                                ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60,
                                                ms80, ms100, ms200, ms300, ms400, ms500, ms600, ms800, ms1000, ms1200,
                                                ms1600, spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
        drx-InactivityTimer                 ENUMERATED {
                                                ms0, ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40,ms50, ms60, ms80,
                                                ms100, ms200, ms300, ms500, ms750, ms1280, ms1920, ms2560, spare9, spare8,
                                                spare7, spare6, spare5, spare4, spare3, spare2, spare1},
        drx-HARQ-RTT-TimerDL                INTEGER (0..56),
        drx-HARQ-RTT-TimerUL                INTEGER (0..56),
        drx-RetransmissionTimerDL           ENUMERATED {
                                                sl0, sl1, sl2, sl4, sl6, sl8, sl16, sl24, sl33, sl40, sl64, sl80, sl96, sl112, sl128,
                                                , , spare15, spare14, spare13, spare12, spare11, spare10, spare9,
                                                spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},
        drx-RetransmissionTimerUL           ENUMERATED {
                                                sl0, sl1, sl2, sl4, sl6, sl8, sl16, sl24, sl33, sl40, sl64, sl80, sl96, sl112, sl1128,
                                                u160sl160, u320sl320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,
                                                spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
        -- FFS units and dependency on numerology for DL and UL retransmission timers
        drx-LongCycleStartOffset        CHOICE {
            ms10                            INTEGER(0..9),
            ms20                            INTEGER(0..19),
            ms32                            INTEGER(0..31),
            ms40                            INTEGER(0..39),
            ms60                            INTEGER(0..59),
            ms64                            INTEGER(0..63),
            ms70                            INTEGER(0..69),
            ms80                            INTEGER(0..79),
            ms128                           INTEGER(0..127),
            ms160                           INTEGER(0..159),
            ms256                           INTEGER(0..255),
            ms320                           INTEGER(0..319),
            ms512                           INTEGER(0..511),
            ms640                           INTEGER(0..639),
            ms1024                          INTEGER(0..1023),
            ms1280                          INTEGER(0..1279),
            ms2048                          INTEGER(0..2047),
            ms2560                          INTEGER(0..2559),
            ms5120                          INTEGER(0..5119),
            ms10240                         INTEGER(0..10239)
        },
        -- FFS need for finer offset granulary
```


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```
        -- FFS need for shorter values for long and short cycles
        shortDRX                            SEQUENCE {
            drx-ShortCycle                      ENUMERATED  {
                                                    ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,
                                                    ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,
                                                    spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
            drx-ShortCycleTimer                 INTEGER (1..16)
        }       OPTIONAL,                                           -- Need R
        drx-SlotOffset                      ENUMERATED  {
                                                ms0, ms1-32,ms2-32, ms3-32, ms4-32, ms5-32, ms6-32, ms7-32, ms8-32, ms9-32, ms10-32, ms11-32,
                                                ms12-32, ms13-32, ms14-32, ms15-32, ms16-32, ms17-32, ms18-32, ms19-32, ms-20-32, ms21-32,
                                                ms22-32, ms23-32, ms24-32, ms25-32, ms26-32, ms27-32, ms28-32, ms29-32, ms30-32, ms31-32 }    }
}

PHR-Config ::=                      CHOICE {
    release                             NULL,
    setup                               SEQUENCE {
        phr-PeriodicTimer                   ENUMERATED {sf10, sf20, sf50, sf100, sf200,sf500, sf1000, infinity},
        phr-ProhibitTimer                   ENUMERATED {sf0, sf10, sf20, sf50, sf100,sf200, sf500, sf1000},
        phr-Tx-PowerFactorChange            ENUMERATED {dB1, dB3, dB6, infinity},
        multiplePHR                         BOOLEAN,
        phr-Type2PCell                      BOOLEAN,
        phr-Type2OtherCell                  BOOLEAN,
        phr-ModeOtherCG                     ENUMERATED {real, virtual}
    }
}


TAG-Config ::=              SEQUENCE {
    tag-ToReleaseList           TAG-ToReleaseList                                   OPTIONAL,   -- Need N
    tag-ToAddModList            TAG-ToAddModList                                    OPTIONAL    -- Need N
}

TAG-ToReleaseList ::=       SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-Id
TAG-ToAddModList ::=        SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-ToAddMod
TAG-ToAddMod ::=            SEQUENCE {
    tag-Id                      TAG-Id,
    timeAlignmentTimer          TimeAlignmentTimer,
    ...
}

TAG-Id ::=                  INTEGER (0.. maxNrofTAGs-1)

TimeAlignmentTimer ::=      ENUMERATED {ms500, ms750, ms1280, ms1920, ms2560, ms5120,ms10240, infinity}

BSR-Config ::=              SEQUENCE {
    -- FFS: other values for periodicBSR-Timer, "every PDU" value
    periodicBSR-Timer           ENUMERATED {
                                    sf1, sf5, sf10, sf16, sf20, sf32, sf40, sf64, sf80, sf128, sf160, sf320, sf640, sf1280, sf2560, infinity},
    retxBSR-Timer               ENUMERATED { sf10, sf20, sf40, sf80, sf160, sf320, sf640, sf1280, sf2560, sf5120, sf10240},
    logicaChannelSR-DelayTimer      ENUMERATED { sf20, sf40, sf64, sf128, sf512, sf1024, sf2560, spare1}   OPTIONAL
```


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```
}


-- TAG-MAC-CELL-GROUP-CONFIG-STOP
-- ASN1STOP
```


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MAC-CellGroupConfig field descriptions
drx-Config Used to configure DRX as specified in TS 38.321 [3].
drx-HARQ-RTT-TimerDL Value in multiple integers of 1ms. ms0 corresponds to 0, ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on.
drx-HARQ-RTT-TimerUL Value in number of symbols.
drx-InactivityTimer Value in number of symbols.
drx-onDurationTimer Value in ms. ms1-32 corresponds to 1/32ms, ms2-32 corresponds to 2/32ms, and so on. ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on.
drx-LongCycleStartOffset *drx-LongCycle* in ms and *drx-StartOffset* in multiples of 1ms.
drx-RetransmissionTimerDL Value in number of slots. sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on.
drx-RetransmissionTimerUL Value in number of slots. sl1 corresponds to 1 slot, sl2 corresponds to 2 slots, and so on.
drx-ShortCycle Value in ms. ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on.
drx-ShortCycleTimer Value in multiples of *drx-ShortCycle*. A value of 1 corresponds to *drx-ShortCycle*, a value of 2 corresponds to 2 * *drx-ShortCycle* and so on.
drx-SlotOffset Value in ms. ms0 corresponds to 0ms, ms1-32 corresponds to 1/32ms, ms2-32 corresponds to 2/32ms, and so on.
logicaChannelSR-DelayTimer Value in number of subframes. sf1 corresponds to one subframe, sf2 corresponds to 2 subframes, and so on.
multiplePHR Indicates if power headroom shall be reported using the Single PHR MAC control element or Multiple PHR MAC control element defined in TS 38.321 [3]. True means to use Multiple PHR MAC control element and False means to use the Single PHR MAC control element defined in TS 38.321 [3].
phr-Tx-PowerFactorChange Value in dBf or PHR reporting as specified in TS 38.321 [3]. 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).
phr-ModeOtherCG FFS
phr-PeriodicTimer Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. sf10 corresponds to 10 subframes, sf20 corresonds to 20 subframes, and so on.
phr-ProhibitTimer Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. sf0 corresponds to 0 subframe, sf10 corresponds to 10 subframes, sf20 corresponds to 20 subframes, and so on.
phr-Type2PCell Indicates whether or not PHR type 2 is reported for the PCell.ms500 corresponds to 500ms, ms750 corresponds to 750ms, and so on.
phr-Type2OtherCell Indicates whether or not PHR type 2 is reported for the PSCell and PUCCH SCells.

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***MAC-CellGroupConfig* field descriptions**
skipUplinkTxDynmaic Indicates whether If configured, the UE skips UL transmissions for an uplink grant other than a configured uplink grant if no data is available for transmission in the UE buffer as described in TS 38.321 [3].
timeAlignmentTimer Value in ms of the *timeAlignmentTimer*for TAG with ID 0 (SpCell) or with ID *tag-Id*, as specified in TS 38.321 [3].

– *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
-- TAG-MEAS-CONFIG-START

MeasConfig ::=                          SEQUENCE {
    -- Measurement objects
    measObjectToRemoveList                  MeasObjectToRemoveList                                  OPTIONAL,
    measObjectToAddModList                  MeasObjectToAddModList                                  OPTIONAL,

    -- Reporting configurations
    reportConfigToRemoveList                ReportConfigToRemoveList                                OPTIONAL,
    reportConfigToAddModList                ReportConfigToAddModList                                OPTIONAL,

    -- Measurement identities
    measIdToRemoveList                      MeasIdToRemoveList                                      OPTIONAL,
    measIdToAddModList                      MeasIdToAddModList                                      OPTIONAL,

    -- Other parameters
    -- s-Measure config
    s-MeasureConfig                         CHOICE {
        ssb-rsrp                                RSRP-Range,
        csi-rsrp                                RSRP-Range
    }                                                                                               OPTIONAL,

    quantityConfig                      QuantityConfig                                              OPTIONAL,

    -- Placehold for measGapConfig
    measGapConfig                           MeasGapConfig                                           OPTIONAL
}

MeasObjectToRemoveList ::=              SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectId

MeasIdToRemoveList ::=                  SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasId
```


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```
ReportConfigToRemoveList ::=            SEQUENCE (SIZE (1..maxNrofReportConfigId)) OF ReportConfigId

-- TAG-MEAS-CONFIG-STOP
-- ASN1STOP
```

Editor's Note: FFS Whether UE speed based TTT scaling (e.g. speedStatePars) is supported in Rel-15.

Editor's Note: FFS Whether measScaleFactor (or equivalent) is supported in Rel-15.

Editor's Note: FFS How to support allowInterruptions in NR (RAN4 input needed) in Rel-15.

Editor's Note: FFS Whether quantityConfig is configured per MeasConfig or MeasObject.

Editor's Note: FFS where to add RLM related parameters: rlm-ResourceConfigCSI-RS, rlm-ResourceConfigSS

***MeasConfig* field descriptions**
measGapConfig FFS Definition of measurement gaps in NR.
measIdToAddModList List of measurement identities.
measIdToRemoveList List of measurement identities to remove.
measObjectToAddModList List of measurement objects to add and/or modify.
measObjectToRemoveList List of measurement objects to remove.
reportConfigToRemoveList List of measurement reporting configurations to remove.
s-MeasureConfig Threshold for PCell or PSCell (when UE is in EN-DC) RSRP measurement controlling when the UE is required to perform measurements associated to neighbouring cells. Choice of *ssb-rsrp* corresponds to cell RSRP based on SS/PBCH block and choice of *csi-rsrp* corresponds to cell RSRP of CSI-RS.

– *MeasId*

The IE *MeasId* is used to identify a measurement configuration, i.e., linking of a measurement object and a reporting configuration.

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MeasId information element

```
-- ASN1START
-- TAG-MEAS-ID-START

MeasId ::=                          INTEGER (1..maxNrofMeasId)

-- TAG-MEAS-ID-STOP
-- 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*.

MeasIdToAddModList information element

```
-- ASN1START
-- TAG-MEAS-ID-TO-ADD-MOD-LIST-START

MeasIdToAddModList ::=              SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasIdToAddMod

MeasIdToAddMod ::=                  SEQUENCE {
    measId                              MeasId,
    measObjectId                        MeasObjectId                                    OPTIONAL,
    reportConfigId                      ReportConfigId
}

-- TAG-MEAS-ID-TO-ADD-MOD-LIST-STOP
-- ASN1STOP
```

Editor's Note: FFS Whether measObjectId is an OPTIONAL field or mandatory as in LTE (discuss the implication in procedural text).

– *MeasObjectEUTRA*

The IE *MeasObjectEUTRA* specifies information applicable for intra-frequency or inter-frequency E-UTRA cells.

Editor's Note: FFS Details of *measObjectEUTRA* that can be configured via NR.

– *MeasObjectId*

The IE *MeasObjectId* used to identify a measurement object configuration.

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MeasObjectId information element

```
-- ASN1START
-- TAG-MEAS-OBJECT-ID-START

MeasObjectId ::=                            INTEGER (1..maxNrofObjectId)

-- TAG-MEAS-OBJECT-ID-STOP
-- ASN1STOP
```

– *MeasObjectNR*

The IE *MeasObjectNR* specifies information applicable for SS/PBCH block(s) intra/inter-frequency measurements or CSI-RS intra/inter-frequency measurements.

MeasObjectNR information element

```
-- ASN1START
-- TAG-MEAS-OBJECT-NR-START

MeasObjectNR ::=                            SEQUENCE {
    carrierFreq                                 ARFCN-ValueNR,

    --RS configuration (e.g. SMTC window, CSI-RS resource, etc.)
    referenceSignalConfig                       ReferenceSignalConfig                                   OPTIONAL,

    --Consolidation of L1 measurements per RS index
        absThreshSS-BlocksConsolidation         ThresholdNR                                             OPTIONAL,
        absThreshCSI-RS-Consolidation           ThresholdNR                                             OPTIONAL,

    --Config for cell measurement derivation
        nroSS-BlocksToAverage                   INTEGER (2..maxNroSS-BlocksToAverage)                   OPTIONAL,
        nroCSI-RS-ResourcesToAverage            INTEGER (2..maxNroCSI-RS-ResourcesToAverage)            OPTIONAL,

    -- Filter coefficients applicable to this measurement object
    quantityConfigIndex                         INTEGER (1..maxQuantityConfigId),

    --Frequency-specific offsets (only for events A3, A6)
    offsetFreq                                  Q-OffsetRangeList,

    -- Cell list
    cellsToRemoveList                           CellIndexList                                           OPTIONAL,
    cellsToAddModList                           CellsToAddModList                                       OPTIONAL,

    -- Black list
    blackCellsToRemoveList                      CellIndexList                                           OPTIONAL,
    blackCellsToAddModList                      BlackCellsToAddModList                                  OPTIONAL,
```


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```
    -- White list
    whiteCellsToRemoveList                  CellIndexList                                           OPTIONAL,
    whiteCellsToAddModList                  WhiteCellsToAddModList                                  OPTIONAL
}

-- FFS / TODO: To be updated based on email discussion[99#31][NR] Additional information for SSB and CSI-RS config (Ericsson)
ReferenceSignalConfig::=                SEQUENCE {

    ssb-MeasurementTimingConfiguration      SSB-MeasurementTimingConfiguration                          OPTIONAL,

    ssbPresence                             CHOICE {
        present                                 SEQUENCE {
            frequencyOffset                         TYPE_FFS!
            subcarrierSpacing                       SubcarrierSpacing,
        },
        notPresent                              SEQUENCE {
            -- FFS: How to inform the UE where else to find the SSB. FFS whether to indicate here a carrier or a cell ID or multiple cell IDs
        },
    }

    -- CSI-RS resources to be used for for CSI-RS based RRM measurements
    csi-rs-ResourceConfig-Mobility          CSI-RS-ResourceConfig-Mobility  OPTIONAL -- Need N

    -- Indicates whether the UE can utilize serving cell timing to derive the index of SS block transmitted by neighbour cell:
    useServingCellTimingForSync             BOOLEAN
}

-- A measurement timing configuration
SSB-MeasurementTimingConfiguration ::=  SEQUENCE {
    -- Primary measurement timing configuration. Applicable for intra- and inter-frequency measurements.
    smtc1                                   SEQUENCE {
        -- Periodicity and offset of the measurement window in which to receive SS/PBCH blocks.
        -- Periodicity and offset are given in number of subframes.
        -- FFS_FIXME: This does not match the L1 parameter table!
        -- (see 38.213, section REF):
        periodicityAndOffset                    CHOICE {
            sf5                                     INTEGER (0..4),
            sf10                                    INTEGER (0..9),
            sf20                                    INTEGER (0..19),
            sf40                                    INTEGER (0..39),
            sf80                                    INTEGER (0..79),
            sf160                                   INTEGER (0..159)
        },
        -- Duration of the measurement window in which to receive SS/PBCH blocks. It is given in number of subframes
        -- (see 38.213, section 4.1)
        -- FFS: RAN1 discusses additional allowed durations:
        duration                                ENUMERATED { sf1, sf5 },

        -- The set of SS blocks to be measured within the SMTC measurement duration.
        -- Corresponds to L1 parameter 'SSB-measured' (see FFS_Spec, section FFS_Section)
        -- When the field is absent the UE measures on all SS-blocks
```


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```
        -- FFS_CHECK: Is this IE placed correctly.
        ssb-ToMeasure                           SetupRelease {
            CHOICE {
                -- bitmap for sub 3 GHz
                shortBitmap                         BIT STRING (SIZE (4)),
                -- bitmap for 3-6 GHz
                mediumBitmap                        BIT STRING (SIZE (8)),
                -- bitmap for above 6 GHz
                longBitmap                          BIT STRING (SIZE (64))
            }
        }                                                                                   OPTIONAL,   -- Need M
    },

    -- Secondary measurement timing confguration for explicitly signalled PCIs. It uses the offset and duration from smtc1.
    -- It is supported only for intra-frequency measurements in RRC CONNECTED.
    smtc2                                   SEQUENCE {
        -- PCIs that are known to follow this SMTC.
        pci-List                            SEQUENCE (SIZE (1..maxNrofPCIsPerSMTC)) OF PhysicalCellId    OPTIONAL
        -- Periodicity for the given PCIs. Timing offset and Duration as provided in smtc1.
        periodicty                          TYPE_FFS!
    }                                                                                       OPTIONAL -- Cond IntraFreqConnected
}

CSI-RS-ResourceConfig-Mobility ::=      SEQUENCE {
    -- MO specific values
csi-rs-MeasurementBW                    SEQUENCE {
        csi-rs-measurementBW-size           ENUMERATED { size24, size48, size96, size192, size268},
        csi-rs-measurement-BW-start         ENUMERATED {ffsTypeAndValue},
        associated-SSB                      ENUMERATED {ffsTypeAndValue},
        qcled-SSB                           BOOLEAN,
        isServingCellMO                     BOOLEAN
}
    -- subcarrier spacing of CSI-RS. It can take the same values available also for the data channels and for SSB
    subcarrierSpacing                       SubcarrierSpacing,

    -- List of resources
    csi-rs-ResourceList-Mobility    SEQUENCE (SIZE (1..maxNrofCSI-RS-ResourcesRRM)) OF CSI-RS-Resource-Mobility
}

CSI-RS-Resource-Mobility                    SEQUENCE {
    csi-rs-ResourceId-RRM                   CSI-RS-ResourceId-RRM,
    cellId                                  PhysicalCellId,
}
    -- Contains periodicity and slot offset for periodic/semi-persistent CSI-RS (see 38.211, section x.x.x.x)FFS_Ref
    -- FFS: Whether ms80 and ms160 are supported
    slotConfig                              CHOICE {
        ms5                                     INTEGER (0..4),
        ms10                                    INTEGER (0..9),
        ms20                                    INTEGER (0..19),
        ms40                                    INTEGER (0..39),
        ms80                                    INTEGER (0..79),
```


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```
        ms160                                   INTEGER (0..159)
    },
    -- Resource Element mapping pattern for CSI-RS (see 38.211, section x.x.x.x) FFS_Ref
    resourceElementMappingPattern           TYPE_FFS!,
    -- FFS / TODO: ADD DESCRIPTION (see 38.211, section x.x.x.x) FFS_Ref
    sequenceGenerationConfig                TYPE_FFS!
}

CSI-RS-ResourceId-RRM ::=               INTEGER (0..maxNrofCSI-RS-ResourcesRRM-1)

Q-OffsetRangeList ::=                   SEQUENCE {
    rsrpOffsetSSB                           Q-OffsetRange               DEFAULT dB0,
    rsrqOffsetSSB                           Q-OffsetRange               DEFAULT dB0,
    sinrOffsetSSB                           Q-OffsetRange               DEFAULT dB0,
    rsrpOffsetCSI-RS                        Q-OffsetRange               DEFAULT dB0,
    rsrqOffsetCSI-RS                        Q-OffsetRange               DEFAULT dB0,
    sinrOffsetCSI-RS                        Q-OffsetRange               DEFAULT dB0
}

ThresholdNR ::=                         SEQUENCE{
    threshold-RSRP                          RSRP-Range                  OPTIONAL,
    threshold-RSRQ                          RSRQ-Range                  OPTIONAL,
    threshold-SINR                          SINR-Range                  OPTIONAL
}

CellsToAddModList ::=                   SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CellsToAddMod

CellsToAddMod ::=                       SEQUENCE {
    cellIndex                               INTEGER (1..maxNrofCellMeas),
    physCellId                              PhysCellId,
    cellIndividualOffset                    Q-OffsetRangeList
}

BlackCellsToAddModList ::=              SEQUENCE (SIZE (1..maxNrofCellMeas)) OF BlackCellsToAddMod

BlackCellsToAddMod ::=                  SEQUENCE {
    cellIndex                               INTEGER (1..maxNrofCellMeas),
    physCellIdRange                         PhysCellIdRange
}


WhiteCellsToAddModList ::=              SEQUENCE (SIZE (1..maxNrofCellMeas)) OF WhiteCellsToAddMod

WhiteCellsToAddMod ::=                  SEQUENCE {
    cellIndex                               INTEGER (1..maxNrofCellMeas),
    physCellIdRange                         PhysCellIdRange
}

-- TAG-MEAS-OBJECT-NR-STOP
-- ASN1STOP
```


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Editor's Note: FFS How to support CGI reporting and whether changes are required in MeasObjectNR (e.g. introduction of cellForWhichToReportCGI)

Editor's Note: FFS Whether alternative TTT is supported in Rel-15.

Editor's Note: FFS measCycleSCell.

Editor's Note: FFS reducedMeasPerformance.

Editor's Note: FFS Whether *offsetFreq* within *measObject* can be set differently for CSI-RS and SS/PBCH block.

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MeasObjectNR field descriptions
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 NR carrier frequency for which this configuration is valid.
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 offsets applicable to a specific cell.
cellsToAddModList List of cells to add/ modify in the cell list.
cellsToRemoveList List of cells to remove from the cell list.
nroCSI-RS-ResourcesToAverage Indicates the maximum number of measurement results per beam based on CSI-RS resources to be averaged. The same value applies for each detected cell in that carrierFreq.
nroSS-BlocksToAverage Indicates the maximum number of measurement results per beam based on SS/PBCH blocks to be averaged. The same value applies for each detected cell in that carrierFreq.
offsetFreq Offset values applicable to the carrier frequency.
physCellId Physical cell identity of a cell in the cell list.
physCellIdRange Physical cell identity or a range of physical cell identities.
absThreshCSI-RS-Consolidation Absolute threshold for the consolidation of measurement results per CSI-RS resource(s) from L1 filter(s). The values above the threshold are used as input to the derivation of cell measurement resuls as described in 5.3.x and the L3 filter(s) per CSI-RS resource as described in 5.5.3.2.
absThreshSS-BlocksConsolidation Absolute threshold for the consolidation of measurement results per SS/PBCH block(s) from L1 filter(s). The values above the threshold are used as input to the derivation of cell measurement resuls as described in 5.3.x and the L3 filter(s) per SS/PBCH block index as described in 5.5.3.2.
whiteCellsToAddModList List of cells to add/modify in the white list of cells.
whiteCellsToRemoveList List of cells to remove from the white list of cells.

– *MeasObjectToAddModList*

The IE *MeasObjectToAddModList* concerns a list of measurement objects to add or modify.

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***MeasObjectToAddModList* information element**

```
-- ASN1START
-- TAG-MEAS-OBJECT-TO-ADD-MOD-LIST-START

MeasObjectToAddModList ::=                SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectToAddMod

MeasObjectToAddMod ::=                    SEQUENCE {
    measObjectId                              MeasObjectId,
    measObject                                CHOICE {
        measObjectNR                              MeasObjectNR
        measObjectEUTRA                           MeasObjectEUTRA
    }
}

-- TAG-MEAS-OBJECT-TO-ADD-MOD-LIST-STOP
-- ASN1STOP
```

– *MeasResults*

The IE *MeasResults* covers measured results for intra-frequency, inter-frequency and inter- RAT mobility.

***MeasResults* information element**

```
-- ASN1START
-- TAG-MEAS-RESULTS-START

MeasResults ::=                           SEQUENCE {
    measId                                    MeasId,
    measResultServingFreqList                 MeasResultServFreqList,
    measResultNeighCells                      CHOICE {
        measResultListNR                          MeasResultListNR,
        measResultListEUTRA                       MeasResultListEUTRA,
        ...
    }                                                                                 OPTIONAL
}

MeasResultServFreqList ::=                SEQUENCE (SIZE (1..maxServCell)) OF MeasResultServFreq

MeasResultServFreq ::=                    SEQUENCE {
    servFreqId                                ServCellIndex                           OPTIONAL,
    measResultServingCell                     MeasResultNR,
    measResultBestNeighCell                   MeasResultNR                          }

MeasResultListNR ::=                      SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultNR

MeasResultNR ::=                          SEQUENCE {
```


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```
    physCellId                              PhysCellId                                                  OPTIONAL,
    --FFS: Details of cgi info
    cgi-Info                                TYPE_FFS!
    measResult                              SEQUENCE {
        cellResults                             SEQUENCE{
            resultsSSBCell                          ResultsSSBCell                                      OPTIONAL,
            resultsCSI-RSCell                       ResultsCSI-RSCell                                   OPTIONAL
        }
        rsIndexResults                          SEQUENCE{
            resultsSSBIndexes                       ResultsPerSSBIndexList                              OPTIONAL,
            resultsCSI-RSIndexes                    ResultsPerCSI-RSIndexList                           OPTIONAL
        }                                                                                               OPTIONAL
    }
}

ResultsSSBCell ::=                      SEQUENCE {
    ssb-Cellrsrp                            RSRP-Range                                                  OPTIONAL,
    ssb-Cellrsrq                            RSRQ-Range                                                  OPTIONAL,
    ssb-Cellsinr                            SINR-Range                                                  OPTIONAL
}

ResultsCSI-RSCell ::=                   SEQUENCE {
    csi-rs-Cellrsrp                         RSRP-Range                                                  OPTIONAL,
    csi-rs-Cellrsrq                         RSRQ-Range                                                  OPTIONAL,
    csi-rs-Cellsinr                         SINR-Range                                                  OPTIONAL
}

ResultsPerSSBIndexList ::=              SEQUENCE (SIZE (1..maxNroSSBs)) OF ResultsPerSSBIndex

ResultsPerSSBIndex ::=                  SEQUENCE {
    Ssb-Index                               SSB-Index,
    ss-rsrp                                 RSRP-Range                                                  OPTIONAL,
    ss-rsrq                                 RSRQ-Range                                                  OPTIONAL,
    ss-sinr                                 SINR-Range                                                  OPTIONAL
}

ResultsPerCSI-RSIndexList ::=           SEQUENCE (SIZE (1..maxNroCSI-RS)) OF ResultsPerCSI-RSIndex

ResultsPerCSI-RSIndex ::=               SEQUENCE {
    csi-rsIndex                             CSI-RSIndex,
    csi-rsrp                                RSRP-Range                                                  OPTIONAL,
    csi-rsrq                                RSRQ-Range                                                  OPTIONAL,
    csi-sinr                                SINR-Range                                                  OPTIONAL
}

-- TAG-MEAS-RESULTS-STOP
-- ASN1STOP
```

Editor's Note: FFS *locationInfo*.

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MeasResults field descriptions
csi-rs-CellRsrp Measured RSRP result per NR cell based on CSI-RSRP value(s) from the L1 filter(s).
csi-rs-CellRsrq Measured RSRQ result per NR cell based on CSI-RSRQ value(s) from the L1 filter(s).
csi-rs-CellSinr Measured SINR result per NR cell based on CSI-SINR value(s) from the L1 filter(s).
csi-rsIndex CSI-RS resource index associated to the measurement information to be reported.
csi-rsrp L3 filtered CSI-RSRP measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-RSRP is defined in TS 38.215 [9].
csi-rsrq L3 filtered CSI-RSRQ measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-RSRQ is defined in TS 38.215 [9].
csi-sinr L3 filtered CSI-SINR measurement per CSI-RS resource index, as defined in 5.5.4.x. CSI-SINR is defined in TS 38.215 [9].
measId Identifies the measurement identity for which the reporting is being performed.
measResult Measured results of an NR cell.
measResultListNR List of measured results for the maximum number of reported best cells for an NR measurement identity.
measResultServingFreqList Measured results of the serving frequencies including measurement results of PCell, configured SCell(s) and best neighbouring cell on each serving frequency.
resultsCSI-RSIndexes List of measurement information per CSI-RS resource index of an NR cell.
resultsSSBIndexes List of measurement information per SS/PBCH index of an NR cell.
resultsCSI-RSCell Cell level measurement results (e.g. RSRP, RSRQ, SINR) to be reported derived from CSI-RS measurements.
resultSSBCell Cell level measurement results (e.g. RSRP, RSRQ, SINR) to be reported derived on SS/PBCH block measurements.
ssb-CellRsrp Measured RSRP result per NR cell based on SS-RSRP value(s) from the L1 filter(s).
ssb-CellRsrq Measured RSRQ result of an NR Cell based on SS-RSRP value(s) from the L1 filter(s).
ssb-CellSinr Measured SS-SINR result of an NR Cell based on SS-SINR value(s) from the L1 filter(s)..
ssbIndex SS/PBCH block index associated to the measurement information to be reported.
ss-rsrp L3 filtered SS-RSRP measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-RSRP is defined in TS 38.215 [9].
ss-rsrq L3 filtered SS-RSRQ measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-RSRQ is defined in TS 38.215 [9].

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MeasResults field descriptions
ss-sinr L3 filtered SS-SINR measurement per SS/PBCH block index, as defined in 5.5.4.x. SS-SINR is defined in TS 38.215 [9].

– *PDCCH-Config*

The *PDCCH-Config* IE is used to configure UE specific PDCCH parameters such as control resource sets (CORESET), search spaces and additional parameters for acquiring the PDCCH.

PDCCH-Config information element

```
-- ASN1START
-- TAG-PDCCH-CONFIG-START

-- Downlink control channel related parameters
PDCCH-Config ::=                        SEQUENCE {
    -- List of Control Resource Sets (CORESETs) to be used by the UE
    controlResourceSetToAddModList          SEQUENCE(SIZE (1..maxNrofControlResourceSets)) OF ControlResourceSet      OPTIONAL,
    controlResourceSetToReleaseList         SEQUENCE(SIZE (1..maxNrofControlResourceSets)) OF ControlResourceId       OPTIONAL

    searchSpacesToAddModList                SEQUENCE(SIZE (1..maxNrofSearchSpaces) OF SearchSpace               OPTIONAL,
    searchSpacesToReleaseList               SEQUENCE(SIZE (1..maxNrofSearchSpaces) OF SearchSpaceId                OPTIONAL


    -- FFS: Is this timing information applicable to the entire PDCCH or could it be different per CORESET?
    -- FFS: Is there a default timing (to be used at least until first reconfiguration). Are the fields optionally present?
    timing                              SEQUENCE {
        dl-assignment-to-DL-data            TYPE_FFS!,
        ul-assignment-to-UL-data            TYPE_FFS!,
        dl-data-to-UL-ACK                   TYPE_FFS!
    }                                                                                                               OPTIONAL,

}

-- A time/frequency control resource set (CORESET) in which to search for downlink control information (see 38.213, section x.x.x.x)FFS_Ref
ControlResourceSet ::=                  SEQUENCE {
    controlResourceSetId                    ControlResourceSetId,

    -- Frequency domain resources for the CORESET. The network ensures that the CORESET is within the BWP configured for a UE. (see 38.213, REF)
    frequencyDomainResources                TYPE_FFS!,
    -- Starting OFDM symbol for the CORESET (see 38.213, REF)
    startSymbol                             INTEGER (0..maxCoReSetStartSymbol),
    -- Contiguouse time duration of the CORESET in number of symbols see 38.213, section x.x.x.x)FFS_Ref
    duration                                INTEGER (1..maxCoReSetDuration),
    -- Resource Element Groups (REGs) can be bundled to create REG bundles. This parameter defines the size of such bundles.
    -- (see 38.211, section 7.3.2.2)
    reg-BundleSize                          ENUMERATED {n2, n3, n6},
```


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```
    -- Mapping of Control Channel Elements (CCE) to Resource Element Groups (REG). (see 38.211, 38.213, FFS_REF)
    cce-reg-MappingType                 ENUMERATED { interleaved, nonInterleaved },
    -- Precoder granularity in frequency domain (see 38.213, section FFS_REF)
    precoderGranularity                 TYPE_FFS!,
    -- Corresponds to L1 parameter 'CORESET-interleaver-rows' (see 38.211, 38.213, section FFS_Section)
    interleaverRows                     ENUMERATED {n2, n3, n6}                                         OPTIONAL,

    -- Corresponds to L1 parameter 'CORESET-shift-index' (see 38.211, 38.213, section FFS_Section)
    shiftIndex                          FFS_Value                                                       OPTIONAL,

    -- Reference to a configured TCI State providing QCL configuration/indication for PDCCH.
    -- Corresponds to L1 parameter 'TCI-StateRefId' (see 38.211, 38.213, section FFS_Section)
    tci-StateRefId                      FFS_Value                                                       OPTIONAL,

    -- PDCCH DMRS scrambling initalization. Corresponds to L1 parameter 'PDCCH-DMRS-Scrambling-ID' (see 38.214, section 5.1)
    -- When the field is absent the UE applies the value TBD/FFS
    pdcch-DMRS-ScramblingID             FFS_Value                                                       OPTIONAL
}

-- ID of a Control Resource Set.
ControlResourceSetId ::=                INTEGER (0..maxNrofControlResourceSets-1)

-- A search space defines how/where to search for PDCCH candidates. A search space is associated with one Control Resource Set
SearchSpace ::=                         SEQUENCE {
    searchSpaceId                           SearchSpaceId,

    -- The CORESET applicable for this SearchSpace.
    -- FFS: Value 0 identifies the common CORESET configured in MIB?
    -- FFS: Values 1..maxNrofControlResourceSets-1 identify CORESETs configured by dedicated signalling?
    controlResourceSetId                ControlResourceSetId,

    -- Slots for PDCCH Monitoring configured as periodicity and offset. Corresponds to L1 parameters 'Montoring-periodicity-PDCCH-slot' and
    -- 'Montoring-offset-PDCCH-slot' (see 38.213, section 10)
    -- sl15, sl10, sl20 FFS
    monitoringSlotPeriodicityAndOffset      CHOICE {
        sl1                                     NULL,
        sl2                                     INTEGER (0..1),
        sl5                                     INTEGER (0..4),
        sl10                                    INTEGER (0..9),
        sl20                                    INTEGER (0..19)
    }                                                                                                   OPTIONAL,

    -- Symbols for PDCCH monitoring in the slots configured for PDCCH monitoring (see monitoringSlotPeriodicityAndOffset).
    -- The most significant (left) bit represents the first OFDM in a slot. The least significant (right) bit represents the last symbol.
    -- Corresponds to L1 parameter 'Montoring-symbols-PDCCH-within-slot' (see 38.213, section 10)
    monitoringSymbolsWithinSlot             BIT STRING (SIZE (14))                                      OPTIONAL,

    -- Number of candidates per aggregation level. Corresponds to L1 parameter 'Aggregation-level-1' to 'Aggregation-level-8'
    -- (see 38.213, section 10)
    nrofCandidates                      SEQUENCE {
        aggregationLevel1                   ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
```


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```
        aggregationLevel2                       ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        aggregationLevel4                       ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        aggregationLevel8                       ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8}
    }



    -- Indicates whether this is a common search space (present) or a UE specific search space.
    -- FFS: How many CSSs can the NW configure? And can a CSS only be in the common CORESET?
    searchSpaceType                         CHOICE {
        common                                  SEQUENCE {
            -- Monitoring of a group common PDCCH for at least SFI (Slot Format Indicator)
            -- FFS_CHECK: Is this really part of the common search space? Or entirely separate?
            sfi-PDCCH                               SFI-PDCCH,
            -- Turn on monitoring of DL preemption DCI
            -- FFS_CHECK: Is Preemp-DL needed at all? Can't this be derived from the presence of the following INT-RNTI field?
            preemp-DL                               BOOLEAN,
            -- RNTI used for indication pre-emption in DL. Also connected to monitoring of a Type2-PDCCH common search space.
            -- (see 38.213, section 10)
            -- FFS: What does the abbreviation stand for? Add a better description
            -- FFS: Verify that RNTI is still 16 bit.
            int-RNTI                                BIT STRING (SIZE (16)),
            -- Set selection for DL-preemption indication, the set indication two different manners the DL preemption DCI
            -- is interpreteded by the UE. Corresponds to L1 parameter 'int-TF-unit' (see 38.213, section 10.1)
            -- FFS: Clarify description.
            int-TF                                  ENUMERATED {set0, set1},
            -- Monitoring periodicity of DCI with INT-RNTI in number of slots.
            -- Corresponds to L1 parameter 'INT-monitoring-periodicity' (see 38.213, section 11.2)
            monitoringPeriodicity                   FFS_Value       OPTIONAL
        },
        ue-Specific                             SEQUENCE {
            -- FFS: Parameters that are applicable only for USS?
        }
    }                                                                                                   OPTIONAL, -- Need M
}

SearchSpaceId ::=                           INTEGER (1..maxNrofSearchSpaces)

-- Configuration of monitoring a Group-Common-PDCCH for Slot-Format-Indicators (SFI)
SFI-PDCCH ::=                               SEQUENCE {

    -- Monitoring periodicity of SFI PDCCH in slots. Should be 8 values in total. RAN1 will decided the remainnig values, i.e. X1, X2, X3
    -- Corresponds to L1 parameter 'SFI-monitoring-periodicity' (see 38.213, section FFS_Section)
    monitoringPeriodicity                   ENUMERATED {sl1, sl2, sl5, sl10, sl20, spare3, spare2, spare1}          OPTIONAL,

    -- Maps a specific cell to a given SFI value within the DCI message
    -- Corresponds to L1 parameter 'SFI-cell-to-SFI' (see 38.213, section FFS_Section)
    sfi-CellToSFI                           SEQUENCE (SIZE(1..maxNrofAggregatedCellsPerCellGroup)) OF CellToSFI      OPTIONAL,

    -- The number of PDCCH candidates for the configured aggregation level.
    -- Corresponds to L1 parameter 'SFI-Num-PDCCH-cand' (see 38.213, section FFS_Section)
```


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```
    nrofPDCCH-Candidates                        ENUMERATED {n1, n2},

    -- The aggregation level for the SFI-PDCCH. Corresponds to L1 parameter 'SFI-Aggregation-Level' (see 38.213, section FFS_Section)
    aggregationLevel                            ENUMERATED {n1, n2, n4, n8},

    -- RNTI used for SFI on the given cell
    -- Corresponds to L1 parameter 'SFI-RNTI' (see 38.213, section FFS_Section)
    sfi-RNTI                                    BIT STRING (SIZE (16))                                  OPTIONAL,

    -- Payload length of SFI DCI. Corresponds to L1 parameter 'SFI-DCI-payload-length' (see 38.213, section FFS_Section)
    dci-PayloadLength                           TYPE_FFS!                                               OPTIONAL,

    -- Defines whether a specific CORESET is used or the CSS. Corresponds to L1 parameter 'SFI-SS' (see 38.213, section FFS_Section)
    searchSpace                                 TYPE_FFS!                                               OPTIONAL,

    -- SFI value location within a DCI message, this fields gives the starting bit in the DCI message, assumption is that lenght is given RAN1 spec.
    -- Corresponds to L1 parameter 'SFI-values' (see 38.213, section FFS_Section)
    -- FFS_CHECK whether this field is placed correctly
    sfi-PositionInDCI                           INTEGER(1…MaxDCIpayload)                                OPTIONAL
}

-- Mapping for a given cell to SFI value within DCI message. Corresponds to L1 parameter 'cell-to-SFI' (see 38.213, section FFS_Section)
CellToSFI ::=                               SEQUENCE {
    FFS: Content and structure of this IE.

    -- A list with SlotFormatCombinations. Each SlotFormatCombination comprises of one or more SlotFormats (see 38.211, section 4.3.2)
    slotFormatCombinations                      SEQUENCE (SIZE (1..maxNrofSlotFormatCombinations) OF SlotFormatCombination  OPTIONAL
}

SlotFormatCombination ::=                   SEQUENCE {
    slotFormatCombinationId                     SlotFormatCombinationId,
    slotFormats                                 SEQUENCE (SIZE (1..maxNrofSlotFormatsPerCombination),
}

-- SFI index that is assoicated with a certian slot-format-combination
-- Corresponds to L1 parameter 'SFI-index' (see 38.213, section FFS_Section)
SlotFormatCombinationId ::=                 INTEGER (0..maxNrofSlotFormatCombinations-1)        OPTIONAL,


-- TAG-PDCCH-CONFIG-STOP
-- ASN1STOP
```

– *PDCP-Config*

The IE *PDCP-Config* is used to set the configurable PDCP parameters for signalling and data radio bearers.

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PDCP-Config information element

```
-- ASN1START
-- TAG-PDCP-CONFIG-START

PDCP-Config ::=         SEQUENCE {
    DRB                     SEQUENCE {
    discardTimer            ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200, ms250, ms300, ms500, ms750, ms1500, infinity}
                                                    OPTIONAL, -- Cond Setup
        pdcp-SN-Size-UL         ENUMERATED {len12bits, len18bits},
        pdcp-SN-Size-DL         ENUMERATED {len12bits, len18bits},
        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
                },
                uplinkOnlyROHC          SEQUENCE {
                    maxCID                  INTEGER (1..16383)              DEFAULT 15,
                    profiles                SEQUENCE {
                        profile0x0006           BOOLEAN
                    }
                },
            ...
            }
        },

        integrityProtection     BOOLEAN,

        statusReportRequired    BOOLEAN                                                 OPTIONAL -- Cond Rlc-AM
    }                                                                                           OPTIONAL,   -- Cond DRB
    -- FFS / TODO: Handle more than two secondary cell groups
    moreThanOneRLC          SEQUENCE {
        primaryPath             SEQUENCE {
            cellGroup               CellGroupId,
            logicalChannel          LogicalChannelIdentity
        },
        ul-DataSplitThreshold   CHOICE {
            release                 NULL,
            setup                   ENUMERATED {
                                        b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,
                                        b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,
```


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```
                                        b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}
        },
        ul-Duplication          BOOLEAN
    }                                                       OPTIONAL -- Cond MoreThanOneRLC

    t-Reordering                ENUMERATED {
                                    ms0, ms5, ms10, ms15, ms20, ms30, ms40, ms60, ms50, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,
                                    ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250, ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,
                                    ms3000}     OPTIONAL -- Need R

    -- FFS: whether ms0 is the same like outOfOrderDelivery
    -- FFS: new values for t-Reordering
    outOfOrderDelivery          BOOLEAN,
    ...
}

-- TAG-PDCP-CONFIG-STOP
-- ASN1STOP
```


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***PDCP-Config*field descriptions**
discardTimer Value in ms of *discardTimer* specified in TS 38.323 [5]. Value ms50 corresponds to 50 ms, ms100 corresponds to 100 ms and so on.
headerCompression If *rohc* is configured, the UE shall apply the configured ROHC profile(s) in both uplink and downlink. If *uplinkOnlyROHC* is configured, the UE shall apply the configure ROHC profile(s) in uplink (there is no header compression in downlink). FFS: restrictions for split bearers FFS: restrictions on reconfigurations (e.g. only at reconfiguration involving PDCP re-establishment)
integrityProtection Indicates whether or not integrity protection is configured for this radio bearer. FFS: text to indicate where to find the key.
maxCID Indicates the value of the MAX_CID parameter as specified in TS 38.323 [5] FFS: need to specify something with respect to UE capabilities.
outOfOrderDelivery Indicates whether or not *outOfOrderDelivery* specified in TS 38.323 [5] is configured.
primaryPath Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 clause 5.2.1 for UL data tranmission when more than one RLC entity is associated with the PDCP entity.
pdcp-SN-Size PDCP sequence number size, 12 or 18 bits.
statusReportRequired For AM DRBs, indicates whether the DRB is configured to send a PDCP status report in the upliink, as specified in TS 38.323 [5]. For UL DRBs, the value shall be ignored by the UE.
t-Reordering Value in ms of t-Reordering specified in TS 38.323 [5]. Value ms0 corresponds to 0ms, value ms20 corresponds to 20ms, value ms40 corresponds to 40ms, and so on.
ul-DataSplitThreshold Parameter specified in TS 38.323 [5]. Value b0 corresponds to 0 bits, value b100 corresponds to 100 bits, value b200 corresponds to 200 bits, and so on. Value Infinity corresponds to a path switch mode operation. FFS_FIXME: Clarify what happens upon “release”. And discuss need for value infinity. E.g. “If ul-DataSplitThreshold is set to release, the UL PDCP entity does not deliver data to RLC entities other than the “prioritizedRlc”
ul-Duplication Set to FALSE in this version of the specification.

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Conditional presence	Explanation
DRB	This field is mandatory present for DRBs, not present for SRBs.
MoreThanOneRLC	This field is mandatory present upon RRC reconfiguration with setup of a PDCP entity for a radio bearer with more than one associated logical channel and upon RRC reconfiguration with the association of an additional logical channel to the PDCP entity. Upon RRC reconfiguration when a PDCP entity is associated with multiple logical channels, this field is optionally present need M. Otherwise, this field is absent and all its included parameters are released.
Rlc-AM	The field is mandatory present upon setup of a PDCP entity for a radio bearer configured with RLC AM. Otherwise, the field is optionally present, need M.
Setup	The field is mandatory present in case of radio bearer setup. Otherwise the field is optionally present, need N.

– *PDSCH-Config*

The *PDSCH-Config* IE is used to configure the UE specific PDSCH parameters.

***PDSCH-Config* information element**

```
-- ASN1START
-- TAG-PDSCH-CONFIG-START

PDSCH-Config ::=                        SEQUENCE {
    -- Indicates whether to use code-block-group (CBG) based transmission (see 38.213, section x.x.x.x) FFS_Ref
    -- FFS: Is this BOOLEAN parameter needed or can it be derived from the presence of the codeBlockGroupsPerTransportBlock?
    codeBlockGroupTransmission              BOOLEAN,
    -- Maximum number of code-block-groups (CBGs) per TB. In case of multiple CW the maximum CBG is 4 (see 38.213, section 9.1.1)
    maxCodeBlockGroupsPerTransportBlock     ENUMERATED {n2, n4, n6, n8},
    -- Indicates whether CBGFI for CBG based (re)transmission in DL is enabled (true). (see FFS_Specification, section FFS_Section)
    codeBlockGroupFlushIndicator            BOOLEAN,

    -- Selection of the DMRS type to be used for DL (see 38.211, section 7.4.1.1.1)
    dmrs-Type                               ENUMERATED {type1, type2}                                   OPTIONAL,   -- Need R
    -- Position for additional DM-RS in DL, see Table 7.4.1.1.2-4 in 38.211.
    -- The four values represent the cases of 1+0, 1+1, 1+1+1. 1+1+1+1 non-adjacent OFDM symbols for DL.
    -- CHECK: Listed in RAN1 table. But should this really be in dedicated signalling?
    dmrs-AdditionalPosition                 ENUMERATED {pos0, pos1, pos2, pos3}                         OPTIONAL,   -- Need R
    -- DM-RS groups that are QCL:ed, i.e. group 1 (see 38.214, section 5.1)
    -- CHECK: Clarify how to configure the DMRS groups and the relation to TCI.
    dmrs-group1                             TYPE_FFS!,
    -- DM-RS groups that are QCL:ed, i.e. group 2 (see 38.214, section 5.1)
    dmrs-group2                             TYPE_FFS!,

    -- Configures downlink PTRS .
    -- If absent of released, the UE assumes that downlink PTRS are not present. See 38.211 section 7.4.1.2.2
    phaseTracking-RS                        SetupRelease { Downlink-PTRS-Config }                       OPTIONAL,   -- Need M

    -- Contains Transmission Configuration Indicator (TCI) states for dynamically indicating (over DCI) a transmission configuration
```


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```
    -- which includes QCL-relationships between the DL RSs in one RS set and the PDSCH DMRS ports
    -- (see 38.214, section 5.1.4)
    tci-States                              TYPE_FFS!,
    -- Reference Signal set within a TCI state, e.g., which RSs, which QCL parameters, etc. (see 38.214, section 5.1.4)
    tci-rs-SetConfig                        TYPE_FFS!,
    -- If at least spatial QCL is configured/indicated, this field indicates if TCI field is present or not present in DL-related DCI.
    -- When the field is absent the UE considers the TCI to be absent/disabled.
    -- FFS_RAN1: details of the granularity of the configuration, e.g. per CORESET, per UE.
    -- Corresponds to L1 parameter 'TCI-PresentInDCI' (see 38,213, section 5.1.5)
    tci-PresentInDCI                        ENUMERATED {enabled}                                                    OPTIONAL,
    -- Accounts for overhead from CSI-RS, CORESET, etc. FFS: Clarify value range and description.
    -- Corresponds to L1 parameter 'Xoh-PDSCH' (see 38.214, section 5.1.3.2)
    xOverhead                               FFS_Value                                                               OPTIONAL,

    -- Indexes to possible symbol allcoations (the indexes point to entries in a UE specific table)
    -- Corresponds to L1 parameter 'PDSCH-symbol-allocation' (see 38.214, section 5.1.2.1)
    pdsch-symbolAllocation                  FFS_Value       OPTIONAL,
    -- Resources that the UE should rate match PDSCH around.
    rateMatchResourcesPDSCH                 SEQUENCE {
        -- Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources
        -- indicated in the nexted bitmaps. Corresponds to L1 parameter 'rate-match-PDSCH-resource-set' (see 38.214, section 5.1.2.2.3)
        -- FFS_ASN1: Consider replacing by AddMod/Release lists
        rateMatchPatterns                       SetupRelease {
            SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern
        }                                                                                                           OPTIONAL, -- Need M
        lte-CRS-ToMatchAround                   SetupRelease {
            SEQUENCE {
                -- Number of LTE CRS antenna port to rate-match around.
                -- Corresponds to L1 parameter 'rate-match-resources-numb-LTE-CRS-antenna-port' (see 38.214, section 5.1.4)
                nrofCRS-Ports                       ENUMERATED {n1, n2, n4},
                -- Shifting value v-shift in LTE to rate match around LTE CRS
                -- Corresponds to L1 parameter 'rate-match-resources-LTE-CRS-v-shift' (see 38.214, section 5.1.4)
                v-Shift                             ENUMERATED {n0, n1, n2, n3, n4, n5},
            }
        }                                                                                                           OPTIONAL, -- Need M
    }

    -- Selection between config 1 and config 2 for RBG size for PDSCH. Corresponds to L1 parameter 'RBG-size-PDSCH' (see 38.214, section 5.1.2.2.1)
    rbg-Size                                ENUMERATED {config1, config2},

    -- Indicates which MCS table the UE shall use for PDSCH. Corresponds to L1 parameter 'MCS-Table-PDSCH' (see 38.214, section 5.1.3.1).
    mcs-Table                               ENUMERATED {64QAM, 256QAM},

    -- Maximum number of code words that a single DCI may schedule. This changes the number of MCS/RV/NDI bits in the DCI message from 1 to 2.
    maxNrofCodeWordsScheduledByDCI          ENUMERATED {n1, n2}                                                     OPTIONAL,   -- Need R

    -- The number of HARQ processes to be used on the PDSCH of a serving cell.
    -- Corresponds to L1 parameter 'number-HARQ-process-PDSCH' (see 38.214, section REF)
    nrofHARQ-processesForPDSCH              TYPE_FFS!,
```


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```
    -- HARQ-ACK codebook is configured to be either semi-static of dynamic. This is applicable to both CA and none CA operation
    -- Corresponds to L1 parameter 'HARQ-ACK-codebook' (see 38.213, section FFS_Section)
    harq-ACK-Codebook                       ENUMERATED {semiStatic, dynamic},

    -- Bundle size the UE may assume. Corresponds to L1 paramter 'PDSCH-bundle-size' (see 38.211, section 7.3.1.5)
    -- FFS: Better description, value range
    pdsch-BundleSize

    -- If set to true, the network indicates the PRB bundle size dynamically via DCI. Corresponds to L1 parameter 'PRB_bundling'
    -- (see 38.214, section 5.1.2.3)
    prbBundlingEnabled                      BOOLEAN

    ...
}

-- Parameters for configuration of downlink PTRS (see 38.211 section 7.4.1.2.2)
Downlink-PTRS-Config ::=                    SEQUENCE {
    -- Presence and  frequency density of DL PT-RS as a function of Scheduled BW (see 38.214, section 5.1)
    -- FFS: To be Configured  per BWP
    frequencyDensity                            TYPE_FFS!,
    -- Presence and time density of DL PT-RS  as a function of MCS (see 38.214, section 5.1)
    -- FFS: To be Configured  per BWP
    timeDensity                                 TYPE_FFS!,
    -- Indicates the number of DL PTRS ports. This is equal or smaller than the number of DMRS groups (related to PDSCH parameters
    -- dmrs-group1 and dmrs-group2). Corresponds to L1 parameter 'DL-PTRS-ports' (see 38.214, section 5.1)
    nrofPorts                                   ENUMERATED {n1, n2},
    -- EPRE ratio between PTRS and PDSCH. Corresponds to L1 parameter 'DL-PTRS-EPRE-ratio' (see 38.214, section 5.1)
    -- FFS: Whether there is one EPRE value per port (a comment in the L1 parameters hints that)
    epre-Ratio                                  FFS_Value                                                   OPTIONAL,
    -- Indicates the subcarrier offset for DL PTRS. Corresponds to L1 parameter 'DL-PTRS-RE-offset' (see 38.214, section 5.1)
    resourceElementOffset                       FFS_Value                                                   OPTIONAL
}

RateMatchPattern ::=                        SEQUENCE {

    -- A resource block level bitmap in the frequency domain. It indicates the PRBs to which the symbolsInResourceBlock bitmap applies.
    -- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap1' (see 38.214, section FFS_Section)
    -- FFS_ASN1: Consider multiple options with different number of bits (for narrower carriers)
    resourceBlocks                              BIT STRING (SIZE (275)),

    -- A symbol level bitmap in time domain. It indicates (FFS: with a bit set to true) the symbols which the UE shall rate match around.
    -- This pattern recurs (in time domain) with the configured periodicityAndOffset.
    -- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap2' (see 38.214, section FFS_Section)
    symbolsInResourceBlock                      BIT STRING (SIZE (14)),

    -- A time domain repetition pattern. It determines the periodicity (FFS: And offset???) at which the symbolsInResourceBlock pattern recurs.
    -- Absence of this field indicates the value n1, i.e., the symbolsInResourceBlock recurs every 14 symbols.
    -- Corresponds to L1 parameter 'rate-match-PDSCH-bitmap3' (see 38.214, section FFS_Section)
    -- FFS: Doesn't one require also an offset to configure from where the repetitions start?
    periodicityAndOffset                        CHOICE {
        n5                                          INTEGER (0..4),
```


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```
        n10                                         INTEGER (0..9),
        n20                                         INTEGER (0..19),
        n40                                         INTEGER (0..39)
    }                                                                                   OPTIONAL, -- Need R

}

-- TAG-PDSCH-CONFIG-STOP
-- ASN1STOP
```

– *PhysCellId*

The *PhysCellId* indentifies the physical cell identity (PCI).

***PhysCellId* information element**

```
-- ASN1START
-- TAG-PHYS-CELL-ID-START

PhysCellId ::=                      INTEGER (0..1007)

-- TAG-PHYS-CELL-ID-STOP
-- ASN1STOP
```

– *PUCCH-Config*

The *PUCCH-Config* IE is used to configure the UE specific PUCCH parameters.

***PUCCH-Config* information element**

```
-- ASN1START
-- TAG-PUCCH-CONFIG-START

PUCCH-Config ::=                        SEQUENCE {
    -- PUCCH resource sets (see 38.213  9.2)
    resourceSets                            SEQUENCE (SIZE (1..FFS_Value)) OF PUCCH-ResourceSet OPTIONAL,

    format1                                 SetupRelease { SEQUENCE {
        -- Enabling inter-slot frequency hopping when PUCCH Format 1 is repetead over multiple slots.
        interslotFrequencyHopping               ENUMERATED {enabled}                        OPTIONAL,
        -- Number of slots with the same PUCCH F1. When the field is absent the UE applies the value n1.
        -- Corresponds to L1 parameter 'PUCCH-F1-number-of-slots' (see 38.213, section 9.2)
        -- FFS_Value: Undefined values y1-y3 in range!
        nrofSlots                               ENUMERATED {n1,ny1,y2,y3}                   OPTIONAL
```


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```
    } }                                                                                                 OPTIONAL, -- Need M

    format2                                 SetupRelease { SEQUENCE {
        -- Maximum coding rate to determine how to feedback UCI on PUCCH Format 2.
        -- Corresponds to L1 parameter 'PUCCH-F2-maximum-coderate' (see 38.213, section 9.2)
        maxCodeRate                         FFS_Value                                                   OPTIONAL,
        -- Number of PRBs for PUCCH Format 2. Corresponds to L1 parameter 'PUCCH-F2-number-of-PRBs' (see 38.213, section 9.2)
        -- FFS_Value range
        nrofPRBs                            INTEGER(1..[16])                                            OPTIONAL,
        -- Enabling simultaneous transmission of CSI and HARQ-ACK feedback with or without SR with PUCCH Format2
        -- Corresponds to L1 parameter 'PUCCH-F2-Simultaneous-HARQ-ACK-CSI' (see 38.213, section 9.2)
        -- When the field is absent the UE applies the value OFF
        simultaneousHARQ-ACK-CSI            ENUMERATED {true}                                           OPTIONAL, -- Need R
    } }                                                                                                 OPTIONAL, -- Need M


    format3                                 SetupRelease { SEQUENCE {
        -- Enabling inter-slot frequency hopping when PUCCH Format 3 is repetead over multiple slots.
        interslotFrequencyHopping           ENUMERATED {enabled}                                        OPTIONAL,
        -- Enabling 2 DMRS symbols per hop of a PUCCH Format 3 if both hops are more than X symbols when FH is enabled.
        -- Enabling 4 DMRS sybmols for a PUCCH Format 3 with more than 2X+1 symbols when FH is disabled.
        -- Corresponds to L1 parameter 'PUCCH-F3-F4-additional-DMRS' (see 38.21X, section FFS_Section)
        additionalDMRS                      ENUMERATED {true}                                           OPTIONAL -- Need R,
        -- Max coding rate to determine how to feedback UCI on PUCCH Format 3
        -- Corresponds to L1 parameter 'PUCCH-F3-maximum-coderate' (see 38.213, section 9.2)
        maxCodeRate                         FFS_Value                                                   OPTIONAL,
        -- Number of slots with the same PUCCH F3. When the field is absent the UE applies the value n1.
        -- Corresponds to L1 parameter 'PUCCH-F3-number-of-slots' (see 38.213, section 9.2)
        -- FFS_Value: Undefined values y1-y3 in range!
        nrofSlots                           ENUMERATED {n1,y1,y2,y3}                                    OPTIONAL,
        -- Enabling pi/2 BPSK for UCI symbols instead of QPSK for PUCCH.
        -- Corresponds to L1 parameter 'PUCCH-PF3-PF4-pi/2PBSK' (see 38.21X, section FFS_Section)
        pi2PBSK                             ENUMERATED {enabled}                                        OPTIONAL,
    } }                                                                                                 OPTIONAL, -- Need M

    format4                                 SetupRelease { SEQUENCE {
        -- Enabling inter-slot frequency hopping when PUCCH Format 4 is repetead over multiple slots.
        interslotFrequencyHopping           ENUMERATED {enabled}                                        OPTIONAL,
        -- Enabling 2 DMRS symbols per hop of a PUCCH Format 4 if both hops are more than X symbols when FH is enabled.
        -- Enabling 4 DMRS sybmols for a PUCCH Format 4 with more than 2X+1 symbols when FH is disabled.
        -- Corresponds to L1 parameter 'PUCCH-F3-F4-additional-DMRS' (see 38.21X, section FFS_Section)
        additionalDMRS                      ENUMERATED {true}                                           OPTIONAL -- Need R,
        -- Max coding rate to determine how to feedback UCI on PUCCH Format 4
        -- Corresponds to L1 parameter 'PUCCH-F4-maximum-coderate' (see 38.213, section 9.2)
        maxCodeRate                         FFS_Value                                                   OPTIONAL,
        -- Number of slots with the same PUCCH F4. When the field is absent the UE applies the value n1.
        -- Corresponds to L1 parameter 'PUCCH-F4-number-of-slots' (see 38.213, section 9.2)
        -- FFS_Value: Undefined values y1-y3 in range!
        nrofSlots                           ENUMERATED {n1,y1,y2,y3}                                    OPTIONAL,
        -- Enabling pi/2 BPSK for UCI symbols instead of QPSK for PUCCH.
        -- Corresponds to L1 parameter 'PUCCH-PF3-PF4-pi/2PBSK' (see 38.21X, section FFS_Section)
```


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```
        pi2PBSK                                 ENUMERATED {enabled}                                                    OPTIONAL,
    } }                                                                                                                 OPTIONAL, -- Need M

    schedulingRequestResources              SetupRelease {
        SEQUENCE (SIZE (1..maxNrofSchedulingRequestResoruces)) OF SchedulingRequestResource-Config
    }                                                                                                                   OPTIONAL, -- Need M

    -- RNTI used for PUCCH TPC. Corresponds to L1 parameter 'TPC-PUCCH-RNTI' (see 38.213, section 10).
    tpc-PUCCH-RNTI                          BIT STRING (SIZE (16))                                                      OPTIONAL,
}

-- A set with one or more PUCCH resource configurations
PUCCH-ResourceSet ::=                       SEQUENCE {
    -- FFS What a PUCCH resource set contains and how the PUCCH resources in a set link to DCIs codepoints.
}

-- A PUCCH Format 0 resource configuration (see 38.213, section 9.2)
-- Corresponds to L1 parameter 'PUCCH-F0-resource-config' (see 38.213, section 9.2)
PUCCH-format0                               SEQUENCE {
    startingSymbolIndex                         INTEGER(0..13),
    nrofSymbols                                 ENUMERATED {n1, n2},
    startingPRB                                 INTEGER(0..maxNrofPhysicalResourceBlocks-1),
    frequencyHopping                            BOOLEAN,
    initialCyclicShift                          INTEGER(0..11)
}

-- A PUCCH Format 1 resource configuration (see 38.213, section 9.2)
-- Corresponds to L1 parameter 'PUCCH-F1-resource-config' (see 38.213, section 9.2)
PUCCH-format1 ::=                           SEQUENCE {
    startingSymbolIndex                         INTEGER(0..10),
    nrofSymbols                                 INTEGER(4..14),
    startingPRB                                 INTEGER(0..maxNrofPhysicalResourceBlocks-1),
    frequencyHopping                            BOOLEAN,
    initialCyclicShift                          INTEGER(0..11),
    timeDomainOCC                               INTEGER(0..6)
}

-- A PUCCH Format 2 resource configuration (see 38.213, section 9.2)
-- Corresponds to L1 parameter 'PUCCH-F2-resource-config' (see 38.213, section 9.2)
PUCCH-format2 ::=                           SEQUENCE {
    startingSymbolIndex                         INTEGER(0..13),
    nrofSymbols                                 ENUMERATED {n1, n2},
    startingPRB                                 INTEGER(0..maxNrofPhysicalResourceBlocks-1),
    nrofPRBs                                    PUCCH-F2-number-of-PRB,
    frequencyHopping                            BOOLEAN
}

-- A PUCCH Format 3 resource configuration(see 38.213, section 9.2)
-- Corresponds to L1 parameter 'PUCCH-F3-resource-config' (see 38.213, section 9.2)
PUCCH-format3 ::=                           SEQUENCE
    startingSymbolIndex                         INTEGER(0..10),
```


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```
    nrofSymbols                                     INTEGER(4..14),
    startingPRB                                     INTEGER(0..maxNrofPhysicalResourceBlocks-1),
    nrofPRBs                                        ENUMERATED {n1,n2,n3,n4,n5,n6,n8,n9,n10,n12,n15,n16},
    frequencyHopping                                BOOLEAN
}

-- A PUCCH Format 4 resource configuration (see 38.213, section 9.2)
-- Corresponds to L1 parameter 'PUCCH-F4-resource-config' (see 38.213, section 9.2)
PUCCH-format4 ::=                                 SEQUENCE {
    startingSymbolIndex                             INTEGER(0..10),
    nrofSymbols                                     INTEGER(4..14),
    startingPRB                                     INTEGER(0..maxNrofPhysicalResourceBlocks-1),
    frequencyHopping                                BOOLEAN,
    occ-Length                                      ENUMERATED {n2,n4},
    occ-Index                                       ENUMERATED {n0,n1,n2,n3}
}


-- TAG-PUCCH-CONFIG-STOP
-- ASN1STOP
```

– *PUSCH-Config*

The IE *PUSCH-Config* IE is used to configure the UE specific PUSCH parameters.

PUSCH-Config information element

```
-- ASN1START
-- TAG-PUSCH-CONFIG-START

PUSCH-Config ::=                          SEQUENCE {
    -- Indicates whether to use code-block-group (CBG) based transmission (see 38.214, section x.x.x.x) FFS_Ref
    -- FFS: Is this BOOLEAN parameter needed or can it be derived from the presence of the codeBlockGroupsPerTransportBlock?
    codeBlockGroupTransmission            ENUMERATED {true}                                   OPTIONAL,   -- Need R
    -- Maximum number of code-block-groups (CBGs) per TB (see 38.xxx, section x.x.x, FFS_Ref)
    maxCodeBlockGroupsPerTransportBlock   ENUMERATED {n2, n4, n6, n8},

    -- Selection of the DMRS type to be used for UL (see section 38.211, section 6.4.1.1.2)
    dmrs-Type                             ENUMERATED {type1, type2}                           OPTIONAL,   -- Need R
    -- Position for additional DM-RS in DL, see Table 7.4.1.1.2-4 in 38.211.
    -- The four values represent the cases of 1+0, 1+1, 1+1+1. 1+1+1+1 non-adjacent OFDM symbols for DL.
    dmrs-AdditionalPosition               ENUMERATED {pos0, pos1, pos2, pos3}                 OPTIONAL,   -- Need R

    -- Configures uplink PTRS (see 38.211, section x.x.x.x) FFS_Ref
    phaseTracking-RS                      SetupRelease { Uplink-PTRS-Config }                 OPTIONAL,   -- Need M
```


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```
    -- If enabled, UE applies TPC commands via accumulation. If not enabled, UE applies the TPC command without accumulation.
    -- (see 38.213, section 7)
    -- FFS: Collect all power control parameters in a common section or keep them per channel?
    tpcAccumulation                         ENUMERATED { enabled }                                          OPTIONAL,   -- Need R

    -- RNTI used for PUSCH TPC
    -- Corresponds to L1 parameter 'TPC-PUSCH-RNTI' (see 38.213, section 10)
    tcp-PUSCH-RNTI                          BIT STRING (SIZE (16))                                          OPTIONAL,
    -- Configured one of two supported frequency hopping mode. If not configured frequency hopping is not configured
    -- Corresponds to L1 parameter 'Frequency-hopping-PUSCH' (see 38.214, section 6)
    -- When the field is absent the UE applies the value Not configured
    frequencyHopping                        ENUMERATED {mode1, mode2},
    -- Configure either LBRM or FBRM for PUSCH. FBRM = Full buffer rate-matchingLBRM = Limited buffer rate-matching
    -- Corresponds to L1 parameter 'LBRM-FBRM-selection' (see 38.212, section 5.4.2)
    rateMatching                            ENUMERATED {FullBufferRM, LimitedBufferRM},
    -- Resources that the UE should rate match PUSCH around (see 38.214, section REF)
    rateMatchResources                      TYPE_FFS!,
    -- Configuration of DCI code points that determine PUSCH resource allocations.
    -- Corresponds to L1 parameter 'PUSCH-symbol-allocation' (see 38.214, section 6.1.2.1)
    symbolAllocationIndexs                  FFS_Value       OPTIONAL,

    -- Indicates which MCS table the UE shall use for PUSCH without transform precoder
    -- Corresponds to L1 parameter 'MCS-Table-PUSCH' (see 38.214, section 6.1.4)
    -- When the field is absent the UE applies the value 64QAM
    mcs-Table                               ENUMERATED {64QAM, 256QAM},
    -- Indicates which MCS table the UE shall use for PUSCH with transform precoding
    -- Corresponds to L1 parameter 'MCS-Table-PUSCH-transform-precoding' (see 38.214, section 6.1.4)
    -- When the field is absent the UE applies the value 64QAM
    mcs-TableTransformPrecoder              ENUMERATED {64QAM, 256QAM},
    -- The UE specifically selection of transformer precoder for PUSCH. When the field is absent the UE applies the value msg3-tp.
    -- Corresponds to L1 parameter 'PUSCH-tp' (see 38.211, section 6.3.1.4)
    transformPrecoder                       ENUMERATED {enabled}                                            OPTIONAL,

    -- Selection between config 1 and config 2 for RBG size for PUSCH. Corresponds to L1 parameter 'RBG-size-PUSCH' (see 38.214, section 6.1.2.2.1)
    rbg-Size                                ENUMERATED {config1, config2},

    -- Select between and configuration of dynamic and semi-static beta-offset
    -- Corresponds to L1 parameter 'UCI-on-PUSCH' (see 38.214, section 9.3)
    uci-on-PUSCH                            SetupRelease { CHOICE {
            dynamic                                 SEQUENCE (SIZE (1..4)) OF BetaOffsets,
            semiStatic                              BetaOffsets
    }   }                                                                                                   OPTIONAL, -- Need M

    -- Accounts for overhead from CSI-RS, CORESET, etc. FFS: Clarify value range and description.
    -- Corresponds to L1 parameter 'Xoh-PDSCH' (see 38.214, section 5.1.3.2)
    xOverhead                               FFS_Value                                                       OPTIONAL,

    ...
}
```


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```
-- Configuration of Uplink Phase-Tracking-Reference-Signals (PTRS)
--  FFS: Is it possible to configure PTRS for CP-OFDM and DFT-S OFDM simultaneously or just one. If the latter, replace below by a CHOICE.
Uplink-PTRS-Config ::=                  SEQUENCE {
    -- Configuration of UL PTRS for CP-OFDM
    cp-OFDM                             SetupRelease { SEQUENCE {
            -- Presence and  frequency density of UL PT-RS for CP-OFDM waveform as a function of scheduled BW (see 38.214, section 6.1)
            -- FFS: Configuration is supposed to be per BWP according to RAN1
            frequencyDensity                    TYPE_FFS!,
            -- Presence and time density of UL PT-RS for CP-OFDM waveform as a function of MCS (see 38.214, section 6.1)
            -- FFS: Configuration is supposed to be per BWP according to RAN1
            timeDensity                         TYPE_FFS!,
            -- Indicator related to the number of UL PTRS ports for CP-OFDM. Details to be further decided.
            -- Corresponds to L1 parameter 'UL-PTRS-ports' (see 38.214, section 6.1)
            nrofPorts                           ENUMERATED {n1, n2},
            -- Indicates the subcarrier offset for UL PTRS for CP-OFDM. Corresponds to L1 parameter 'UL-PTRS-RE-offset' (see 38.214, section 6.1)
            resourceElementOffset               FFS_Value                                                       OPTIONAL
        }
    }                                                                                                           OPTIONAL, -- Cond M
    -- Configuration of UL PTRS for DFT-S-OFDM.
    dft-S-OFDM                          SetupRelease { SEQUENCE {
            -- Sample density of PT-RS for DFT-s-OFDM, pre-DFT, indicating a set of thresholds T={NRBn,n=0,1,2,3,4},
            -- that indicates dependency between presence of PT-RS and scheduled BW and the values of X and K the UE should
            -- use depending on the scheduled BW according to the table in 38.214 FFS_Section.
            -- FFS: Configuration is supposed to be per BWP according to RAN1
            -- Corresponds to L1 parameter 'UL-PTRS-pre-DFT-density' (see 38.214, section 6.1)
            sampleDensity                   FFS_Value                                                           OPTIONAL,
            -- Time density (OFDM symbol level) of PT-RS for DFT-s-OFDM
            -- Corresponds to L1 parameter 'UL-PTRS-time-density-transform-precoding' (see 38.214, section 6.1)
            timeDensity                     ENUMERATED {d1, d2}                                                 OPTIONAL,
            -- PTRS sequence for DFT-s-OFDM. Corresponds to L1 parameter 'UL-PTRS-sequence-transform-precoding' (see 38.214, section 6.1)
            sequence                        FFS_Value                                                           OPTIONAL
        }
    }                                                                                                           OPTIONAL, -- Cond M
}

-- A set of beta-offset values
BetaOffsets ::=                         SEQUENCE {
    -- Up to 2 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-1' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 11
    betaOffsetACK-Index1                INTEGER(0..31)                                                          OPTIONAL, -- Need M
    -- Up to 11 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-2' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 11
    betaOffsetACK-Index1                INTEGER(0..31)                                                          OPTIONAL, -- Need M
    -- Above 11 bits HARQ-ACK. Corresponds to L1 parameter 'betaOffset-ACK-Index-3' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 11
    betaOffsetACK-Index1                INTEGER(0..31)                                                          OPTIONAL, -- Need M
    -- Up to 11 bits of CSI part 1 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-1-Index-1' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 13
    betaOffsetACK-Index1                INTEGER(0..31)                                                          OPTIONAL, -- Need M
    -- Above 11 bits of CSI part 1 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-1-Index-2' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 13
```


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```
    betaOffsetACK-Index1                        INTEGER(0..31)                                                  OPTIONAL, -- Need M
    -- Up to 11 bits of CSI part 2 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-2-Index-1' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 13
    betaOffsetACK-Index1                        INTEGER(0..31)                                                  OPTIONAL, -- Need M
    -- Above 11 bits of CSI part 2 bits. Corresponds to L1 parameter 'betaOffset-CSI-part-2-Index-2' (see 38.213, section 9.3)
    -- When the field is absent the UE applies the value 13
    betaOffsetACK-Index1                        INTEGER(0..31)                                                  OPTIONAL, -- Need M
}

-- TAG-PUSCH-CONFIG-STOP
-- ASN1STOP
```

– *Q-OffsetRange*

The IE *Q-OffsetRange* is used to indicate a cell, beam 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
```

Editor's Note: FFS Confirm the exact values that are supported.

– *QuantityConfig*

The IE *QuantityConfig* specifies the measurement quantities and layer 3 filtering coefficients for NR and inter-RAT measurements.

QuantityConfig information element

```
-- ASN1START
-- TAG-QUANTITY-CONFIG-START


    quantityConfigRSindex                   QuantityConfigRS                                        OPTIONAL
}
```


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```
QuantityConfigRS ::=                    SEQUENCE {
    -- SS Block based
    ssbFilterCoefficientRSRP                FilterCoefficient                                   DEFAULT FFS!,
    ssbFilterCoefficientRSRQ                FilterCoefficient                                   DEFAULT FFS!,
    ssbFilterCoefficientRS-SINR             FilterCoefficient                                    DEFAULT FFS!,

    -- CSI-RS based
    csi-rsFilterCoefficientRSRP             FilterCoefficient                                   DEFAULT FFS!,
    csi-rsFilterCoefficientRSRQ             FilterCoefficient                                   DEFAULT FFS!,
    csi-rsFilterCoefficientRS-SINR          FilterCoefficient                                    DEFAULT FFS!
}

-- TAG-QUANTITY-CONFIG-STOP
-- ASN1STOP
```

QuantityConfig field descriptions
quantityConfigCell Specifies L3 filter configurations for cell measurement results for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).
quantityConfigNR Specifies filter configurations for NR measurements.
quantityConfigRSindex Specifies L3 filter configurations for measurement results per RS index for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).
ssbFilterCoefficientRSRP Specifies L3 filter configurations for SS-RSRP measurement results from the L1 filter(s), as defined in 38.215 [9].
ssbFilterCoefficientRSRQ Specifies L3 filter configurations for SS-RSRQ measurement results from the L1 filter(s), as defined in 38.215 [9].
ssbFilterCoefficientSINR Specifies L3 filter configurations for SS-SINR measurement results from the L1 filter(s), as defined in 38.215 [9].
csi-rsFilterCoefficientRSRP Specifies L3 filter configurations for CSI-RSRP measurement results from the L1 filter(s), as defined in 38.215 [9].
csi-rsFilterCoefficientRSRQ Specifies L3 filter configurations for CSI-RSRQ measurement results from the L1 filter(s), as defined in 38.215 [9].
csi-rsFilterCoefficientRSRP Specifies L3 filter configurations for CSI-SINR measurement results from the L1 filter(s), as defined in 38.215 [9].

– *RACH-ConfigCommon*

The *RACH-ConfigCommon* IE is used to specify the cell specific random-access parameters.

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RACH-ConfigCommon information element

```
-- ASN1START
-- TAG-RACH-CONFIG-COMMON-START

RACH-ConfigCommon ::=               SEQUENCE {

    --  FFS: whether any of the parameter(s) in the L1 TP should be within CBRA-SSB-ResourceList
    groupBconfigured                SEQUENCE {
        -- FFS: ra-Msg3SizeGroupA values
        ra-Msg3SizeGroupA               ENUMERATED {b56, b144, b208, b256, b282, b480, b640, b800, b1000, spare7, spare6, spare5,
                                            spare4, spare3, spare2, spare1},
        -- FFS: Need and definition of messagePowerOffsetGroupB
        messagePowerOffsetGroupB        ENUMERATED { minusinfinity, dB0, dB5, dB8, dB10, dB12, dB15, dB18}
    } OPTIONAL,

    cbra-SSB-ResourceList               CBRA-SSB-ResourceList,

    ra-ContentionResolutionTimer        ENUMERATED { sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64},

    -- Msg1 (RA preamble):  -- UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission
    -- based on SS blocks that satisfy the threshold (see 38.213, section REF)
    ssb-Threshold                       TYPE_FFS!                                                   OPTIONAL,
    -- FFS: Provide proper description
    -- Corresponds to L1 parameter 'SUL-RSRP-Threshold' (see FFS_Spec, section FFS_Section)
    sul-RSRP-Threshold                  FFS_Value                                                   OPTIONAL,

    -- PRACH configuration index. Corresponds to L1 parameter 'PRACHConfigurationIndex' (see 38.211, section 6.3.3.2)
    prach-ConfigurationIndex            INTEGER (0..255)                                            OPTIONAL,
    -- PRACH root sequence index. Corresponds to L1 parameter 'PRACHRootSequenceIndex' (see 38.211, section 6.3.3.1).
    -- The value range depends on whether L=839 or L=139
    prach-RootSequenceIndex             CHOICE {
        l839                                INTEGER (0..837),
        l139                                INTEGER (0..137}
    }                                                                                               OPTIONAL,

    -- N-CS configuration, see Table 6.3.3.1-3 in 38.211
    zeroCorrelationZoneConfig           INTEGER(0..15),
    -- Configuration of restricted sets, see 38.211 6.3.3.1
    -- CHECK: RAN1 value said "restrictedTypeA". Does it mean "restrictedToTypeA"? If not, what else?
    restrictedSetConfig                 ENUMERATED {unrestricted, restrictedToTypeA, restrictedToTypeB},
    -- (see 38.213, section 7.4)
    preambleReceivedTargetPower         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, dBm-88, dBm-86, dBm-84,dBm-82, dBm-80, dBm-78, dBm-76,
                                            dBm-74, dBm-72, dBm-70, dBm-68, dBm-66, dBm-64, dBm-62, dBm-60, dBm-58, dBm-56, dBm-54, dBm-52,
                                                dBm-50, dBm-48, dBm-46, dBm-44, dBm-42, dBm-42, dBm-40, dBm-38, dBm-36, dBm-34, dBm-32, dBm-30,
                                                    dBm-28, dBm-26, dBm-24, dBm-22, dBm-20, dBm-18, dBm-16, dBm-14, dBm-12, dBm-10, dBm-8, dBm-
6,                                                      dBm-4, dBm-2, dBm-0, dBm2, dBm4, dBm6 }     OPTIONAL,
    -- Power ramping steps for PRACH (see 38.321, FFS_section)
    powerRampingStep                    ENUMERATED {dB0, dB2, dB4, dB6}                             OPTIONAL, -- Need R
```


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```
    -- CHECK: PreambleTransMax parameter usage (parameter was not provided by RAN1 and not yet discussed in RAN2)
    PreambleTransMax ::=                ENUMERATED {n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200}


    -- Msg2 (RAR) window length. Corresponds to L1 parameter 'msg2-scs' (see 38.213, section 8.1)
    ra-ResponseWindow                   TYPE_FFS!,  -- Subcarrier spacing for msg2 for contention-free RA procedure for handover.
    -- Corresponds to L1 parameter 'msg2-scs' (see 38.321?, section FFS_Section)
    msg2-SubcarrierSpacing              SubcarrierSpacing,
    -- CORESET configured for random access. When the field is absent the UE uses the CORESET according to pdcchConfigSIB1
    -- Corresponds to L1 parameter 'rach-coreset-configuration' (see 38.211?, section FFS_Section)
    rach-ControlResourceSet                 FFS_Value       OPTIONAL,

    -- Subcarrier spacing for Msg3. Corresponds to L1 parameter 'msg3-scs' (see 38.213, section 8.1)
    msg3-SubcarrierSpacing              SubcarrierSpacing,
    -- Indicates to a UE whether transform precoding is enabled for Msg3 transmission.
    -- Corresponds to L1 parameter 'msg3-tp' (see 38.213, section 8.1)
    msg3-transformPrecoding             ENUMERATED {true}                                                   OPTIONAL, -- Need R
}

CBRA-SSB-ResourceList ::=       SEQUENCE (SIZE(1..maxRAssbResources)OF CBRA-SSB-Resource
CBRA-SSB-Resource ::=           SEQUENCE {
    ssb                             SSB-ID,
    startIndexRA-PreambleGroupA     PreambleStartIndex,
    numberofRA-PreamblesGroupA      NumberOfRA-Preambles,
    numberOfRA-Preambles            NumberOfRA-Preambles,

    -- PRACH configuration for SSB configuration (i.e. time and frequency location)
    -- FFS / TODO: Type Definition for RA-Resources.
    ra-Resources                RA-Resources
}

PreambleStartIndex      ::= INTEGER (0..maxRA-PreambleIndex)
NumberofRA-Preambles    ::= INTEGER (1.. maxNrOfRA-PreamblesPerSSB)

-- TAG-RACH-CONFIG-COMMON-STOP
-- ASN1STOP
```

– *RACH-ConfigDedicated*

The IE *RACH-ConfigDedicated* is used to specify the dedicated random access parameters.

RACH-ConfigDedicated information element

```
-- ASN1START
-- TAG-RACH-CONFIG-DEDICATED-START

-- FFS: resources for msg1-based on-demand SI request
```


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```
-- FFS: resources for beam failure recovery request

RACH-ConfigDedicated ::=        SEQUENCE {
    -- Resources for handover to the cell
    cfra-Resources                  CFRA-Resources,
    -- Subcarrier spacing for msg2 for contention-free RA procedure for handover
    rar-SubcarrierSpacing           SubcarrierSpacing
}

-- FFS_CHECK: Isn't it sufficient to have just one list and the CHOICE inside the list element (around the ssb/csirs)?
CFRA-Resources ::=              CHOICE {
    cfra-ssb-ResourceList           SEQUENCE (SIZE(1..maxRAssbResources) OF CFRA-SSB-Resource,
    cfra-csirs-ResourceList         SEQUENCE (SIZE(1..maxRAcsirsResources)OF CFRA-CSIRS-Resource
}

CFRA-SSB-Resource ::=           SEQUENCE {
    ssb                             SSB-ID,
    ra-PreambleIndex                INTEGER (0..FFS_XX),
    --  PRACH configuration for SSB configuration (i.e. time and frequency location)
    ra-Resources                RA-Resources -- Definition FFS
}

CFRA-CSIRS-Resource ::=         SEQUENCE {
    csirs                           CSIRS-ID, -- FFS where the CSI-RS are defined (e.g. MO)
    ra-PreambleIndex                INTEGER (0..FFS_XX),
    --  PRACH configuration for CSIRS configuration (i.e. time and frequency location)
    ra-Resources                    RA-Resources -- Definition FFS
}

-- TAG-RACH-CONFIG-DEDICATED-STOP
-- ASN1STOP
```

– *RadioBearerConfig*

The IE *RadioBearerConfig* is used to add, modify and release signalling- and/or data radio bearers. Specifically, this IE carries the parameters for PDCP and, if applicable, SDAP entities for the radio bearers.

***RadioBearerConfig* information element**

```
-- ASN1START
-- TAG-RADIO-BEARER-CONFIG-START

RadioBearerConfig ::=                   SEQUENCE {
    srb-ToAddModList                        SRB-ToAddModList                                OPTIONAL, -- Need M
    srb-ToReleaseList                       INTEGER (3)                                     OPTIONAL, -- Need M
    drb-ToAddModList                        DRB-ToAddModList                                OPTIONAL, -- Need M
    drb-ToReleaseList                       DRB-ToReleaseList                               OPTIONAL, -- Need M
```


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```
    securityConfig                          SecurityConfig                                          OPTIONAL  -- Cond KeyChange
}

SRB-ToAddModList ::=                    SEQUENCE (SIZE (1..2)) OF SRB-ToAddMod
SRB-ToAddMod ::=                        SEQUENCE {
    srb-Identity                            SRB-Identity,

    -- may only be set if the cell groups of all linked logical channels are reset or released
    reestablishPDCP                         ENUMERATED{true}                                        OPTIONAL,      -- Cond KeyChange
    pdcp-Config                             PDCP-Config                                             OPTIONAL,      -- Cond PDCP
    ...
}


DRB-ToAddModList ::=                    SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod
DRB-ToAddMod ::=                        SEQUENCE {
    cnAssociation                           CHOICE {
        -- The EPS bearer ID determines the EPS bearer when NR connects to EPC using EN-DC
        eps-BearerIdentity                      INTEGER (0..15)                                     OPTIONAL,      -- Cond EPS-DRB-Setup
        --  The SDAP configuration determines how to map QoS flows to DRBs when NR connects to the 5GC
        sdap-Config                             SDAP-Config                                         OPTIONAL    -- Cond NGC
    },
    drb-Identity                            DRB-Identity,

    -- may only be set if the cell groups of all linked logical channels are reset or released
    reestablishPDCP                         ENUMERATED{true}                                        OPTIONAL,      -- Cond HO
    recoverPDCP                             ENUMERATED{true}                                        OPTIONAL,      -- Need N
    pdcp-Config                             PDCP-Config                                             OPTIONAL,      -- Cond PDCP
    ...
}

DRB-ToReleaseList ::=                   SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity


SecurityConfig ::=                      SEQUENCE {
    securityAlgorithmConfig                 SecurityAlgorithmConfig                                 OPTIONAL,   -- Need M
    keyToUse                                ENUMERATED{KeNB, S-KgNB}                                OPTIONAL -- Need M
    ...
}

-- TAG-RADIO-BEARER-CONFIG-STOP
-- ASN1STOP
```


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***RadioBearerConfig* field descriptions**
drb-Identity In case of DC, the DRB identity is unique within the scope of the UE, i.e. an MCG DRB cannot use the same value as a split DRB. For a split DRB the same identity is used for the MCG- and SCG parts of the configuration.
cnAssociation Indicates if the bearer is associated with the eps-bearerIdentity (when connected to EPC) or sdap-Config (when connected to 5GC).
keyToUse Indicates if the bearer configured with this list is using KeNB or S-KgNB for deriving ciphering and/or integrity protection keys. Network should not configure SRB1 and SRB2 with S-KeNB and SRB3 with KeNB.
srb-Identity Value 1 is applicable for SRB1 only. Value 2 is applicable for SRB2 only. Value 3 is applicable for SRB3 only.

Conditional Presence	Explanation
KeyChange	The field is mandatory present in case of with key change, otherwise the field is not present
PDCP	The field is mandatory present if the corresponding DRB is being setup or reconfigured with NR PDCP; otherwise the field is optionally present, need M

– *ReportConfigId*

The IE *ReportConfigId* is used to identify a measurement reporting configuration.

***ReportConfigId* information element**

```
-- ASN1START
-- TAG-REPORT-CONFIG-ID-START

ReportConfigId ::=                          INTEGER (1..maxNrofReportConfigId)

-- TAG-REPORT-CONFIG-ID-STOP
-- ASN1STOP
```

– *ReportConfigNR*

The IE *ReportConfigNR* specifies criteria for triggering of an NR measurement reporting event. Measurement reporting events are based on cell measurement results, which can either be derived based on SS/PBCH block or CSI-RS. These events are labelled AN with N equal to 1, 2 and so on.

Event A1: Serving becomes better than absolute threshold;

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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.

ReportConfigNR information element

```
-- ASN1START
-- TAG-REPORT-CONFIG-START

ReportConfigNR ::=                          SEQUENCE {
    reportType                                  CHOICE {
        periodical                                  PeriodicalReportConfig,
        eventTriggered                              EventTriggerConfig,
        reportCGI                                   Type_FFS!,
        ...
    }
}

-- FFS / TODO: Consider separating trgger configuration (trigger, periodic, …) from report congiguration.
-- Current structure allows easier definiton of new events and new report types e.g. CGI, etc.
EventTriggerConfig::=                       SEQUENCE {
    eventId                                     CHOICE {
        eventA1                                     SEQUENCE {
            a1-Threshold                                MeasTriggerQuantity,
            reportOnLeave                               BOOLEAN,
            hysteresis                                  Hysteresis,
            timeToTrigger                               TimeToTrigger
        },
        eventA2                                     SEQUENCE {
            a2-Threshold                                MeasTriggerQuantity,
            reportOnLeave                               BOOLEAN,
            hysteresis                                  Hysteresis,
            timeToTrigger                               TimeToTrigger
        },
        eventA3                                     SEQUENCE {
            a3-Offset                                   MeasTriggerQuantityOffset,
            reportOnLeave                               BOOLEAN,
            hysteresis                                  Hysteresis,
            timeToTrigger                               TimeToTrigger,
            useWhiteCellList                            BOOLEAN                                 OPTIONAL
        },
        eventA4                                     SEQUENCE {
            a4-Threshold                                MeasTriggerQuantity,
```


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```
            reportOnLeave                           BOOLEAN,
            hysteresis                              Hysteresis,
            timeToTrigger                           TimeToTrigger,
            useWhiteCellList                        BOOLEAN                                         OPTIONAL
        },
        eventA5                                 SEQUENCE {
            a5-Threshold1                           MeasTriggerQuantity,
            a5-Threshold2                           MeasTriggerQuantity,
            reportOnLeave                           BOOLEAN,
            hysteresis                              Hysteresis,
            timeToTrigger                           TimeToTrigger,
            useWhiteCellList                        BOOLEAN                                         OPTIONAL
        },
        eventA6                                 SEQUENCE {
            a6-Offset                               MeasTriggerQuantityOffset,
            reportOnLeave                           BOOLEAN,
            hysteresis                              Hysteresis,
            timeToTrigger                           TimeToTrigger,
            useWhiteCellList                        BOOLEAN                                         OPTIONAL
        },
    },

    rsType                                  ENUMERATED {ss, csi-rs}

    -- Common reporting config (at least to periodical and eventTriggered)
    reportInterval                          ReportInterval,
    reportAmount                            ENUMERATED {FFS!},

    -- Cell reporting configuration
    reportQuantityCell                      MeasReportQuantity,
    maxReportCells                          INTEGER (1..maxCellReport),

    -- RS index reporting configuration
    reportQuantityRsIndexes                 MeasReportQuantity                                      OPTIONAL,
    maxNroIndexesToReport                       INTEGER (1..maxNroIndexesToReport)                  OPTIONAL,
    onlyReportBeamIds                       BOOLEAN                                                 OPTIONAL,

    -- If configured the UE includes the best neighbour cells per serving frequency
    reportAddNeighMeas                      TYPE_FFS!
}

PeriodicalReportConfig ::=              SEQUENCE {
    rsType                                  ENUMERATED {ssb, csi-rs}

    -- Common reporting config (at least to periodical and eventTriggered)
    reportInterval                          ReportInterval,
    reportAmount                            ENUMERATED {FFS!},

    -- Cell reporting configuration
    reportQuantityCell                      MeasReportQuantity,
    maxReportCells                          INTEGER (1..maxCellReport),
```


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```
    -- RS index reporting configuration
    reportQuantityRsIndexes                 MeasReportQuantity                              OPTIONAL,
    maxNroRsIndexesToReport                 INTEGER (1..maxNroIndexesToReport)              OPTIONAL,
    onlyReportBeamIds                       BOOLEAN                                         OPTIONAL
}

MeasTriggerQuantity::=                  CHOICE {
    rsrp                                    RSRPRange,
    rsrq                                    RSRQRange,
    sinr                                    SINRRange
}

MeasTriggerQuantityOffset::=            CHOICE {
    rsrp                                    INTEGER (FFS!)                                  OPTIONAL,
    rsrq                                    INTEGER (FFS!)                                  OPTIONAL,
    sinr                                    INTEGER (FFS!)                                  OPTIONAL
}


MeasReportQuantity::=                   SEQUENCE {
    rsrp                                    BOOLEAN,
    rsrq                                    BOOLEAN,
    sinr                                    BOOLEAN
}


-- TAG-REPORT-CONFIG-START
-- ASN1STOP
```


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ReportConfigNR field descriptions
a3-Offset/ a6-Offset Offset value(s) to be used in NR measurement report triggering condition for event a3/ a6.
aN-ThresholdM Threshold value associated to the selected trigger quantity (e.g. RSRP, RSRQ, SINR) per RS Type (e.g. SS/PBCH block, CSI-RS) to be used in NR measurement report triggering condition for event number aN. If multiple thresholds are defined for event number aN, the thresholds are differentiated by M. The network configures aN-Threshold1 only for events A1, A2, A4, A5 and a5-Threshold2 only for event A5.
eventId Choice of NR event triggered reporting criteria.
maxReportCells Max number of non-serving cells to include in the measurement report.
maxNroRsIndexesToReport Max number of measurement information per RS index to include in the measurement report for A1-A6 events.
reportAmount *Number* of measurement reports applicable for *eventTriggered* as well as for *periodical* report types
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.
reportQuantityCell The cell measurement quantities to be included in the measurement report.
reportQuantityRsIndexes Indicates which measurement information per RS index the UE shall include in the measurement report.
reportAddNeighMeas Indicates that the UE shall includes the best neighbour cells per serving frequency.
timeToTrigger Time during which specific criteria for the event needs to be met in order to trigger a measurement report.
useWhiteCellList Indicates whether only the cells included in the white-list of the associated measObject are applicable as specified in 5.5.4.1.

Editor's Note: FFS ASN.1 details of *reportCGI*.

Editor's Note: FFS Whether *MeasTriggerQuantityOffset* should be a CHOICE instead of a SEQUENCE e.g. in case multiple trigger quantities are supported.

– *ReportConfigToAddModList*

The IE *ReportConfigToAddModList* concerns a list of reporting configurations to add or modify.

ReportConfigToAddModList information element

```
-- ASN1START
-- TAG-REPORT-CONFIG-TO-ADD-MOD-LIST-START

ReportConfigToAddModList ::=        SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod
```


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```
ReportConfigToAddMod ::=    SEQUENCE {
    reportConfigId                      ReportConfigId,
    reportConfig                        CHOICE {
        reportConfigNR                      ReportConfigNR,
        reportConfigEUTRA                   ReportConfigEUTRA
    }
}

-- TAG- REPORT-CONFIG-TO-ADD-MOD-LIST-STOP
-- ASN1STOP
```

Editor's Note: FFS Definition of *reportConfigEUTRA* in 38.331.

– *RLC-Config*

The IE *RLC-Config* is used to specify the RLC configuration of SRBs and DRBs.

RLC-Config information element

```
-- ASN1START
-- TAG-RLC-CONFIG-START

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
    },
    ...
}

UL-AM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength-AM,
    t-PollRetransmit                    T-PollRetransmit,
    pollPDU                             PollPDU,
    pollByte                            PollByte,
    maxRetxThreshold                    ENUMERATED { t1, t2, t3, t4, t6, t8, t16, t32 }
```


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```
}

DL-AM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength-AM,
    t-Reassembly                        T-Reassembbly,
    t-StatusProhibit                    T-StatusProhibit
}

UL-UM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength-UM
}

DL-UM-RLC ::=                       SEQUENCE {
    sn-FieldLength                      SN-FieldLength-UM,
    t-Reassembly                        T-Reassembly
}

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, ms800, ms1000,
                                        ms2000, ms4000, spare5, spare4, spare3,
                                        spare2, spare1}


PollPDU ::=                         ENUMERATED {
                                        p4, p8, p16, p32, p64, p128, p256, p512, p1024, p2048, p4096, p6144, p8192, p12288, p16384, p20480,
                                        p24576, p28672, p32768, p40960, p49152, p57344, p65536, infinity, spare8, spare7, spare6, spare5, spare4,
                                        spare3, spare2, spare1}

PollByte ::=                        ENUMERATED {
                                        kB1, kB2, kB5, kB8, kB10, kB15, kB25, kB50, kB75,
                                        kB100, kB125, kB250, kB375, kB500, kB750, kB1000,
                                        kB1250, kB1500, kB2000, kB3000, kB4000, kB4500,
                                        kB5000, kB5500, kB6000, kB6500, kB7000, kB7500,
                                        mB8, mB9, mB10, mB11, mB12, mB13, mB14, mB15,
                                        mB16, mB17, mB18, mB20, mB25, mB30, mB40, infinity,
                                        spare20, spare19, spare18, spare17, spare16,
                                        spare15, spare14, spare13, spare12, spare11,
                                        spare10, spare9, spare8, spare7, spare6, spare5,
                                        spare4, spare3, spare2, spare1}

T-Reassembly ::=                    ENUMERATED {
                                        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
                                        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
```


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```
                                    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, ms800, ms1000,
                                    ms1200, ms1600, ms2000, ms2400, spare2, spare1}

SN-FieldLength-UM ::=               ENUMERATED {size6, size12}
SN-FieldLength-AM ::=               ENUMERATED {size12, size18}

-- TAG-RLC-CONFIG-STOP
-- ASN1STOP
```

***RLC-Config*field descriptions**
maxRetxThreshold Parameter for RLC AM in TS 38.322 [4]. Value t1 corresponds to 1 retransmission, t2 to 2 retransmissions and so on.
pollByte Parameter for RLC AM in TS 38.322 [4]. 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 38.322 [4]. 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 RLC SN field size, see TS 38.322 [4], in bits. Value ssize6 means 6 bits, size12 means 12 bits, size18 means 18 bits.
t-PollRetransmit Timer for RLC AM inTS 38.322 [4], in milliseconds. Value ms5 means 5ms, ms10 means 10ms and so on.
t-Reassembly Timer for reassembly in TS 38.322 [4], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on. If is FFS whether ms1600 is supported in this version of the specification.
t-StatusProhibit Timer for status reporting in TS 38.322 [4], in milliseconds. Value ms0 means 0ms, ms5 means 5ms and so on.

– *RLF-TimersAndConstants*

Editor's Note: FFS / TODO: Insert the RLF timers and related functionality. Check what is needed for EN-DC.

The *RLF-TimersAndConstants* IE is used to configure UE specific timers and constants.

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***RLF-TimersAndConstants* information element**

```
-- ASN1START
-- TAG-RLF-TIMERS-AND-CONSTANTS-START

RLF-TimersAndConstants ::=                SEQUENCE {
    -- FFS / TODO: Add RRC parameters such as timers and constants.
}

-- TAG-RLF-TIMERS-AND-CONSTANTS-STOP
-- ASN1STOP
```

– *SCellIndex*

The IE *SCellIndex* concerns a short identity, used to identify an SCell.

***SCellIndex* information element**

```
-- ASN1START
-- TAG-SCELL-INDEX-START

-- FFS: Value range and usage across Cell Groups (shared value range or separate value range). RAN1 indicated 16 serving cells per CG.
SCellIndex ::=                      INTEGER (1..31)

-- TAG-SCELLINDEX-STOP
-- ASN1STOP
```

– *SchedulingRequest-Config*

The IE *SchedulingRequest-Config* is used to configure the parameters, for the dedicated scheduling request (SR) resources.

***SchedulingRequest-Config* information element**

```
-- ASN1START
-- TAG-SCHEDULING-REQUEST-CONFIG-START

SchedulingRequestConfig ::=         SEQUENCE {
    schedulingRequestToAddModList       SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestToAddMod      OPTIONAL, -- Need N
    schedulingRequestToReleaseList      SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestId            OPTIONAL  -- Need N
}

SchedulingRequestToAddMod ::=       SEQUENCE {
    schedulingRequestID                 SchedulingRequestId,
```


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```
    sr-prohibitTimer                    ENUMERATED {ms1, ms2, ms4, ms8, ms16, ms32, ms64, ms128},
    sr-TransMax                         ENUMERATED { n4, n8, n16, n32, n64, spare3, spare2, spare1}
}

-- FFS_TODO: provide resources for each SchedulingRequestID in ServingCellConfigDedicated (TBD whether directly, in PUCCH-Config, in each BWP)

-- TAG-SCHEDULING-REQUEST-CONFIG-STOP
-- ASN1STOP
```

***SchedulingRequest-Config*field descriptions**
schedRequestToAddModList List of Scheduling Request configurations to add or modify.
SchedulingRequestId Used to modify a SR configuration and to indicate, in LogicalChannelConfig, the SR configuration to which a logical channel is mapped.
sr-prohibitTimer Timer for SR transmission on PUCCH in TS 38.321 [3]. Value in ms. ms1 corresponds to 1ms, ms2 corresponds to 2ms, and so on.

– *SchedulingRequestResource-Config*

The IE SchedulingRequestResource-Config determines physical layer resources on PUCCH where the UE may send the dedicated scheduling request (D-SR) (see 38.213, section 9.2.2).

```
SchedulingRequestResource-Config ::=            SEQUENCE {
    -- SR periodicity. Corresponds to L1 parameter 'SR-periodicity' (see 38.213, section 9.2.2)
    periodicity                                 FFS_Value: Probably periodicity and offset should be encoded together OPTIONAL,
    -- SR offset. Corresponds to L1 parameter 'SR-offset' (see 38.213, section 9.2.2)
    offset                                      FFS_Value                                                              OPTIONAL,
    -- Format, length, ... of this SR reosurce. Corresponds to L1 parameter 'SR-resource' (see 38.213, section 9.2.2)
    resource            FFS_Value                                                                                      OPTIONAL
}
```

– *SDAP-Config*

The IE *SDAP-Config* is used to set the configurable SDAP parameters for a data radio bearer. All configured instances of SDAP-Config with the same value of pduSession correspond to the same SDAP entity as specified in TS 37.324 [FFS_Ref].

***SDAP-Config* information element**

```
-- ASN1START
-- TAG-SDAP-CONFIG-START

SDAP-Config ::=                     SEQUENCE {
```


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```
    -- FFS / TODO: Definition of PDUsessionID to be added
    pduSession                          PDUsessionID,

    -- FFS: separate configuration for UL and DL
    sdap-Header-DL                      ENUMERATED {present, absent},
    sdap-Header-UL                      ENUMERATED {present, absent}
    defaultDRB                          BOOLEAN,
    reflectiveQoS                       BOOLEAN,    -- It is FFS whether this field is needed

    -- FFS: Is the simple list sufficient? Replace by add/mod/release list? Or bitmap?
    mappedQoSflows                      SEQUENCE (SIZE (0..maxNrofQFIs)) OF QFI                         OPTIONAL, -- Need N
    ...
}


QFI :: =                            INTEGER (0..maxQFI)

-- TAG-SDAP-CONFIG-STOP
-- ASN1STOP
```

***SDAP-Config*field descriptions**
defaultDRB Indicates whether or not this is the default DRB for this PDU session. Among all configured instances of *SDAP-Config* with the same value of *pduSession*, this field shall be set to TRUE in one instance of SDAP-Config and to FALSE in all other instances.
mappedQosflows List of QFIs of QoS flows of the PDU session indicated by pduSession which are configured to be mapped to this DRB. A QFI value can be included at most once in all configured instances of *SDAP-Config* with the same value of *pduSession*.
pduSession Identity of the PDU session whose QoS flows are mapped to the DRB
reflectiveQoS Indicates whether or not reflective QoS is active for QoS flows transmitted via this DRB.
sdap-Header-UL Indicates whether or not a SDAP header is present for UL data on this DRB.
sdap-Header-DL Indicates whether or not a SDAP header is present for DL data on this DRB.

– *SecurityAlgorithmConfig*

The IE *SecurityAlgorithmConfig* is used to configure AS integrity protection algorithm (SRBs) and AS ciphering algorithm (SRBs and DRBs).

***SecurityAlgorithmConfig* information element**

```
-- ASN1START
```


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```
SecurityAlgorithmConfig ::=         SEQUENCE {
    cipheringAlgorithm                  CipheringAlgorithm,
    integrityProtAlgorithm              IntegrityProtAlgorithm

}

IntegrityProtAlgorithm ::=          ENUMERATED {
                                            nia0, nia1, nia2, nia3, spare4, spare3,
                                            spare2, spare1, ...}

CipheringAlgorithm ::=              ENUMERATED {
                                            nea0, nea1, nea2, nea3, spare4, spare3,
                                            spare2, spare1, ...}

-- ASN1STOP
```

***SecurityAlgorithmConfig* field descriptions**
cipheringAlgorithm Indicates the ciphering algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms nea0-nea3 are identical to the LTE algorithms eea0-3. For EN-DC, the algorithms configured for bearers using KeNB shall be the same as for all bearers using KeNB.
integrityProtAlgorithm For EN-DC, this IE indicates the integrity protection algorithm to be used for SRBs, as specified in TS 33.501 [11]. The algorithms nia0-nia3 is identical to the LTE algorithms eia0-3. For EN-DC, the algorithms configured for SRBs using KeNB shall be the same as for all SRBs using KeNB.

– *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
-- TAG-SERV-CELL-INDEX-START

ServCellIndex ::=                   INTEGER (0..16)

-- TAG-SERV-CELL-INDEX-STOP
-- ASN1STOP
```


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– *ServingCellConfigCommon*

The *ServingCellConfigCommon* IE is used to configure cell specific parameters of a UE's serving cell. The IE contains parameters which a UE would typically acquire from SSB, MIB or SIBs when accessing the cell from IDLE. With this IE, the network provides this information in dedicated signalling when configuring a UE with a SCells or with an additional cell group (SCG). It also provides it for SpCells (MCG and SCG) upon reconfiguration with sync.

ServingCellConfigCommon information element

```
-- ASN1START
-- TAG-SERVING-CELL-CONFIG-COMMON-START

ServingCellConfigCommon ::=     SEQUENCE {

    -- Parameters identifying the target cell (reconfiguration with sync, SCell addition, PSCell addition)
    -- FFS: Need to indicate initial BWP here?
    -- FFS: Update the following based on input from RAN1 and RAN4
    physCellId                          PhysCellId                                              OPTIONAL, -- Cond HOAndSCellAdd,
    frequencyInfoDL                     SEQUENCE {
        carrierFreqDL                       ARFCN-ValueNR
        carrierBandwidthDL                  CarrierBandwidthNR
    }                                                                                           OPTIONAL, -- Cond InterFreqHOAndSCellAdd
    frequencyInfoUL                     FrequencyInfoUL                                         OPTIONAL, -- Cond InterFreqHOAndUplinkSCellAdd

    -- FFS: How to indicate the FrequencyInfoUL for the SUL
    supplementaryUplink                 SEQUENCE {
        frequencyInfoUL                     FrequencyInfoUL,
        -- FFS: Add additional (selection) criteria determining when/whether the UE shall use the SUL frequency
    }                                                                                           OPTIONAL -- Cond SUL


    -- Subcarrier spacing for SIB1, Msg.2/4 for initial access and SI-messages.
    -- Values 15, and 30 kHz are applicable for carrier frequencies <6GHz; Values 60 and 120 kHz are applicable for carrier frequencies >6GHz
    subcarrierSpacingCommon             SubcarrierSpacing,

    -- The frequency domain offset between SSB and the overall resource block grid in number of subcarriers.
    -- Absence of the field indicates that no offset if applied (offset = 0). See 38.211, section 7.4.3.1)
    ssb-subcarrier-offset               INTEGER (1..11)                                         OPTIONAL,

    -- Indicates the time domain positions of the transmitted SS-blocks in an SS-burst.
    -- Corresponds to L1 parameter 'SSB-Transmitted' (see 38.213, section 4.1)
    -- FFS_CECHK: Is the NW required to provide always a valid bitmap? If not, we cannot use "need M"
    ssb-PositionsInBurst                CHOICE {
        -- bitmap for sub 3 GHz
        shortBitmap                         BIT STRING (SIZE (4)),
        -- bitmap for 3-6 GHz
        mediumBitmap                        BIT STRING (SIZE (8)),
        -- bitmap for above 6 GHz
        longBitmap                          BIT STRING (SIZE (64))
    }                                                                                               OPTIONAL, -- Need M,
```


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```
-- The SSB periodicity in msec for the rate matching purpose (see 38.211, section [7.4.3.1])
ssb-periodicityServingCell          ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160 }           OPTIONAL,

-- CHECK: This field is usually in MIB. Assuming that the UE does not need to acquire MIB before sending RA to target cell, this parameter
-- should also be here
-- Position of (first) DL DM-RS (see 38.211, section 7.4.1.1.1)
dmrs-TypeA-Position                 ENUMERATED {pos2, pos3},


-- Subcarrier spacing of SSB. Used only for non-initial access (e.g. SCells, PCell of SCG).
-- If the field is absent the UE shall assume the default value of the band.
-- FFS in RAN1: Possibility to have several default values? May the field be absent in that case?
subcarrierSpacingSSB                SubcarrierSpacingSSB                                        OPTIONAL, -- Need R

tdd-UL-DL-configurationCommon       SEQUENCE {
    -- Periodicity of the DL-UL pattern. Corresponds to L1 parameter 'DL-UL-transmission-periodicity' (see 38.211, section FFS_Section)
    dl-UL-TransmissionPeriodicity       ENUMERATED {ms0dot5, ms1, ms2, ms5, ms10}               OPTIONAL,

    -- Number of consecutive full DL slots at the beginning of each DL-UL pattern.
    -- Corresponds to L1 parameter 'number-of-DL-slots' (see 38.211, section FFS_Section)
    -- FFS_Value: Verify that 160 is correct (maximum number of slots within the longest period (10 ms) and the largest subcarrier spacing.
    nrofDownlinkSlots                   INTEGER (0..160)                                        OPTIONAL,

    -- Number of consecutive DL symbols in the beginning of the slot following the last full DL slot (as derived from nrofDownlinkSlots).
    -- Corresponds to L1 parameter 'number-of-DL-symbols-common' (see 38.211, section FFS_Section).
    nrofDownlinkSymbols                 INTEGER (0..maxSymbolIndex)                             OPTIONAL,

    -- Number of consecutive full UL slots at the end of each DL-UL pattern.
    -- Corresponds to L1 parameter 'number-of-UL-slots' (see 38.211, section FFS_Section)
    -- FFS_Value: Verify that 160 is correct (maximum number of slots within the longest period (10 ms) and the largest subcarrier spacing.
    nrofUplinkSlots                     INTEGER (0..160)                                        OPTIONAL,

    -- Number of consecutive UL symbols in the end of the slot preceding the first full UL slot (as derived from nrofUplinkSlots).
    -- Corresponds to L1 parameter 'number-of-UL-symbols-common' (see 38.211, section FFS_Section)
    nrofUplinkSymbols                   INTEGER (0..maxSymbolIndex)                             OPTIONAL,
}                                                                                               OPTIONAL, -- Cond TDD

-- TX power that the NW used for SSB transmission. The UE uses it to estimate the RA preamble TX power.
-- CHECK: Value range and step size (table says [-60...50]) (see 38.213, section 7.4)
ss-PBCH-BlockPower                  INTEGER (-60..50),

-- Parameters that are also conveyed via system information (SIB1) but which are provided here to accelerate handover
-- and to avoid that UEs need to read system information from SCells.
rach-ConfigCommon                   RACH-ConfigCommon,

-- ====================================
-- FFS which of the following are needed
--
--  BandwidthPart-Confi
--  ControlResourceSet
```


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```
    --  SearchSpace
    --  or include pdcchConfigSIB1 instead of BWP, CORESET and SearchSpace?
    --  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,

}

-- TAG-SERVING-CELL-CONFIG-COMMON-STOP
-- ASN1STOP
```

– *ServingCellConfigDedicated*

The *ServingCellConfigDedicated* IE is used to configure (add or modify) the UE with a serving cell, which may be the SpCell or an SCell of an MCG or SCG. The parameters herein are UE specific.

ServingCellConfigDedicated information element

```
-- ASN1START
-- TAG-SERVING-CELL-CONFIG-DEDICATED-START

ServingCellConfigDedicated ::=      SEQUENCE {
    -- L1 parameters:

    tdd-UL-DL-configurationDedicated    SEQUENCE {
        -- The slotSpecificConfiguration allows overriding UL/DL allocations provided in tdd-UL-DL-configurationCommon.
        -- FFS_ASN1: Consider making this an AddMod/Release list
        -- FFS_ASN1: Replace absolute numbers by variables... once RAN1 confirms.
        slotSpecificConfigurations          SEQUENCE (SIZE(0..160) OF {
            -- Identifies a slot within a dl-UL-TransmissionPeriodicity (given in tdd-UL-DL-configurationCommon)
            slotIndex                           INTEGER (0..160),

            -- FFS_ASN1: Consider a choice structure with options [allDownlink, allUplink, explicit] where the following two fields are provided
            -- only in case of "explicit".

            -- Number of consecutive DL symbols in the beginning of the slot identified by slotIndex
            -- Corresponds to L1 parameter 'number-of-DL-symbols-dedicated' (see 38.211, section FFS_Section)
            nrofDownlinkSymbols                 INTEGER (0..maxSymbolIndex)                                     OPTIONAL,

            -- Number of consecutive UL symbols in the end of the slot identified by slotIndex
            -- Corresponds to L1 parameter 'number-of-UL-symbols-dedicated' (see 38.211, section FFS_Section)
            nrofUplinkSymbols                   INTEGER (0..maxSymbolIndex)                                     OPTIONAL,
```


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```
        }                                                                                                   OPTIONAL, -- Need M
    }                                                                                                       OPTIONAL, -- Cond TDD

    bandwidthParts                      BandwidthParts                                                      OPTIONAL,

    -- Identifer used to initalite data scrambling (c_init) for both PDSCH and PUSCH.
    -- Corresponds to L1 parameter 'Data-scrambling-Identity' (see 38,214, section FFS_Section)
    dataScramblingIdentity              FFS_Value                                                           OPTIONAL,

    pdcch-Config                        PDCCH-Config                                                        OPTIONAL,
    pdsch-Config                        PDSCH-Config                                                        OPTIONAL,

    -- FFS in RAN1: Tracking Reference Signals configuration: TRS-Config?
    csi-MeasConfig                      CSI-MeasConfig                                                      OPTIONAL,

    pucch-Config                        PUCCH-Config                                                        OPTIONAL,
    pusch-Config                        PUSCH-Config                                                        OPTIONAL,
    srs-Config                          SRS-Config                                                          OPTIONAL,

    -- MAC parameters:
    -- FFS: Is it per BWP?


    -- FFS: Resources for scheduling request (per BWP)

    sps-Config                          SPS-Config                                                          OPTIONAL,

    -- Indicates whether this SCell is cross-carrier scheduled by another serving cell.
    -- FFS: How to indicate whether CIF is present in the DCIs of the PCell? Should the CrossCarrierSchedulingConfig be included
    -- and set to own so that the field "cif-Presence" can be set?
    crossCarrierSchedulingConfig        CrossCarrierSchedulingConfig                                        OPTIONAL,   -- Cond SCell

    -- Timing Advance Group ID, as specified in TS 38.321 [3],  which this cell belongs to.
    tag-Id                              TAG-Id,
    -- Enables the "UE beam lock function (UBF)", which disable changes to the UE beamforming configuration when in NR_RRC_CONNECTED.
    -- FFS: Parameter added preliminary based on RAN4 LS in R4-1711823. Decide where to place it (maybe ServingCellConfigCommon or
    -- in a BeamManagement IE??)
    ue-BeamLockFunction                 ENUMERATED {enabled}                                                OPTIONAL,

    -- Indicates whether UE shall apply as pathloss reference either the downlink of PCell or of SCell that corresponds with this uplink
    -- (see 38.213, section 7)
    pathlossReferenceLinking            ENUMERATED {pCell, sCell}                                           OPTIONAL -- Cond SCell
}

-- TAG-SERVING-CELL-CONFIG-DEDICATED-STOP
-- ASN1STOP
```


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– *SRB-Identity*

The IE SRB-Identity is used to identify a Signalling Radio Bearer (SRB) used by a UE.

```
-- ASN1START
-- TAG-SRB-IDENTITY-START

SRB-Identity ::=                    INTEGER (1..3)

-- TAG-SRB-IDENTITY-STOP
-- ASN1START
```

– *SPS-Config*

Editor's Note: FFS: Relation between (UL-)SPS and "ULtransmissionWithoutGrant". Is it one feature with different configurations as the L1 parameters suggest? How is it modelled in MAC? What about DL?

Editor's Note: FFS: RAN1 indicated in the L1 table: "Note: Multiple configurations is possible, how many needs to be determined". RAN2 agreed that SPS can be used on Pcell and SCell... But each UE can use it on at most one serving cell of a cell group at a time. Are the "multiple configuration" meant for one carrier? Does the UE then use several SPS-RNTIs?

The *SPS-Config* IE is used to configure semi-persistent transmission according to two possible schemes. The actual uplink grant may either be configured via RRC (type1) or provided via the PDCCH (addressed to SPS-RNTI) (type2).

SPS-Config information element

```
-- ASN1START
-- TAG-SPS-CONFIG-START

-- SPS may be configured on the PCell as well as on SCells. But it shall not be configured for more than
-- one serving cell of a cell group at once.
SPS-Config ::=                          SEQUENCE {
    -- FFS: Same SPS for UL and DL (like in LTE)? See also naming FFS above.
    -- sps-RNTI                         BIT STRING (SIZE (16))                 OPTIONAL,

    -- FSS / TODO: ADD DL SPS!

    -- UL SPS configuration
    -- FFS CHECK: Add possibility to release UL SPS
    uplink                              SEQUENCE {      periodicity                    TYPE_FFS!,
        powerControl                        TYPE_FFS!,

        -- Enable transformer precoder for type1 and type2. Absence indicates that it is disabled.
        -- Corresponds to L1 parameter 'UL-TWG-tp' (see 38.214, section FFS_Section)
        transformPrecoder                   ENUMERATED {enabled}                                                OPTIONAL,
```


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```
        -- The number of HARQ processes configured. It applies for both Type 1 and Type 2
        -- Corresponds to L1 parameter 'UL-TWG-numbHARQproc' (see 38.214, section FFS_Section)
        nrofHARQ-processes                      INTEGER(1..FFS_Value)                                                   OPTIONAL,

        -- If repetitions is used, this field indicates the redundancy version (RV) sequence to use.
        -- Corresponds to L1 parameter 'UL-TWG-RV-rep' (see 38.214, section FFS_Section)
        repK-RV                                 ENUMERATED {s1-0231, s2-0303, s3-0000}                                  OPTIONAL,
        -- Periodicity for UL transmission without UL grant for type 1 and type 2
        -- Corresponds to L1 parameter 'UL-TWG-periodicity' (see 38.321, section FFS_Section)
        -- The following periodicities are supported depending on the configured subcarrier spacing [ms]:
        --  15kHz: 2 symbols, 7 symbols, 1, 2, 5, 10, 20, 32, 40, 64, 80, 128, 160, 320, 640
        --  30kHz: 2 symbols, 7 symbols, 0.5, 1, 2, 5, 10, 20, 32, 40, 64, 80, 128, 160, 320, 640
        --  60kHz: 2 symbols, 7 symbols (6 symbols for ECP), 0.25,0.5,1,2,5,10,20,32, 40, 64, 80, 128, 160, 320, 640
        --  120kHz: 2 symbols, 7 symbols, 0.125,0.25,0.5,1,2,5,10,20, 32, 40, 64, 80, 128, 160, 320, 640   OPTIONAL,
        --  2 symbols, 7 symbols, 0.125,0.25,0.5,1,2,5,10,20, 32, 40, 64, 80, 128, 160, 320, 640
        priodicity                              ENUMERATED {sym2, sym7, ms0dot125, ms0dot25, ms0dot5, ms1, ms2, ms5, ms10, ms20,
                                                            ms32, ms40, ms64, ms80, ms128, ms160, ms320, ms640}         OPTIONAL,


        -- UL-SPS transmission with fully RRC-configured UL grant (Type1) (see 38.214, section x.x.x.x). FFS_Ref
        -- If not provided or set to release, use UL-SPS transmission with UL grant configured by DCI addressed to SPS-RNTI (Type2).
        rrcConfiguredUplinkGrant                CHOICE {
            setup                                   SEQUENCE {
                FFS: Merge the following two into one. Possibly don't use "periodicity" for rrcConfiguredUplinkGrant
                timeDomainOffset                        TYPE_FFS!,
                timeDomainAllocation                    TYPE_FFS!,
                frequencyDomainAllocation               TYPE_FFS!,
                -- UE-specific DMRS configuration:
                dmrs                                    TYPE_FFS!,
                mcsAndTBS                               TYPE_FFS!,
                --  The number or repetitions of K:
                repK                                    TYPE_FFS!           },
            release                         NULL
        }                                                                                       OPTIONAL,   -- Need M
    }                                                                                           OPTIONAL,   -- Need M
}

-- TAG-SPS-CONFIG-STOP
-- ASN1STOP
```

– *SRS-Config*

The *SRS-Config* IE is used to configure sounding reference signal transmissions. The configuration defines a list of SRS-Resources and a list of SRS-ResourceSets. Each resource set defines a set of SRS-Resources. The network triggers the transmission of the set of SRS-Resources using a configured aperiodicSRS-ResourceTrigger (L1 DCI).

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SRS-Config information element

```
-- ASN1START
-- TAG-SRS-CONFIG-START

-- SRS configuration allowing to add and remove sets of SRS resources
SRS-Config ::=                          SEQUENCE {
    srs-ResourceSetToReleaseList            SEQUENCE (SIZE(0..maxNrofSRS-ResourceSets) OF SRS-ResourceSetId          OPTIONAL,   -- Need M
    srs-ResourceSetToAddModList             SEQUENCE (SIZE(0..maxNrofSRS-ResourceSets) OF SRS-ResourceSet         OPTIONAL    -- Need M

    srs-ResourceToReleaseList               SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-ResourceId            OPTIONAL,   -- Need M
    srs-ResourceToAddModList                SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource           OPTIONAL    -- Need M


    -- RNTI used for SRS TPC. Corresponds to L1 parameter 'TPC-SRS-RNTI' (see 38.213, section 10)
    tpc-SRS-RNTI                            BIT STRING (SIZE (16))                                             OPTIONAL,
}

-- A set of SRS resources
SRS-ResourceSet ::=                     SEQUENCE {
    srs-ResourceSetId                       SRS-ResourceSetId,
    srs-ResourcesIds                        SEQUENCE (SIZE(1..maxNrofSRS-ResourcesPerSet)) OF SRS-ResourceId,

    -- The DCI "code point" upon which the UE shall transmit SRS according to this SRS resource set configuration.
    -- FFS: Verify definition and usage.
    -- Corresponds to L1 parameter 'AperiodicSRS-ResourceTrigger' (see 38.214, section FFS_Section)
    aperiodicSRS-ResourceTrigger            TYPE_FFS!
}

SRS-ResourceSetId ::=                   INTEGER (0..maxNrofSRS-ResourceSets-1)

SRS-Resource ::=                        SEQUENCE {
    srs-ResourceId                          SRS-ResourceId,
    nrofSRS-Ports                           ENUMERATED {1port, 2ports, 4ports},
    -- Comb value (2 or 4) and comb offset. Corresponds to L1 parameter 'SRS-TransmissionComb' (see 38.214, section 6.2.1)
    transmissionComb                        ENUMERATED {n2, n4},
    -- OFDM symbol location of the SRS resource within a slot including number of OFDM symbols (1, 2, or 4 per SRS resource)
    -- Corresponds to L1 parameter 'SRS-ResourceMapping' (see 38.214, section 6.2.1)
    resourceMapping                         TYPE_FFS!,
    -- Parameter(s) defining frequency domain position and configurable shift to align SRS allocation to 4 PRB grid.
    -- Corresponds to L1 parameter 'SRS-FreqDomainPosition' (see 38.214, section 6.2.1)
    freqDomainPosition                      FFS_Value                                                          OPTIONAL,
    -- Includes parameters capturing SRS frequency hopping
    -- Corresponds to L1 parameter 'SRS-FreqHopping' (see 38.214, section 6.2.1)
    freqHopping                             TYPE_FFS!,
    -- Parameter(s) for configuring group or sequence hopping including hopping sequence initialization
    -- Corresponds to L1 parameter 'SRS-GroupSequenceHopping' (see 38.211, section FFS_Section)
    groupOrSequenceHopping                  FFS_Value                                                          OPTIONAL,
    -- Time domain behavior of SRS resource configuration
    -- Corresponds to L1 parameter 'SRS-ResourceConfigType' (see 38.214, section 6.2.1)
    -- FFS: Add configuration parameters for the different SRS resource types?
```


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```
    resourceType                            CHOICE {
        aperiodic                               SEQUENCE {
        },
        semi-persistent                         SEQUENCE {
        },
        periodic                                SEQUENCE {
        }
    }                                                                                                   OPTIONAL, -- Need M
    -- Periodicity and slot offset for periodic/semi-persistent SRS
    -- Corresponds to L1 parameter 'SRS-SlotConfig' (see 38.214, section 6.2.1)
    -- FFS_Value: RAN1 discusses whether more values for other subcarrier spacings are needed.
    periodicityAndOffset                    CHOICE {
        sl2                                     INTEGER(0..1),
        sl5                                     INTEGER(0..4),
        sl10                                    INTEGER(0..9),
        sl20                                    INTEGER(0..19),
        sl40                                    INTEGER(0..39),
        sl80                                    INTEGER(0..79),
        sl160                                   INTEGER(0..159),
        sl320                                   INTEGER(0..319)
    },
    -- Sequence ID. Corresponds to L1 parameter 'SRS-SequenceId' (see 38.214, section 6.2.1)
    sequenceId                              TYPE_FFS!,
    -- SRS antenna switching. Corresponds to L1 parameter 'SRS-AntSwitching' (see 38.211, section 6.2.1)
    antennaSwitching                        TYPE_FFS!,
    -- Includes parameters for configuration of carrier based SRS  switching
    -- Corresponds to L1 parameter 'SRS-CarrierSwitching' (see 38,214, section FFS_Section)
    carrierSwitching                        FFS_Value                                                   OPTIONAL,
    -- Parameter(s) defining cyclic shift configuration. Corresponds to L1 parameter 'SRS-CyclicShiftConfig' (see 38.214, section 6.2.1)
    cyclicShift                             FFS_Value                                                   OPTIONAL,
    -- Configuration of the spatial relation between a reference RS and the target SRS. Reference RS can be SSB/CSI-RS/SRS
    -- Corresponds to L1 parameter 'SRS-SpatialRelationInfo' (see 38.214, section 6.2.1)
    spatialRelationInfo                     FFS_Value                                                   OPTIONAL
}

SRS-ResourceId ::=                      INTEGER (0..maxNrofSRS-Resources-1)

-- TAG-SRS-CONFIG-STOP
-- ASN1STOP
```

– *SubcarrierSpacing*

The *SubcarrierSpacing* IE determines the subcarrier spacing.

SubcarrierSpacing information element

```
-- ASN1START
-- TAG-SUBCARRIER-SPACING-START
```


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```
-- Check value range! Currently used for subcarrierSpacingCommon (SIB1, Msg2, Msg4
-- FFS: Replace this 2-bit field by a 1-bit field: ENUMERATED {sc1, sc2}. Then define that sc1 = 15 kHz and sc2 = 30 kHz
-- when carrier frequency < 6 GHz and sc1 = 60 kHz and sc2 = 120 kHz when carrier frequency is > 6GHz?
SubcarrierSpacing ::=                   ENUMERATED {kHz15, kHz30, kHz60, kHz120}

-- 15 or 30 kHz (<6GHz), 120 and 240 kHz (>6GHz).
SubcarrierSpacingSSB ::=                ENUMERATED {kHz15, kHz30, kHz120, kHz240)

SubcarrierSpacingRACH ::=               TYPE_FFS!

-- TAG-SUBCARRIER-SPACING-STOP
-- ASN1STOP
```

6.3.3 UE capability information elements

– *BandCombinationList*

The IE *BandCombinationList* contains a list of NR CA and/or MR-DC band combinations.

***BandCombinationList* information element**

```
-- ASN1START

BandCombinationList ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination

BandCombination ::= SEQUENCE {
    -- FFS How to decouple DL and UL
    -- FFS How to address NC CA in relation to carrier separation
    -- intraBandSimultaneousTxRx will be added with FFS (per UE or per band combination)    -- multipleTimingAdvance will be added with FFS (per UE
or per band combination)
    -- singleTx will be included per band combination
    -- scalingFactor will be included per band per band combination
}

-- ASN1STOP
```

– *RAT-Type*

The IE *RAT-Type* is used to indicate the radio access technology (RAT), including NR, of the requested/ transferred UE capabilities.

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RAT-Type information element

```
-- ASN1START

RAT-Type ::= ENUMERATED {nr, mrdc, spare1, ...}

-- FFS utra, geran-cs, geran-ps and cdma2000-1XRTT
-- ASN1STOP
```

– *UE-CapabilityRAT-ContainerList*

The IE *UE-CapabilityRAT-ContainerList* contains a 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-CapabilityContainers)) 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 NR: the encoding of UE capabilities is defined in *UE-NR-Capability*.
For MRDC: the encoding of UE capabilities is defined in *UE-MRDC-Capability*.
For E-UTRA: the octet string contains the *UE-EUTRA-Capability* as defined in TS 36.331 [xx].

– *UE-MRDC-Capability*

The IE *UE-MRDC-Capability* is used to convey the UE Radio Access Capability Parameters for MR-DC, see TS 38.306 [yy].

UE-MRDC-Capability information element

```
-- ASN1START

UE-MRDC-Capability ::=  SEQUENCE {
```


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```
    measParameters-MRDC         MeasParameters-MRDC,
    rf-Parameters-MRDC          RF-Parameters-MRDC,
    phyLayerParameters-MRDC     PhyLayerParameters-MRDC
    -- FFS on other parameters
}

RF-Parameters-MRDC ::= SEQUENCE {
    supportedBandCombination    BandCombinationList
    -- FFS on other parameters
}

PhyLayerParameters-MRDC ::= SEQUENCE {
    supportedBasebandProcessingCombination-MRDC     BasebandProcessingCombination-MRDC
    -- FFS if supportedBasebandProcessingCombination-MRDC is included here or BandCombinationList
    -- FFS on other parameters
}

BasebandProcessingCombination-MRDC ::= SEQUENCE (SIZE (1..maxBasebandProcComb)) OF LinkedBasebandProcessingCombination
}

LinkedBasebandProcessingCombination ::= SEQUENCE {
    BasebandProcessingCombinationIndex,
    BasebandProcessingCombinationLinkedIndex    SEQUENCE (SIZE (1..maxBasebandProcComb)) OF BasebandProcessingCombinationIndex
}

BasebandProcessingCombinationIndex ::= INTEGER (1..maxBasebandProcComb)

MeasParameters-MRDC ::= SEQUENCE {
    intraCarrierConcurrentMeas  ENUMERATED {supported}  OPTIONAL,
    independentGapConfig        ENUMERATED {supported}  OPTIONAL,
    sstd-MeasType1              ENUMERATED {supported}  OPTIONAL
}

--ASN1STOP
```

– *UE-NR-Capability*

The IE *UE-NR-Capability* is used to convey the NR UE Radio Access Capability Parameters, see TS 38.306 [yy].

UE-NR-Capability information element

```
-- ASN1START

UE-NR-Capability ::= SEQUENCE {
    pdcp-Parameters                 PDCP-Parameters,
    rlc-Parameters                  RLC-Parameters,                     -- FFS OPTIONAL
    mac-Parameters                  MAC-Parameters,                     -- FFS OPTIONAL
    phyLayerParameters              PhyLayerParameters,
```


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```
    rf-Parameters                   RF-Parameters,
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

PhyLayerParameters ::=  SEQUENCE {
    supportedBasebandProcessingCombination      SupportedBasebandProcessingCombination,
    -- FFS on other parameters
}

RF-Parameters ::= SEQUENCE {
    supportedBandListNR                 SupportedBandListNR,
    supportedBandCombination            BandCombinationList,
    intraBandAsyncFDD                   ENUMERATED {supported}  OPTIONAL
    -- FFS Whether intraBandAsyncFDD is included per UE or per band combination
}

SupportedBandListNR ::= SEQUENCE (SIZE (1..maxBands)) OF BandNR

SupportedBandCombination ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination

SupportedBasebandProcessingCombination ::= SEQUENCE (SIZE (1..maxBasebandProcComb)) OF BasebandProcessingCombination

BasebandProcessingCombination ::= SEQUENCE {
    basebandParametersPerBand       SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BasebandParametersPerBand
    -- FFS on other parameters
}

BasebandParametersPerBand ::= SEQUENCE {
    ca-BandwidthClassDL         CA-BandwidthClass,
    ca-BandwidthClassUL         CA-BandwidthClass,
    basebandParametersPerCC     SEQUENCE (SIZE (1..maxServCell)) OF BasebandParametersPerCC,
    supportedBWPerCC                BWPerCC,
    -- FFS on the need (e.g. if ca-BandwidthClass is sufficient to cover BWPerCC)
    -- FFS on other parameters
}

BasebandParametersPerCC ::= SEQUENCE {
    supportedMIMO-CapabilityDL      MIMO-Capability                     OPTIONAL,
    supportedMIMO-CapabilityUL      MIMO-Capability                     OPTIONAL,
    modulationOrder                 ModulationOrder,
    subCarrierSpacing               SubCarrierSpacing,
    -- FFS if modulationOrder and subCarrierSpacing are included per Band or per CC
    -- FFS on other parameters
}

BandNR ::=  SEQUENCE {
    bandNR                          FreqBandIndicatorNR,
    supportedMIMO-CapabilityDL      MIMO-Capability                     OPTIONAL,
    supportedMIMO-CapabilityUL      MIMO-Capability                     OPTIONAL,
    -- FFS on other parameters
}
```


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```
CA-BandwidthClass ::= ENUMERATED {a, b, c, d, e, f, ...}

MIMO-Capability ::= SEQUENCE {
    -- FFS on the parameters
}

ModulationOrder ::= SEQUENCE {
    -- FFS on the parameters
}

SubCarrierSpacing ::= SEQUENCE {
    -- FFS on the parameters
}

PDCP-Parameters ::= SEQUENCE {
    dataRateDRB-IP      ENUMERATED {64kbps, spare6, spare5, spare4, spare3, spare2, spare1, spare0}    OPTIONAL,
    supportedROHC-Profiles  SEQUENCE {
        profile0x0000       BOOLEAN,
        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},
    uplinkOnlyROHC-Profiles         ENUMERATED {supported}  OPTIONAL,
    continueROHC-Context            ENUMERATED {supported}  OPTIONAL,
    outOfOrderDelivery              ENUMERATED {supported}  OPTIONAL,
    shortSN                         ENUMERATED {supported}  OPTIONAL,
    volteOverNR-PDCP                ENUMERATED {supported}  OPTIONAL
}

RLC-Parameters ::= SEQUENCE {
    amWithShortSN                   ENUMERATED {supported}  OPTIONAL,
    umWithShortSN                   ENUMERATED {supported}  OPTIONAL,
    umWIthLongSN                    ENUMERATED {supported}  OPTIONAL
}

MAC-Parameters ::= SEQUENCE {
    lcp-Restriction                 ENUMERATED {supported}  OPTIONAL,
    skipUplinkTxDynamic             ENUMERATED {supported}  OPTIONAL,
    logicalChannelSR-DelayTimer     ENUMERATED {supported}  OPTIONAL,
    longDRX-Cycle                   ENUMERATED {supported}  OPTIONAL,
    shortDRX-Cycle                  ENUMERATED {supported}  OPTIONAL,
    numberOfSR-Configurations       ENUMERATED {n2, n3, n4,…}   OPTIONAL, -- FFS value range
```


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```
    numberOfConfiguredGrantConfigurations   ENUMERATED {n2, n3, n4,…}   OPTIONAL -- FFS value range
}

-- TAG-UE-NR-CAPABILITY-STOP
-- ASN1STOP
```

6.3.4 Other information elements

6.4 RRC multiplicity and type constraint values

– Multiplicity and type constraint definitions

```
-- ASN1START
-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-START

maxBandComb                             INTEGER ::= FFS     -- Maximum number of DL band combinations
maxBasebandProcComb                     INTEGER ::= FFS     -- Maximum number of base band processing combinations
maxNrofSCells                           INTEGER ::= 15      -- Max number of secondary serving cells per cell group
maxNrofCellMeas                         INTEGER ::= FFS     -- Maximum number of entries in each of the cell lists in a measurement object
maxNroSS-BlocksToAverage                INTEGER ::= FFS     -- Max number for the (max) number of SS blocks to average to determine cell measurement
maxNroCSI-RS-ResourcesToAverage         INTEGER ::= FFS     -- Max number for the (max) number of CSI-RS to average to determine cell measurement

maxNrofSR-CongigPerCellGroup            INTEGER ::= 8       -- Maximum number of SR configurations per cell group

maxLCG-ID                               INTEGER ::= 7       -- Maximum value of LCG ID
macLC-ID                                INTEGER ::= FFS     -- Maximum value of Logical Channel ID
maxNrofTAGs                             INTEGER ::= 4       -- Maximum number of Timing Advance Groups
maxNrofTAGs-1                           INTEGER ::= 3       -- Maximum number of Timing Advance Groups minus 1

maxNrofBandwidthParts                   INTEGER ::= 4       -- Maximum number of BWPs per serving cell
maxNrofBandwidthParts-1                 INTEGER ::= 3       -- Maximum number of BWPs per serving cell minus 1

maxSymbolIndex                          INTEGER ::= 13      -- Maximum index identifying a symbol within a slot (14 symbols, indexed from 0..13)

maxNrofPhysicalResourceBlocks           INTEGER ::= 275     -- Maximum number of PRBs
maxNrofPhysicalResourceBlocks-1         INTEGER ::= 274     -- Maximum number of PRBs
maxNrofPhysicalResourceBlocksTimes4     INTEGER ::= FFS:1100    -- Maximum number of PRBs (used to reference PRBs in another subcarrier spacing)

maxNrofControlResourceSets              INTEGER ::= FFS     -- Max number of CoReSets configurable on a serving cell
maxNrofControlResourceSets-1            INTEGER ::= FFS     -- Max number of CoReSets configurable on a serving cell minus 1
maxCoReSetStartSymbol                   INTEGER ::= FFS     -- Highest possible start symbol for a control resource set
maxCoReSetDuration                      INTEGER ::= 3       -- Max number of OFDM symbols in a control resource set
maxNrofSearchSpacesPerCoReSet           INTEGER ::= FFS     -- Max number of search spaces configurable per Control Resource Set

maxNrofRateMatchPatterns                INTEGER ::= FFS     -- Max number of rate matching patterns that may be configured
```


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```
maxNrofRateMatchPatterns-1              INTEGER ::= FFS     -- Max number of rate matching patterns that may be configured minus 1
maxNrofCSI-Reports                      INTEGER ::= FFS     -- Maximum number of report configurations
maxNrofCSI-Reports-1                    INTEGER ::= FFS     -- Maximum number of report configurations minus 1
maxNrofCSI-ResourceConfigurations       INTEGER ::= FFS     -- Maximum number of resource configurations
maxNrofCSI-ResourceConfigurations-1     INTEGER ::= FFS     -- Maximum number of resource configurations minus 1
maxNrofCSI-ResourceSets                 INTEGER ::= FFS     -- Maximum number of resource sets per resource configuration
maxNrofCSI-ResourceSets-1               INTEGER ::= FFS     -- Maximum number of resource sets per resource configuration minus 1
maxNrofNZP-CSI-RS-Resources             INTEGER ::= FFS     -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources
maxNrofNZP-CSI-RS-Resources-1           INTEGER ::= FFS     -- Maximum number of Non-Zero-Power (NZP) CSI-RS resources minus 1
maxNrofZP-CSI-RS-Resources              INTEGER ::= FFS     -- Maximum number of Zero-Power (NZP) CSI-RS resources
maxNrofZP-CSI-RS-Resources-1            INTEGER ::= FFS     -- Maximum number of Zero-Power (NZP) CSI-RS resources minus 1
maxNrofCSI-IM-Resources                 INTEGER ::= FFS     -- Maximum number of CSI-IM resources. See CSI-IM-ResourceMax in 38.214.
maxNrofCSI-IM-Resources-1               INTEGER ::= FFS     -- Maximum number of CSI-IM resources minus 1. See CSI-IM-ResourceMax in 38.214.
maxNrofSSB-Resources                    INTEGER ::= 64      -- Maximum number of SSB resources in a resource set
maxNrofSSB-Resources-1                  INTEGER ::= 63      -- Maximum number of SSB resources in a resource set minus 1
maxNrofCSI-RS-ResourcesPerSet           INTEGER ::= 8       -- Maximum number of CSI-RS resources per resource set
maxNrofCSI-MeasId                       INTEGER ::= FFS     -- Maximum number of link configurations
maxNrofCSI-MeasId-1                     INTEGER ::= FFS     -- Maximum number of link configurations minus 1
maxNrofCSI-RS-ResourcesRRM              INTEGER ::= FFS     -- Maximum number of CSI-RS resources for an RRM measurement object
maxNrofCSI-RS-ResourcesRRM-1            INTEGER ::= FFS     -- Maximum number of CSI-RS resources for an RRM measurement object minus 1

maxNrofObjectId                         INTEGER ::= FFS     -- Maximum number of configured measurement objects
maxNrOfRA-PreamblesPerSSB               INTEGER ::= FFS     -- Maximum number of Random Access Preamble value per SSB
maxNrofReportConfigId                   INTEGER ::= FFS     -- Maximum number of reporting configurations
maxNrofMeasId                           INTEGER ::= FFS     -- Maximum number of configured measurements
maxNroQuantityConfig                    INTEGER ::= 2       -- Maximum number of quantity configurations

maxNrofSRS-ResourceSets                 INTEGER ::= FFS     -- Maximum number of SRS resource sets.
maxNrofSRS-ResourceSets-1               INTEGER ::= FFS     -- Maximum number of SRS resource sets minus 1.
maxNrofSRS-Resources                    INTEGER ::= FFS     -- Maximum number of SRS resources in an SRS resource set.
maxNrofSRS-Resources-1                  INTEGER ::= FFS     -- Maximum number of SRS resources in an SRS resource set minus 1.
maxRA-PreambleIndex                     INTEGER ::= FFS     -- Maximum value of Random Access Preamble Index
maxRAT-CapabilityContainers             INTEGER ::= FFS     -- Maximum number of interworking RAT containers (incl NR and MRDC)
maxServCell                             INTEGER ::= FFS     -- Maximum number of serving cells
maxSimultaneousBands                    INTEGER ::= FFS     -- Maximum number of simultaneously aggregated bands


-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-STOP
-- ASN1STOP
```


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7 Variables and constants

7.1 Timers

7.1.1 Timers (Informative)

Timer	Start	Stop	At expiry
T304	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/NR about the SCG change failure by initiating the SCG failure information procedure as specified in 5.7.3.
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 NR cell or a cell using another RAT.	Enter RRC_IDLE
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/NR about the SCG radio link failure by initiating the SCG failure information procedure as specified in 5.7.3.

7.1.2 Timer handling

When the UE applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

7.2 Counters

Counter	Reset	Incremented	When reaching max value

7.3 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

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7.4 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.

– *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.

VarMeasConfig UE variable

```
-- ASN1START
-- TAG-VAR-MEAS-CONFIG-START

VarMeasConfig ::=                   SEQUENCE {
    -- Measurement identities
    measIdList                          MeasIdToAddModList                  OPTIONAL,
    -- Measurement objects
    measObjectList                      MeasObjectToAddModList              OPTIONAL,
    -- Reporting configurations
    reportConfigList                    ReportConfigToAddModList            OPTIONAL,
    -- Other parameters
    quantityConfig                      QuantityConfig                      OPTIONAL,

    s-MeasureConfig                         CHOICE {
        ssb-rsrp                                RSRP-Range,
        csi-rsrp                                RSRP-Range
    }                                                                       OPTIONAL,

}

-- TAG-VAR-MEAS-CONFIG-STOP
-- ASN1STOP
```

Editor's Note: FFS Revisit whether we really need *VarMeasConfig*.

– *VarMeasReportList*

The UE variable *VarMeasReportList* includes information about the measurements for which the triggering conditions have been met.

VarMeasReportList UE variable

```
-- ASN1START
-- TAG-VAR-MEAS-REPORT-START
```


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```
VarMeasReportList ::=               SEQUENCE (SIZE (1..maxNrofMeasId)) OF VarMeasReport

VarMeasReport ::=                   SEQUENCE {
    -- List of measurement that have been triggered
    measId                              MeasId,
    cellsTriggeredList                  CellsTriggeredList              OPTIONAL,
    numberOfReportsSent                 INTEGER
}

CellsTriggeredList ::=              SEQUENCE (SIZE (1.. maxNrofCellMeas)) OF CHOICE {
    physCellIdEUTRA                     PhysCellIdEUTRA,
    phyCellNR                           PhyCellNR
    }
}

-- TAG-VAR-MEAS-REPORT-STOP
-- ASN1STOP
```


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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 [6] and X.681 [7]. 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 [8].

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 or CCCH) 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.

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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.

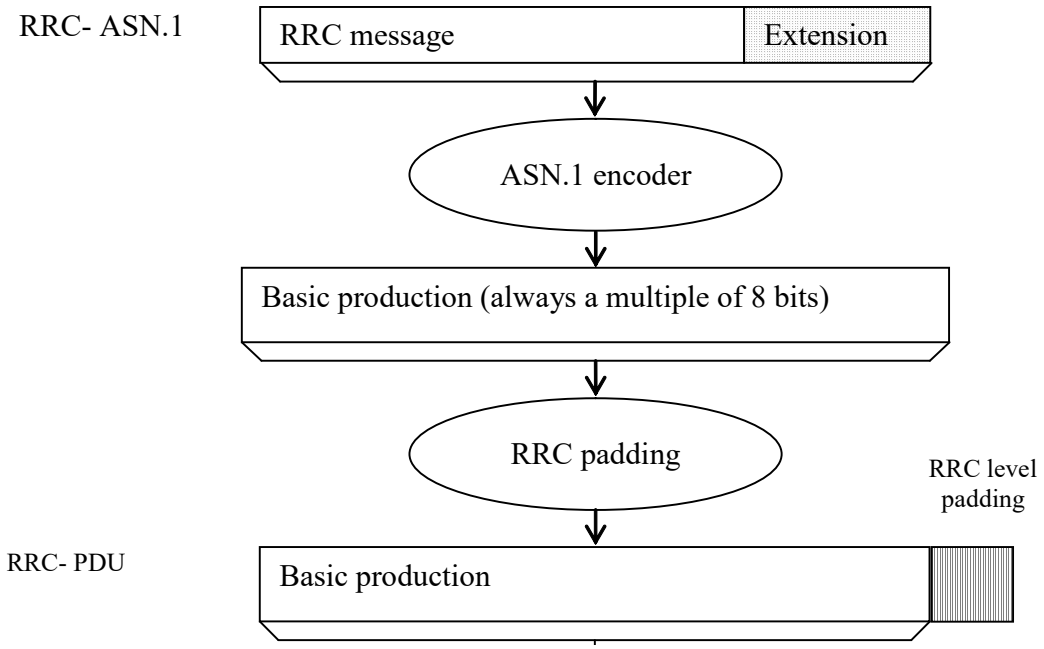

Figure 8.5-1: RRC level padding

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.

Editor's Note: FFS / FIXME: Default configurations

9.1 Specified configurations

FFS

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9.2 Default radio configurations

9.2.1 SRB configurations

9.2.1.1 SRB1/SRB1S

Parameters (FFS)

Name	Value	Semantics description	Ver
RLC configuration CHOICE	am		
ul-RLC-Config			
>*t-PollRetransmit*	ms45		
>*pollPDU*	infinity		
>*pollByte*	infinity		
>*maxRetxThreshold*	t4		
dl-RLC-Config			
>*t-Reordering*	ms35		
>*t-StatusProhibit*	ms0		
>*enableStatusReportSN-Gap*	N/A		
Logical channel configuration			
priority	1	Highest priority	
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		
logicalChannelSR-Prohibit	N/A		

9.2.1.2 SRB2/SRB2S

Parameters (FFS)

Name	Value	Semantics description	Ver
RLC configuration CHOICE	am		
ul-RLC-Config			
>*t-PollRetransmit*	ms45		
>*pollPDU*	infinity		
>*pollByte*	infinity		
>*maxRetxThreshold*	t4		
dl-RLC-Config			

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Name	Value	Semantics description	Ver
>*t-Reordering* >*t-StatusProhibit*	ms35 ms0		
Logical channel configuration			
priority	3		
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		

9.2.1.3 SRB3

Parameters (FFS)

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* >*enableStatusReportSN-Gap*	 ms35 ms0 N/A		
Logical channel configuration			
priority	1	Highest priority	
prioritisedBitRate	infinity		
bucketSizeDuration	N/A		
logicalChannelGroup	0		
logicalChannelSR-Prohibit	N/A		

9.2.2 SRB configurations

9.2.2.1 SRB1/SRB1S

Parameters

Name	Value	Semantics description	Ver

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Name	Value	Semantics description	Ver
RLC configuration			
logicalChannelIdentity	1		

9.2.2.2 SRB2/SRB2S

Parameters

Name	Value	Semantics description	Ver
RLC configuration			
logicalChannelIdentity	2		

9.2.2.3 SRB3

Parameters

Name	Value	Semantics description	Ver
RLC configuration			
logicalChannelIdentity	3		

10 Generic error handling

10.1 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.

10.2 ASN.1 violation or encoding error

The UE shall:

1> when receiving an RRC message on the [FFS] for which the abstract syntax is invalid [6]:

2> ignore the message;

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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.

10.3 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 10.4;

10.4 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 NR operation e.g. NR not observing conditional presence.

The following ASN.1 further clarifies the levels applicable in case of nested error handling for errors in extension fields.

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```
-- /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 N
    ...
    [[  field3-r9                       Field3-r9               OPTIONAL,           -- Cond Cond1
        field4-r9                       Field4-r9               OPTIONAL            -- Need N
    ]]
}

-- Example with traditional non-critical extension (empty sequence)

BroadcastInfoBlock1 ::=             SEQUENCE {
    itemIdentity                        INTEGER (1..max),
    field1                              Field1,
    field2                              Field2                  OPTIONAL,           -- Need N
    nonCriticalExtension                BroadcastInfoBlock1-v940-IEs    OPTIONAL
}

BroadcastInfoBlock1-v940-IEs::= SEQUENCE {
    field3-r9                           Field3-r9               OPTIONAL,           -- Cond Cond1
    field4-r9                           Field4-r9               OPTIONAL,           -- Need N
    nonCriticalExtension                SEQUENCE {}             OPTIONAL            -- Need S
}

-- 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*).

10.5 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 10.3.

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11 Radio information related interactions between network nodes

11.1 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 NR radio interface, i.e. the same transfer syntax and protocol extension mechanisms apply.

11.2 Inter-node RRC messages

11.2.1 General

This section specifies RRC messages that are sent either across the Xn- or the NG-interface, either to or from the gNB, 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.

```
-- ASN1START

NR-InterNodeDefinitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    RRCReconfiguration,
    UE-CapabilityRAT-ContainerList
FROM NR-RRC-Definitions;

-- ASN1STOP
```

11.2.2 Message definitions

– *HandoverCommand*

This message is used to transfer the handover command as generated by the target gNB.

Direction: target gNB to source gNB/ source RAN

HandoverCommand message

```
-- ASN1START
```


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```
-- TAG-HANDOVER-COMMAND-START

HandoverCommand ::=                 SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            handoverCommand-r15                 HandoverCommand-r15-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

HandoverCommand-r15-IEs ::=             SEQUENCE {
    handoverCommandMessage              OCTET STRING (CONTAINING RRCReconfiguration),
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL
}

-- TAG-HANDOVER-COMMAND-STOP
-- ASN1STOP
```

HandoverCommand field descriptions
handoverCommandMessage Contains the *RRCConnectionReconfiguration* message used to perform handover within NR or handover to NR, as generated (entirely) by the target gNB.

– *HandoverPreparationInformation*

This message is used to transfer the NR RRC information used by the target gNB during handover preparation, including UE capability information.

Direction: source gNB/ source RAN to target gNB

***HandoverPreparationInformation* message**

```
-- ASN1START
-- TAG-HANDOVER-PREPARATION-INFORMATION-START

HandoverPreparationInformation ::=  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            handoverPreparationInformation-r15      HandoverPreparationInformation-r15-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

HandoverPreparationInformation-r15-IEs ::= SEQUENCE {
    ue-CapabilityRAT-List               UE-CapabilityRAT-ContainerList,
    sourceConfig                        OCTET STRING (CONTAINING RRCReconfiguration)
    rrm-Config                          RRM-Config              OPTIONAL,
```


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```
    as-Context                          AS-Context              OPTIONAL,
    nonCriticalExtension                SEQUENCE {}             OPTIONAL
}

AS-Context ::=                          SEQUENCE {
    reestablishmentInfo                     EQUENCE {
        sourcePhysCellId                    PhysCellId,
        targetCellShortMAC-I                ShortMAC-I,
        additionalReestabInfoList           AdditionalReestabInfoList           OPTIONAL,
    }                                                                           OPTIONAL,
    -- FFS Whether to change e.g. move all re-establishment info to Xx
    configRestrictInfo                  ConfigRestrictInfoSCG                   OPTIONAL,
    ...
}

ReestabNCellInfoList ::=        SEQUENCE ( SIZE (1..maxCellPrep) ) OF ReestabNCellInfo

ReestabNCellInfo::= SEQUENCE{
    cellIdentity                        CellIdentity,
    key-gNodeB-Star                 BIT STRING (SIZE (256)),
    shortMAC-I                          ShortMAC-I
}

RRM-Config ::=              SEQUENCE {
    ue-InactiveTime             INTEGER,
    candidateCellInfoList       CandidateCellInfoList       OPTIONAL
    ...,
}

-- TAG-HANDOVER-PREPARATION-INFORMATION-STOP
-- ASN1STOP
```

HandoverPreparationInformation field descriptions
as-Config The radio resource configuration as used in the source cell.
as-Context Local RAN context required by the target gNB.
rrm-Config Local RAN context used mainly for RRM purposes.
ue-RadioAccessCapabilityInfo The UE radio access related capabilities concerning RATs supported by the UE. FFS whether certain capabilities are mandatory to provide by source e.g. of target and/ or source RAT.

– *SCG-Config*

This message is used to transfer the SCG radio configuration as generated by the SgNB.

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Direction: Secondary gNB to master gNB or eNB

SCG-Config message

```
-- ASN1START
-- TAG-SCG-CONFIG-START

SCG-Config ::=                      SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            scg-Config-r15                  SCG-Config-r15-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SCG-Config-r15-IEs ::=              SEQUENCE {
    scg-CellGroupdConfig                OCTET STRING (CONTAINING RRCReconfiguration)        OPTIONAL,
    p-maxFR1                            P-Max                                               OPTIONAL,
    scg-RB-Config                       OCTET STRING (CONTAINING RadioBearerConfiguration)  OPTIONAL,
    configRestrictModReq                ConfigRestrictModReqSCG                             OPTIONAL,
    candidateCellInfoList               CandidateCellInfoList                               OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                                         OPTIONAL
}

ConfigRestrictModReqSCG ::=         SEQUENCE {
    requestedBC-List-NR                 SEQUENCE OF INTEGER                 OPTIONAL,
    requestedBPC-List-NR                SEQUENCE OF INTEGER                 OPTIONAL,
    -- FFS Signalling details of BC and BPC restrictions requested by SgNB to be alleviated
    ...
}

-- TAG-SCG-CONFIG-STOP
-- ASN1STOP
```

SCG-Config field descriptions
p-maxFR1 Indicates the maximum power for FR1 (see TS 38.104 [12]) the UE can use in NR SCG.
scg-CellGroupConfig Contains the RRCReconfiguration message, used to (re-)configure the SCG configuration upon SCG establishment or modification, as generated (entirely) by the target SgNB
scg-RB-Config Contains the IE RadioBearerConfig, used to establish or reconfigure the SCG configuration, used to (re-)configure the SCG RB configuration upon SCG establishment or modification, as generated (entirely) by the target SgNB
configRestrictModReq Used by SN to re-negotiate SCG configuration restrictions previously set by MN to ensure UE capabilities are respected. E.g. used to request configure an NR band combination which use MN has previously forbidden.

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– *SCG-ConfigInfo*

This message is used by master eNB or gNB to request the SgNB to perform certain actions e.g. to establish, modify or release an SCG. The message may include additional information e.g. to assist the SgNB to set the SCG configuration.

Direction: Master eNB or gNB to secondary gNB

SCG-ConfigInfo message

```
-- ASN1START
-- TAG-SCG-CONFIG-INFO-START

SCG-ConfigInfo ::=                  SEQUENCE {
    criticalExtensions                  CHOICE {
        c1                                  CHOICE{
            scg-ConfigInfo-r15                  SCG-ConfigInfo-r15-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

SCG-ConfigInfo-r15-IEs ::=          SEQUENCE {
    eutra-CapabilityInfo            OCTET STRING (CONTAINING UECapabilityInformation)   OPTIONAL,
    candidateCellInfoList           CandidateCellInfoList                               OPTIONAL,
    measResultSSTD                  MeasResultSSTD                                      OPTIONAL,
    configRestrictInfo              ConfigRestrictInfoSCG                               OPTIONAL,
    drx-InfoMCG                     DRX-Info                                            OPTIONAL,
    sourceConfigSCG             OCTET STRING (CONTAINING RRCReconfiguration)        OPTIONAL,
    p-maxFR1                        P-Max                                               OPTIONAL,
    mcg-RB-Config                   OCTET STRING (CONTAINING RadioBearerConfiguration)  OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                         OPTIONAL
}

ConfigRestrictInfoSCG ::=           SEQUENCE {
    restrictedBandCombinationNR             INTEGER                         OPTIONAL,
    restrictedBasebandCombinationNR-NR      SEQUENCE OF INTEGER             OPTIONAL,
    -- FFS Signalling details of BC and BPC restrictions to be observed by SgNB
    -- FFS Signalling details regarding power coordination
    maxMeasFreqsSCG-NR                  INTEGER                         OPTIONAL,
    ...
}

DRX-Info ::=                    SEQUENCE {
    cycle                           INTEGER,
    offset                          INTEGER
}

-- TAG-SCG-CONFIG-INFO-STOP
-- ASN1STOP
```


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SCG-ConfigInfo field descriptions
candidateCellInfoList Contains information regarding cells that the source suggests the target gNB to consider configuring.
mcg-RB-Config Contains the IE RadioBearerConfig of the MN, used to support delta configuration for bearer type change between MN terminated to SN terminated bearer and SN change.
p-maxFR1 Indicates the maximum power for FR1 (see TS 38.104 [12]) the UE can use in NR SCG.
sourceConfigSCGIncludes the current dedicated SCG configuration in the same format as SCG-Config, i.e. not only CellGroupConfig but also e.g. rb-Config, measConfig.
ConfigRestrictInfo Includes fields for which SgNB is explictly indicated to observe a configuration restriction.
restrictedBandCombinationNR Indicates restrictions regarding the NR BCs the SN can configure by signalling the LTE BC selected by MN. The SN may configure any EN-BC including the indicated LTE BC selected by MN.
restrictedBasebandCombinationNR Indicates restrictions regarding the NR BPCs the SN can/ cannot configure i.e. by signalling the list of NR BPC the SN may configure.

11.3 Inter-node RRC information element definitions

– *CandidateCellInfoList*

The *CandidateCellInfoList* IE contains information regarding cells that the source suggests the target gNB to consider configuring.

***CandidateCellInfoList* information element**

```
-- ASN1START
-- TAG-CANDIDATE-CELL-INFO-LIST-START

CandidateCellInfoList ::=   SEQUENCE (SIZE (1..maxCellSCG)) OF CandidateCellInfo

CandidateCellInfo ::=               SEQUENCE {
    -- FFS whether to introduce something additional for transfer of SN configured measurements
    cellIdentification              SEQUENCE {
        physCellId                      PhysCellId,
        dl-CarrierFreq                  ARFCN-ValueNR
    },
    measResultCell                  SEQUENCE {
        rsrpResultCell                      RSRP-Range,
        rsrqResultCell                      RSRQ-Range
    -- FFS whether to support SINR
    }                                                           OPTIONAL,
    candidateRS-IndexList               CandidateRS-IndexInfoList   OPTIONAL,
    ...
}
```


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```
CandidateBeamInfoList ::=   SEQUENCE (SIZE (1..maxRS-IndexReport)) OF CandidateRS-IndexInfo

CandidateRS-IndexInfo ::=               SEQUENCE {
    -- FFS whether to support CSI RS based beam results also
    ssb-Index                           SSB-Index,
    measResultSSB                       SEQUENCE {
        rsrpResultCell                      RSRP-Range,
        rsrqResultCell                      RSRQ-Range
    -- FFS whether to support SINR
    }                                                           OPTIONAL,
    ...
}

-- TAG-CANDIDATE-CELL-INFO-LIST-STOP
-- ASN1STOP
```

11.4 Inter-node RRC multiplicity and type constraint values

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12 Processing delay requirements for RRC procedures

The UE performance requirements for RRC procedures are specified in the following tables. The performance requirement is expressed as the time in [ms] from the end of reception of the network -> UE message on the UE physical layer up to when the UE shall be ready for the reception of uplink grant for the UE -> network 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).

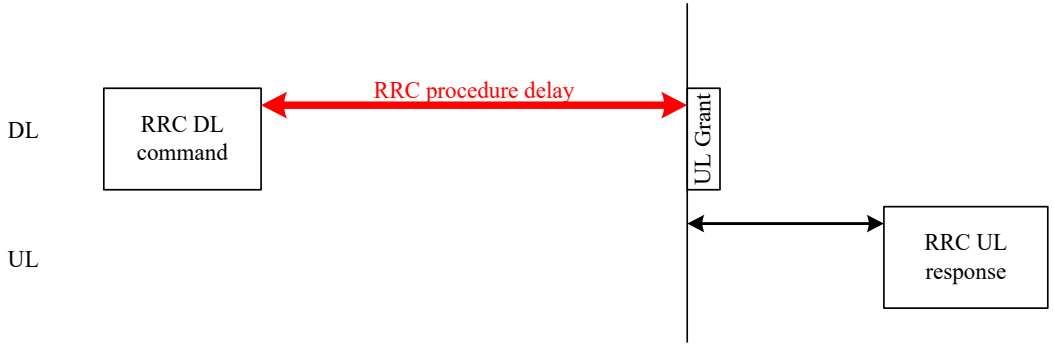

Figure 11.2-1: Illustration of RRC procedure delay

Table 11.2-1: UE performance requirements for RRC procedures for UEs

Procedure title:	Network -> UE	UE -> Network	Value [ms]	Notes
RRC Connection Control Procedures				
RRC reconfiguration	*RRCReconfiguration*	*RRCReconfigurationComplete*	X	

Annex A (informative): Guidelines, mainly on use of ASN.1

A.1 Introduction

The following clauses contain guidelines for the specification of RRC protocol data units (PDUs) with ASN.1.

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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].

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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 the following:

- a first 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).

- a second text paragraph consisting entirely of a *block start tag* is included, which consists of a double hyphen followed by a single space and the text string "TAG_NAME_START" (in all upper case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters).

Similarly, each ASN.1 section ends with the following:

- a first text paragraph consisting entirely of a *block stop tag*, which consists of a double hyphen followed by a single space and the text string "TAG_NAME_STOP" (in all upper-case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters).

- a second text paragraph consisting entirely of an *ASN.1 stop tag*, which consists of a double hyphen followed by a singlespace and the text "ASN1STOP" (in all upper case letters):

This results in the following tags:

```
-- ASN1START
-- TAG_NAME_START

-- TAG_NAME_STOP
-- ASN1STOP
```

The text paragraphs containing either of thestart 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. Abbreviations should be avoided in these identifiers and 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*.

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- 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 should convey the meaning of the identifier and should avoid adding unnecessary postfixes (e.g. abstractions like 'Info') for the name.

- 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.

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Table A.3.1.2-1: Examples of typical abbreviations used in ASN.1 identifiers

Abbreviation	Abbreviated word
Config	Configuration
DL	Downlink
Ext	Extension
Freq	Frequency
Id	Identity
Ind	Indication
Meas	Measurement
MIB	MasterInformationBlock
Neigh	Neighbour(ing)
Param(s)	Parameter(s)
Phys	Physical
PCI	Physical Cell Id
Proc	Process
Reconfig	Reconfiguration
Reest	Re-establishment
Req	Request
Rx	Reception
Sched	Scheduling
SIB	SystemInformationBlock
Sync	Synchronisation
Thr	Threshold
Tx	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 identifier of the referenced type. 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 should be made using the corresponding ASN.1 field identifier followed by the word "message", e.g., a reference to the *rrcRelease* 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 {
```


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```
    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 {}
}
```


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```
-- 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.

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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 fields here.
    ...
}

-- 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 may be 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.

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%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 N
}

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.

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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 N
```


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```
}

-- 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 code. The need code includes the keyword "Need", followed by one of the predefined semantics tags (S, M, N or R) defined in sub-clause 6.1. If the semantics tag S 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.

The addition of OPTIONAL keywords for capability groups is based on the following guideline. If there is more than one field in the lower level IE, then OPTIONAL keyword is added at the group level. If there is only one field in the lower level IE, OPTIONAL keyword is not added at the group level.

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.

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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.3.8 Guidelines on use of parameterised SetupRelease type

The usage of the parameterised *SetupRelease* type is like a function call in programming languages where the element type parameter is passed as a parameter. The parameterised type only implies a textual change in abstract syntax where all references to the parameterised type are replaced by the compiler with the release/setup choice. Two examples of the usage are shown below;

```
-- /example/ ASN1START

RRCMessage-r15-IEs ::= SEQUENCE {
    field-r15              SetupRelease { IE-r15 }               OPTIONAL,   --  Need M
    ...
```


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```
}


RRCMessage-r15-IEs ::= SEQUENCE {
    field-r15       SetupRelease { SEQUENCE {
            field1-r15                  IE1-r15,
            field2-r15                  IE2-r15                         OPTIONAL    -- Need N
        }
    }                                                                   OPTIONAL,   -- Need M
}
-- /example/ 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.

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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{
```


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```
                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 N
    field2-rN                           InformationElement2-rN              OPTIONAL,   -- Need N
    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 N, if field2-rN is absent. Otherwise the field is not present

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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 but empty sequences may be used if 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

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  - 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, BR-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 may be used until the number of values reaches the next power of 2, while the extension marker caters for extension beyond that limit, given that the use of spare values in a later Release is possible without any error cases
  - 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" code 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" code when the field is not actually used either.

Further, more general, guidelines:

- In case a need code is not provided for a group, a "Need" code 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 {
```


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```
    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 R
    ]],
    [[  field3-v9a0                         InformationElement3-v9a0    OPTIONAL,       -- Need R
        field4-r9                           InformationElement4         OPTIONAL        -- Need R
    ]]
}

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 R
    field4-r9                           InformationElement4             OPTIONAL,   -- Need R
    field5-r10                          BOOLEAN,
    field6-r10                          InformationElement6-r10         OPTIONAL,   -- Need R
    ...,
    [[  field3-v1170                        InformationElement3-v1170       OPTIONAL    -- Need R
    ]]
}

-- 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*.

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– 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 N
    nonCriticalExtension            RRCMessage-v860-IEs                 OPTIONAL
}

RRCMessage-v860-IEs ::=         SEQUENCE {
    field4-v860                     InformationElement4                 OPTIONAL,   -- Need S
    field5-v860                     BOOLEAN                             OPTIONAL,   -- Cond C54
    nonCriticalExtension            RRCMessage-v940-IEs                 OPTIONAL
}

RRCMessage-v940-IEs ::=         SEQUENCE {
    field6-v940                     InformationElement6-r9                  OPTIONAL,   -- Need R
    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.

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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 N
    childIE2-WithoutEM                  ChildIE2-WithoutEM              OPTIONAL,       -- Need N
    ...,
    [[  childIE1-WithoutEM-vNx0             ChildIE1-WithoutEM-vNx0     OPTIONAL,       -- Need N
        childIE2-WithoutEM-vNx0             ChildIE2-WithoutEM-vNx0     OPTIONAL        -- Need N
    ]]
}

-- 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.

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***ChildIE1-WithoutEM* information elements**

```
-- /example/ ASN1START

ChildIE1-WithoutEM ::=              SEQUENCE {
    -- Root encoding, including:
    chIE1-ConfigurableFeature           ChIE1-ConfigurableFeature       OPTIONAL         -- Need N
}

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 R, 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 {
```


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```
    chIE2-NewField-rN                   INTEGER (0..31)                 OPTIONAL    -- Cond ConfigF
}

-- ASN1STOP
```

Conditional presence	Explanation
ConfigF	The field is optional present, need R, 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 Guidelines regarding use of need codes

The following rule provides guidance for determining need codes for optional downlink fields:

- if the field needs to be stored by the UE (i.e. maintained) when absent:
  - use Need M (=Maintain)
- else, if the field needs to be released by the UE when absent:
  - use Need R (=Release)
- else, if UE shall take no action when the field is absent (i.e. UE does not even need to maintain any existing value of the field):
  - use Need N (=None)
- else (UE behaviour upon absence doesn’t fit any of the above conditions):

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- use Need S (=Specified)

- specify the UE behaviour upon absence of the field in the procedural text or in the field description table.

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Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
04/2017	RAN2#97bis	R2-1703395					0.0.1
04/2017	RAN2#97bis	R2-1703922					0.0.2
05/2017	RAN2#98	R2-1705815					0.0.3
06/2017	RAN2#NR2	R2-1707187					0.0.4
08/2017	RAN2#99	R2-1708468					0.0.5
09/2017	RAN2#99bis	R2-1710557					0.1.0
11/2017	RAN2#100	R2-1713629					0.2.0
11/2017	RAN2#100	R2-1714126					0.3.0
12/2017	RAN2#100	R2-1714259					0.4.0
12/2017	RAN#78	RP-172570				Submitted for Approval in RAN#78	1.0.0
12/2017	RAN#78					Upgraded to Rel-15 (MCC)	15.0.0

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