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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT09-1362
		Application Number	
Title of Invention	LTE MBMB SIB13 CHANGE		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

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☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1					Remove
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Prefix	Given Name	Middle Name	Family Name	Suffix	
	Young Dae		LEE		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Seongnam	Country Of Residenceⁱ	KR		
Citizenship under 37 CFR 1.41(b)ⁱ		KR			
Mailing Address of Applicant:					
Address 1		LG ELECTRONICS INC. IP GROUP			
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do			
City	Anyang	State/Province			
Postal Code	431-080	Countryⁱ	KR		
Applicant 2					Remove
Applicant Authority ☒ Inventor		☐ Legal Representative under 35 U.S.C. 117		☐ Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Sung Duck		CHUN		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Anyang	Country Of Residenceⁱ	KR		
Citizenship under 37 CFR 1.41(b)ⁱ		KR			
Mailing Address of Applicant:					
Address 1		LG ELECTRONICS INC. IP GROUP			
Address 2		533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do			
City	Anyang	State/Province			
Postal Code	431-080	Countryⁱ	KR		
Applicant 3					Remove
Applicant Authority ☒ Inventor		☐ Legal Representative under 35 U.S.C. 117		☐ Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Sun Hee		KIM		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Seoul	Country Of Residenceⁱ	KR		

IPR2024-00608

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Ex.1007.00001

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT09-1362
		Application Number	
Title of Invention	LTE MBMB SIB13 CHANGE		

Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Country ⁱ	KR
Applicant 4			Remove
Applicant Authority		☒ Inventor ☐ Legal Representative under 35 U.S.C. 117 ☐ Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name Suffix
	Seung June		YI
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service			
City	Anyang	Country Of Residence ⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Country ⁱ	KR
Applicant 5			Remove
Applicant Authority		☒ Inventor ☐ Legal Representative under 35 U.S.C. 117 ☐ Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name Suffix
	Sung Jun		PARK
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service			
City	Ansan	Country Of Residence ⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	
Mailing Address of Applicant:			
Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Country ⁱ	KR
Applicant 6			Remove
Applicant Authority		☒ Inventor ☐ Legal Representative under 35 U.S.C. 117 ☐ Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name Suffix
	Kyung Jun		LEE
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service			
City	Anyang	Country Of Residence ⁱ	KR
Citizenship under 37 CFR 1.41(b) i		KR	

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT09-1362
		Application Number	
Title of Invention	LTE MBMB SIB13 CHANGE		

Mailing Address of Applicant:			
Address 1	LG ELECTRONICS INC. IP GROUP		
Address 2	533 Hogye-1dong, Dongan-gu, Anyang-si, Gyeonggi-do		
City	Anyang	State/Province	
Postal Code	431-080	Country ⁱ	KR
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.			Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	67487		
Email Address	info@kpatent.com	Add Email	Remove Email
Email Address	sjpark@kpatent.com	Add Email	Remove Email

Application Information:

Title of the Invention	LTE MBMB SIB13 CHANGE		
Attorney Docket Number	UT09-1362	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)

IPR2024-00668

Petitioners' Ex. 1007
Ex.1007.00003

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT09-1362
		Application Number	
Title of Invention	LTE MBMB SIB13 CHANGE		
Customer Number	67487		

Domestic Benefit Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

Additional Domestic Priority Data may be generated within this form by selecting the **Add** button. [Add](#)

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

			Remove
Application Number	Country ⁱ	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			☒ Yes ☐ No

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Assignee Information:

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Assignee ¹	Remove		
If the Assignee is an Organization check here. ☒			
Organization Name	LG Electronics Inc.		

Mailing Address Information:

Address 1	20 Yeouido-dong, Yeongdeungpo-gu		
Address 2			
City	Seoul	State/Province	
Country ⁱ	KR	Postal Code	150-721
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the **Add** button. [Add](#)

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

IPR2024-00608
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number		UT09-1362	
		Application Number			
Title of Invention		LTE MBMB SIB13 CHANGE			
Signature		/Andrew S. Park/		Date (YYYY-MM-DD)	
				2009-10-29	
First Name	Andrew	Last Name	Park	Registration Number	47841

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Petitioners' Ex. 1007

Ex.1007.00006

**PROVISIONAL APPLICATION FOR UNITED STATES PATENT
IN THE NAMES OF**

Young Dae LEE, Sung Duck CHUN, Sun Hee KIM, Seung June YI,
Sung Jun PARK and Kyung Jun LEE

for

LTE MBMB SIB13 CHANGE

prepared by:

KBK & Associates

Customer Number: 67487

Attorney Docket Number: UT09-1362

Total Number of pages: 19 (including cover)

Title : PWS for Aggregated LTE carriers

Document for : Discussion and Decision

1 Prior Art

PWS is the Public Warning System in 3GPP which is used to broadcast a warning message to UEs. ETWS (Earthquake and Tsunami Warning System) in EU and Japan and CMAS (Commercial Mobile Alert System) in North America are part of PWS.

Details are described in Annex.

2 Problem of the prior art

If multiple downlink carriers are aggregated, PWS messages are broadcast from each downlink carrier. Hence, the same PWS messages will be duplicated on all downlink carriers which are aggregated.

To avoid duplicated transmission of PWS messages from all aggregated DL carriers, eNB may broadcast PWS messages only from one of the aggregated DL carriers, in particular from non-backward compatible carrier or extension carrier. However, UE staying at a DL carrier which does not broadcast PWS messages cannot receive the PWS messages.

3 Invented art

If multiple DL carriers e.g. DL CC#1, CC#2, CC#3 are aggregated, the network transmits PWS messages only from one of the DL carrier e.g. DL CC#1 that we call "PWS-CC" in this document.

In this case, the following options can help UE staying on CC#2 or CC#3 to receive the PWS messages. The CC that does not broadcast PWS messages is called "non-PWS-CC" in this document. Non-PWS CC could be either non-backward compatible CC or extension CC.

A PWS message is carried in one or more SIB from PWS-CC.

3.1 Reception of PWS indications before reception of PWS messages

PWS indication is used to inform UEs about a coming PWS message which will be transmitted in one or more SIBs.

The network will transmit PWS notifications on PWS-CC. Before the transmission of PWS notifications on PWS-CC, the network sends PWS notification indication. The PWS notification indication can be sent on PWS-CC and non-PWS-CC.

The PWS notification indication can be transmitted by one of the following ways:

1. By paging
2. By system information e.g. SIB Type 1
3. By PDCCH with a PWS specific RNTI (Radio Network Temporary Identity)
4. By a MAC control element on a common channel
5. By a RRC message on a common channel
6. By a dedicated signalling to a specific UE

Even if the PWS notification indication is not transmitted on SIB1 e.g. but transmitted in paging, SIB1 on PWS-CC can indicate that any PWS message is present on PWS-CC. Also, SIB1 on non-PWS-CC can indicate that any PWS message is present on PWS-CC. SIB1 on non-PWS-CC can also indicate which DL carrier is PWS-CC.

Thus, even if the PWS notification indication is not transmitted on SIB1 e.g. but transmitted in paging, UE can know if any PWS message is present by receiving SIB1 from either PWS-CC or non-PWS-CC.

Content of the PWS notification indication

The PWS notification indication can include an indication or a value tag informing UEs that a new PWS message is or will be transmitted from PWS-CC. If it is the value tag, when UE receives the value tag, UE stores the value tag. And then whenever UE receives a value tag, UE compares the stored value tag and the received value tag. If the stored value tag and the received value tag are different, UE considers a new PWS message to be transmitted from PWS-CC.

Furthermore, if the PWS notification indication is transmitted on non-PWS-CC, the PWS notification indication can indicate which DL CC(s) among all of the aggregated CCs will transmit a new PWS message (i.e. the DL CC index for a new PWS message). In this case, UE can receive the new PWS message from the indicated DL PWS-CC(s) e.g. during any of DRX periods.

Where UE receives the PWS notification indication

One or more DL carriers will be configured for a UE. Then, UE would receive the configured DL carriers.

UE receives the PWS notification indication from either PWS-CC or one of non-PWS-CC.

If PWS-CC is not configured and only non-PWS-CC(s) are configured for the UE, UE can receive PWS notification indication from one of the configured non-PWS-CCs. However, even if PWS-CC is not configured and only non-PWS-CC(s) are configured for the UE, UE could receive PWS notification indication from PWS-CC during any of DRX periods.

If PWS-CC is configured for the UE, UE can receive PWS notification indication from the configured PWS-CC.

Alternatively, regardless of the configured DL carriers for UE, system information from each DL CC can indicate which DL CC(s) among all of the aggregated CCs will transmit the PWS notification indication. In this case, UE can receive PWS notification indication from the indicated DL CC(s) e.g. during any of DRX periods. In addition, if system information from a certain DL CC does not indicate which DL CC(s) among all of the aggregated CCs will transmit the PWS notification indication, UE assumes that the PWS notification indication is transmitted on the DL CC and then receives the PWS notification indication on the DL CC.

3.2 Reception of PWS messages

According to section 3.1, UE receives the new PWS message based on the received PWS notification indication.

If UE assumes that a new PWS message will be transmitted from PWS-CC by receiving the indication or the value tag, UE receives the new PWS message on PWS-CC.

UE can know one specific PWS-CC or the list of PWS-CC(s) among the aggregated CCs by receiving system information e.g. SIB1 in a cell.

If system information indicates the list of PWS-CCs, which means there are more than one PWS-CC among the aggregated CCs, the PWS notification indication can indicate which DL CC(s) among all of the aggregated CCs will transmit a new PWS message (i.e. the DL CC index for a new PWS message). In this case, UE can receive the new PWS message from the indicated DL PWS-CC(s) e.g. during any of DRX periods.

Furthermore, if the PWS notification indication is transmitted on PWS-CC, the PWS notification indication transmitted on PWS-CC may not indicate the DL CC index for a new PWS message. If the PWS notification indication transmitted on PWS-CC does not indicate the DL CC index for a new PWS message, UE assumes that the new PWS message is transmitted on the DL CC where the PWS notification indication was transmitted and then receives the new PWS message on that DL CC.

Else if system information indicates only one specific PWS-CC, UE can receive the new PWS message on the PWS-CC that the system information indicates.

Else if system information does not indicate any PWS-CC, UE assumes that the new PWS message is transmitted on the DL CC where the system information was transmitted and then receives the new PWS message on that DL CC.

Discard of Message ID/SN and message segment

When UE receives a PWS message which includes a message ID and a serial number (SN), the UE stores the recently received message ID and SN and if the PWS message is not completely received, the UE also store a received segment of the PWS message. Then, whenever a cell changes, UE discard them.

However, if UE moves between DL carriers which are aggregated, UE dose not discard the stored message ID/SN or the stored segment of the PWS message.

Title : Implicit Release of SPS for Aggregated LTE carrier
Document for : Discussion and Decision

1 Prior Art

The Semi-Persistent Scheduling (SPS) for uplink or downlink is configured by RRC. SPS is mainly used for VoIP for which the data packets are periodically transmitted and small and semi-static in size. Semi-Persistent Scheduling C-RNTI is used as unique identification for semi-persistent scheduling and is indicated on PDCCH for SPS control or SPS data transmission.

E-UTRAN can allocate semi-persistent downlink resources for the first HARQ transmissions to UEs:

- RRC defines the periodicity of the semi-persistent downlink grant;
- PDCCH indicates whether the downlink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

When required, retransmissions are explicitly signalled via the PDCCH(s). In the sub-frames where the UE has semi-persistent downlink resource, if the UE cannot find its C-RNTI on the PDCCH(s), a downlink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI is assumed. Otherwise, in the sub-frames where the UE has semi-persistent downlink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the semi-persistent allocation for that TTI and the UE does not decode the semi-persistent resources.

In addition, E-UTRAN can allocate a semi-persistent uplink resource for the first HARQ transmissions and potentially retransmissions to UEs:

- RRC defines the periodicity of the semi-persistent uplink grant;
- PDCCH indicates whether the uplink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

In the sub-frames where the UE has semi-persistent uplink resource, if the UE cannot find its C-RNTI on the PDCCH(s), an uplink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI can be made. The network performs decoding of the pre-defined PRBs according to the pre-defined MCS. Otherwise, in the sub-frames where the UE has semi-persistent uplink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the persistent allocation for that TTI and the UE's transmission follows the PDCCH allocation, not the semi-persistent allocation. Retransmissions are either implicitly allocated in which case the UE uses the semi-persistent uplink allocation, or explicitly allocated via PDCCH(s) in which case the UE does not follow the semi-persistent allocation.

2 Problem of the prior art

Multiple carriers can be aggregated. Then, UE can receive higher-rate data or transmits higher-rate data through multiple aggregated Component Carriers (CC). However, this is mainly used for higher-rate service. Therefore, it seems unnecessary that VoIP service by using SPS is transmitted over more than two carriers.

On the other hand, the network can reconfigure the SPS from one CC #1 to another CC #2. In that case, the network should set up the new SPS configuration in CC #2 and release the old SPS configuration in CC #1, which cause two different procedures.

3 Invented art

To simplify SPS reconfiguration from one CC to another CC (either in uplink or in downlink), we provide several options.

Option 1: Implicit release of RRC SPS configuration in one CC

When UE RRC has the SPS configuration such as SPS interval in CC #1, if eNB RRC configures another SPS in CC #2 for the UE (and if eNB does not explicitly indicate keeping the SPS configuration in CC #1), the UE RRC implicitly release the SPS configuration in CC #1.

Example 1a:

1. UE L1/L2 receives data from SPS resource on DL CC #1 according to the old SPS configuration given by eNB RRC
2. UE RRC receives a new SPS configuration which is given by eNB RRC and is applied to DL CC #2.
3. UE RRC implicitly releases the old SPS configuration on DL CC #1 and stops receiving any SPS data on DL CC #1.
4. UE RRC applies the new SPS configuration to DL CC #2.
5. UE L1/L2 receives data from SPS resource on DL CC #2 according to the new SPS configuration given by eNB RRC .

Furthermore, when UE RRC has the SPS configuration for CC #1, if eNB RRC indicates CC #2 for SPS without detailed SPS configuration such as SPS interval i.e. eNB RRC signals an empty SPS configuration with CC #2, the UE applies the SPS configuration to CC #2, instead of CC #1.

Example 1b:

1. UE L1/L2 receives data from SPS resource on DL CC #1 according to the old SPS configuration given by eNB RRC
2. UE RRC receives an empty SPS configuration with a CC index indicating DL CC #2 which is given by eNB RRC without detailed SPS configuration.
3. UE L1/L2 stops receiving any SPS data on DL CC #1.
4. UE RRC applies the SPS configuration to DL CC #2 instead of DL CC #1.
5. UE L1/L2 receives data from SPS resource on DL CC #2 according to the SPS configuration given by eNB RRC .

Option 2: Implicit release of initiated(active) SPS resource in one CC

eNB may configure more than one CC for SPS and so UE could receive/transmit SPS data through one CC or the other CC. The same RRC SPS configuration such as SPS interval is applied to either one CC or the other CC.

When PDCCH with SPS-CRNTI initiates/re-initiates a DL assignment or a UL grant for SPS transmission, the PDCCH also indicates which CC a radio resource (i.e. the DL assignment or the UL grant) is initiated/re-initiated for SPS transmission on (i.e. a CC index). If PDCCH with SPS-CRNTI initiates/re-initiates a radio resource for SPS transmission on CC #2 while another radio resource is still active for SPS transmission on CC #1 with a RRC SPS configuration, the UE corresponding to SPS-CRNTI implicitly releases the radio resource for SPS transmission on CC #1 and initiates/re-initiates the radio resource for SPS transmission on CC #2 while keeping the same RRC SPS configuration.

Example 2a:

1. UE MAC receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE MAC receives PDCCH with SPS-CRNTI and a CC index which initiates/re-initiates a SPS resource which was periodically assigned on CC #2 for SPS transmission.
3. UE MAC implicitly releases the SPS resource which was periodically assigned on DL CC #1 and stops receiving data from the SPS resource on DL CC #1.
4. UE MAC receives data from the SPS resource which was periodically assigned on DL CC #2 according to the initiation/re-initiation by the PDCCH with SPS-CRNTI and the CC index indicating CC #2.

Sub-option 2-1: SPS Re-transmission on another CC

Furthermore, when PDCCH with SPS-CRNTI indicates a DL assignment or a UL grant for SPS retransmission, the CC index on the PDCCH also indicates which CC the DL assignment or the UL grant is used for the SPS retransmission on. Even if SPS is released(deactivated) on the CC that the PDCCH indicates for SPS retransmission,

For instance, in the example 2a, even if SPS is release(deactivated) on DL CC #1, when PDCCH with SPS-CRNTI indicates DL CC #1 as well as a SPS resource for SPS retransmission, the UE temporarily receives SPS retransmission from the SPS resource on DL CC #1 and turns back to DL CC #2 for SPS (re)transmission.

Example 2b:

1. UE receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE receives PDCCH with SPS-CRNTI and a CC index which indicates a DL assignment for SPS retransmission on DL CC #2
3. UE receives data on the SPS resource assigned by the DL assignment for SPS retransmission, through the CC indicated by the CC index i.e. DL CC #2.
4. UE turns back to DL CC #1 to receives SPS transmission or re-transmission.

Sub-option 2-2: Explicit SPS release for a specific CC

In addition, when PDCCH with SPS-CRNTI indicates SPS release, the CC index on the PDCCH also indicates which CC the (re)initiated DL assignment or the (re)initiated UL grant is released for the SPS on.

Example 2b:

1. UE receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE receives PDCCH with SPS-CRNTI and a CC index which indicates SPS release for the the (re)initiated DL assignment for SPS transmission on DL CC #1
3. UE clears the the (re)initiated DL assignment for SPS transmission for the CC indicated by the CC index i.e. DL CC #1 and UE stops receiving data on the SPS resource through the CC indicated by the CC index.

Annex: Detailed Prior Art

3.1 5.3 DL-SCH data transfer

3.1.1 5.3.1 DL Assignment reception

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
 - if this is the first downlink assignment for this Temporary C-RNTI:
 - consider the NDI to have been toggled.
 - if the downlink assignment is for UE's C-RNTI and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:
 - consider the NDI to have been toggled regardless of the value of the NDI.

- indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI not to have been toggled;
 - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
 - else, if the NDI in the received HARQ information is 0:
 - if PDCCH contents indicate SPS release:
 - clear the configured downlink assignment (if any);
 - if *timeAlignmentTimer* is running:
 - indicate a positive acknowledgement for the downlink SPS release to the physical layer.
 - else:
 - store the downlink assignment and the associated HARQ information as configured downlink assignment;
 - initialise (if not active) or re-initialise (if already active) the configured downlink assignment to start in this TTI and to recur according to rules in subclause 5.10.1;
 - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
 - consider the NDI bit to have been toggled;
 - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been configured and there is no measurement gap in this TTI and this TTI is not an MBSFN subframe:
 - instruct the physical layer to receive, in this TTI, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;
 - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
 - consider the NDI bit to have been toggled;
 - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.

For configured downlink assignments, the HARQ Process ID associated with this TTI is derived from the following equation:

$$\text{HARQ Process ID} = [\text{floor}(\text{CURRENT_TTI} / (\text{Downlink Semi-Persistent Scheduling Interval})) \bmod \text{Number of Configured SPS Processes}]$$

where $\text{CURRENT_TTI} = [(\text{SFN} * 10) + \text{subframe number}]$, Downlink Semi-Persistent Scheduling Interval is the periodicity of semi-persistent scheduling signalled via RRC and Number of Configured SPS Processes is the number of HARQ processes allocated for semi-persistent scheduling signalled via RRC.

When the UE needs to read BCCH, the UE may, based on the scheduling information from RRC:

- if a downlink assignment for this TTI has been received on the PDCCH for the SI-RNTI;
- if the redundancy version is not defined in the PDCCH format:
 - the redundancy version of the received downlink assignment for this TTI is determined by $RV_k = \text{ceiling}(3/2 * k) \bmod 4$, where k depends on the type of system information message: for *SystemInformationBlockType1* message,

$k = (\text{SFN}/2) \text{ modulo } 4$, where SFN is the system frame number; for *SystemInformation* messages, $k=i \text{ modulo } 4$, $i = 0, 1, \dots, n_s^w - 1$, where i denotes the subframe number within the SI window n_s^w ;

- indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity for this TTI.

3.1.2 5.3.2 HARQ operation

3.1.2.1 5.3.2.1 HARQ Entity

There is one HARQ entity at the UE which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of DL HARQ processes is specified in [2], clause 7.

When the physical layer is configured for spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
 - allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
 - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

3.1.2.2 5.3.2.2 HARQ process

For each subframe where a transmission takes place for the HARQ process, one or two (in case of spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

- if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or
- if the HARQ process is equal to the broadcast process and if this is the first received transmission for the TB according to the system information schedule indicated by RRC; or
- if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):
 - consider this transmission to be a new transmission.
- else:
 - consider this transmission to be a retransmission.

The UE then shall:

- if this is a new transmission:
 - replace the data currently in the soft buffer for this TB with the received data.
- else if this is a retransmission:
 - if the data has not yet been successfully decoded:
 - combine the received data with the data currently in the soft buffer for this TB.

- if the TB size is different from the last valid TB size signalled for this TB:
 - the UE may replace the data currently in the soft buffer for this TB with the received data.
- attempt to decode the data in the soft buffer for this TB;
- if the data in the soft buffer was successfully decoded for this TB:
 - if the HARQ process is equal to the broadcast process:
 - deliver the decoded MAC PDU to upper layers.
 - else if this is the first successful decoding of the data in the soft buffer for this TB:
 - deliver the decoded MAC PDU to the disassembly and demultiplexing entity.
 - generate a positive acknowledgement (ACK) of the data in this TB.
- else:
 - generate a negative acknowledgement (NACK) of the data in this TB.
- if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or
- if the HARQ process is equal to the broadcast process; or
- if *timeAlignmentTimer* is stopped or expired:
 - do not indicate the generated positive or negative acknowledgement to the physical layer.
- else:
 - indicate the generated positive or negative acknowledgement for this TB to the physical layer.

The UE shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

3.1.3 5.3.3 Disassembly and demultiplexing

The UE shall disassemble and demultiplex a MAC PDU as defined in subclause 6.1.2.

3.2 5.4 UL-SCH data transfer

3.2.1 5.4.1 UL Grant reception

In order to transmit on the UL-SCH the UE must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently. To perform requested transmissions, the MAC layer receives HARQ information from lower layers.

When *timeAlignmentTimer* is running and the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI :

- if an uplink grant for this TTI has been received on the PDCCH for the UE's C-RNTI or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
 - if the uplink grant is for UE's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the UE's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:
 - consider the NDI to have been toggled regardless of the value of the NDI.
- deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.

- else, if an uplink grant for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI not to have been toggled;
 - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
 - else if the NDI in the received HARQ information is 0:
 - if PDCCH contents indicate SPS release:
 - clear the configured uplink grant (if any).
 - else:
 - store the uplink grant and the associated HARQ information as configured uplink grant;
 - initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI and to recur according to rules in subclause 5.10.2;
 - consider the NDI bit to have been toggled;
 - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI.
 - else, if an uplink grant for this TTI has been configured:
 - consider the NDI bit to have been toggled;
 - deliver the configured uplink grant, and the associated HARQ information to the HARQ entity for this TTI.

NOTE: The period of configured uplink grants is expressed in TTIs.

NOTE: If the UE receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions in the same UL subframe, the UE may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the UE processes the grant but does not transmit on UL-SCH.

3.2.2 5.4.2 HARQ operation

3.2.2.1 5.4.2.1 HARQ entity

There is one HARQ entity at the UE, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for HARQ the feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes is specified in [2], clause 8.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process.

When TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e the TTI corresponding to TTI_BUNDLE_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle.

For transmission of Msg3 during Random Access (see section 5.1.5) TTI bundling does not apply.

For each TTI, the HARQ entity shall:

- identify the HARQ process associated with this TTI;

- if an uplink grant has been indicated for this TTI:
 - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
 - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or
 - if the uplink grant was received in a Random Access Response:
 - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
 - obtain the MAC PDU to transmit from the Msg3 buffer.
 - else:
 - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
 - deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
 - instruct the identified HARQ process to trigger a new transmission.
 - else:
 - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
 - instruct the identified HARQ process to generate an adaptive retransmission.
- else, if the HARQ buffer of the HARQ process corresponding to this TTI is not empty:
 - instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

3.2.2.2 5.4.2.2 HARQ process

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable *CURRENT_TX_NB*, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable *HARQ_FEEDBACK*, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, *CURRENT_TX_NB* shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable *CURRENT_IRV* is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt.

The UE is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set *HARQ_FEEDBACK* to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set *CURRENT_TX_NB* to 0;

- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
- if the HARQ entity requests an adaptive retransmission:
 - store the uplink grant received from the HARQ entity;
 - set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
 - set HARQ_FEEDBACK to NACK;
 - generate a transmission as described below.
- else if the HARQ entity requests a non-adaptive retransmission:
 - if HARQ_FEEDBACK = NACK:
 - generate a transmission as described below.

NOTE: When receiving a HARQ ACK alone, the UE keeps the data in the HARQ buffer.

NOTE: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer in this TTI:
 - instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
 - increment CURRENT_IRV by 1;
 - if there is a measurement gap at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
 - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions – 1:
 - flush the HARQ buffer;

3.3 5.10 Semi-Persistent Scheduling

When Semi-Persistent Scheduling is enabled by RRC, the following information is provided [8]:

- Semi-Persistent Scheduling C-RNTI;
- Uplink Semi-Persistent Scheduling interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;
- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;
- Downlink Semi-Persistent Scheduling interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

3.3.1 5.10.1 Downlink

After a Semi-Persistent downlink assignment is configured, the UE shall consider that the assignment recurs in each subframe for which:

- $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalDL}] \text{ modulo } 10240$, for all $N > 0$.

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured downlink assignment were (re-)initialised.

3.3.2 5.10.2 Uplink

After a Semi-Persistent Scheduling uplink grant is configured, the UE shall:

- if *twoIntervalsConfig* is enabled by upper layer:
 - set the *Subframe_Offset* according to Table 7.4-1.
- else:
 - set *Subframe_Offset* to 0.
- consider that the grant recurs in each subframe for which:
 - $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalUL} + \text{Subframe_Offset} * (N \text{ modulo } 2)] \text{ modulo } 10240$, for all $N > 0$.

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured uplink grant were (re-)initialised.

The UE shall clear the configured uplink grant immediately after *implicitReleaseAfter* [8] number of consecutive new MAC PDUs each containing zero MAC SDUs have been provided by the Multiplexing and Assembly entity, on the Semi-Persistent Scheduling resource.

NOTE: Retransmissions for Semi-Persistent Scheduling can continue after clearing the configured uplink grant.

3.4 5.11 Handling of unknown, unforeseen and erroneous protocol data

When a MAC entity receives a MAC PDU for the UE's C-RNTI or Semi-Persistent Scheduling C-RNTI, or by the configured downlink assignment, containing reserved or invalid values, the MAC entity shall:

- discard the received PDU.

1 Introduction

DC-HSUPA에서 secondary carrier는 primary carrier와 달리 NodeB에 의해 dynamic 하게 activation/de-activation 될 수 있다. 그런데, secondary carrier가 de-activation 된 뒤 re-activation 될 때의 UE behaviour에 대해서는 논의된 바가 없다.

따라서, 이 문서에서는 secondary carrier가 de-activation 및 re-activation될 때의 UE behaviour 에 대하여 논의하고자 한다.

2 Discussion

2.1 Flush of HARQ process buffer on secondary carrier

단말의 secondary carrier가 de-activation 될 때, 단말의 HARQ buffer에는 전송할 데이터가 존재하는 경우가 발생할 수 있다. 예를 들어, NodeB가 UE로부터 secondary carrier를 통해 데이터를 수신하고 HARQ ACK을 전송한 뒤 해당 secondary carrier를 de-activation시켰을 때, 만약 UE 쪽에서 ACK-to-NACK이 발생했다면 UE는 해당 데이터를 HARQ buffer에서 삭제하지 않을 수 있다. 그 후 다시 Node B에 의해 UE의 secondary carrier가 re-activation 된다면, UE의 HARQ buffer가 비어있지 않기 때문에, UE는 해당 HARQ buffer 에 남아있던 데이터를 재전송하려 할 것이다. 따라서, secondary carrier가 de-activation 될 때, UE는 HARQ buffer를 flush해야 불필요한 전송을 방지할 수 있다.

Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated (or re-activated).

2.2 Initial variables on secondary carrier

현재 agreement에 따르면, 단말은 secondary carrier가 de-activation 될 때 Serving Grant 값을 초기화하지 않는다. 따라서, 상기 secondary carrier가 re-activation 되면, 단말은 상기 secondary carrier가 de-activation 되었을 때의 Serving Grant 값을 그대로 사용한다. 이 경우, 단말은 secondary carrier의 re-activation 이후 실제로는 NodeB로부터 Serving Grant를 수신하지 못하였는데도 불구하고, 마치 Serving Grant를 수신한 것처럼 잘못 판단할 수 있다.

따라서, UE는 secondary carrier가 처음 activation 될 때와 마찬가지로 re-activation 될 때 Serving Grant Update Function에 관련된 변수나 타이머 값을 초기화하는 과정이 필요하다.

Proposal 2: The UE shall initialize variables and timers related to serving grant update function when secondary carrier is re-activated (or de-activated).

3 Conclusion

For the correct operation of secondary carrier, the followings are proposed at secondary carrier de-activation or re-activation:

Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier.

Proposal 2: The UE shall initialize variables and timers for serving grant update function.

A text proposal is attached in section 4.

4 Appendix

11.8.1.3.2 Handling at start of E-DCH transmission

In CELL_DCH state when E-DCH transmission is started or Secondary Uplink Frequency is re-activated by lower layer, the UE shall on that carrier:

- activate all HARQ processes;
- if the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:
 - update the state variables and timers according to subclause 11.8.1.3.5.
- else:
 - initialise the state variable Serving_Grant to Zero_Grant;
 - initialise the state variable Primary_Grant_Available to "False";
 - initialise the state variable Stored_Secondary_Grant to "Zero_Grant".
- initialise the state variables reference_ETPR and reference_ETPR2 to "Minimum_Grant";
- initialise the state variable Maximum_Serving_Grant to the highest possible value (i.e. index 37 in table 9.2.5.2.1.1 or 9.2.5.2.1.2 as configured by higher layers).

11.8.1.10 De-activation on Secondary Uplink Frequency

If Secondary Uplink Frequency is de-activated by lower layer, the UE shall:

- deactivate all HARQ processes corresponding to secondary carrier
- flush all buffers corresponding to secondary carrier;

Or

11.8.1.10 De-activation on Secondary Uplink Frequency

If Secondary Uplink Frequency is de-activated by lower layer, the UE shall:

- deactivate all HARQ processes and flush all buffers corresponding to secondary carrier;

Title : SIB13 Change for LTE MBMS

Document for : Discussion and Decision

Introduction

In this document, we discuss how to handle SIB13 change for LTE MBMS.

Value Tag in SIB1

In the last meeting, it was identified in [1] that if MBSFN areas dynamically change, cells will be added to or removed from an MBSFN area in short intervals, in which case SIB13 content would change quite often. This might lead unicast UEs to wake up frequently and unnecessarily for paging.

To limit impact on unicast UEs, it was proposed in [2] that change of SIB 13 does not change the value tag in SIB1. We also support this proposal because, if change of SIB 13 changes the value tag in SIB1, unicast UEs will wake up frequently and unnecessarily.

Proposal 1: change of SIB 13 does not change the value tag in SIB1.

How to indicate SIB13 change

It was also proposed in [2] that change of SIB 13 for MBMS is indicated in a paging message, similar to change of SIB10, SIB11 and SIB12 for PWS. However, we see some differences between MBMS SIB and PWS SIBs.

First of all, PWS SIBs are used for emergency situations and so change of PWS SIBs may occur once a year. However, MBMS SIB is used for normal MBMS services. If MBMS is deployed in the network, MBMS SIB changes occur more often. That means if SIB13 change is indicated in paging, unnecessary wake-up of unicast UEs would happen more frequently for a whole life of UEs.

Secondly, even though PWS is optional, reception of PWS SIBs would be required for most of UEs in some regions due to regulation. However, reception of MBMS is optional and not a regulatory issue. Thus, we assume that indication of MBMS SIB change in paging would cause more occurrence of unnecessary UE wake-up than indication of PWS SIB change in paging.

Due to the reasons above, we propose not to accept indication of SIB13 change in paging. Instead, we provide alternatives for limiting impact on unicast UEs. We propose to accept one of the alternatives below.

Proposal 2: we propose not to indicate SIB change in paging.

Alternative 1: SIB13 change indication on PDCCH with M-RNTI

MBMS UE receives M-RNTI on PDCCH to identify whether a service it is interested to receive is started or ongoing in a cell. In addition to M-RNTI on PDCCH, MBSFN area ID is indicated on PDCCH. Even though we did not decide how many bits will be used for the short indication of MBSFN area on PDCCH, we think that 1 bit on PDCCH with M-RNTI could be sufficient to indicate change of SIB13. (If 2 or more bits on PDCCH remain unused, they could be used as a MBMS specific value tag for indicating SIB13 change.)

In fact, MBSFN area ID on PDCCH is linked to the list of MBSFN areas in SIB13. If a MBSFN area is added or removed from the list in SIB13, meaning of the short indication of MBSFN area on PDCCH can be changed. Thus, if UE does not find out SIB13 change, UE could misunderstand the short indication of MBSFN area on PDCCH and so may receive incorrect MBSFN subframe for reading MCCH. In this sense, SIB13 change indication on PDCCH with M-RNTI could be beneficial because UE can know that meaning of the short indication of MBSFN area on PDCCH is changed at the same time when it knows SIB13 change indication.

Use of 1 bit on PDCCH could be a drawback of this scheme. However, it seems to be not painful. And someone could argue that reading PDCCH for MBMS notification is optional for UE. But, we think that it is not costly for MBMS capable UEs.

Proposal 3 for alternative 1: MBMS capable UE from Rel-9 checks PDCCH with M-RNTI to know change of SIB13.

One thing to say is that since SIB13 does not dynamically change in Rel-9, 1 bit on PDCCH with M-RNTI seems to be not needed for Rel-9. Thus, if dynamic change of MBSFN areas is not used, the network could indicate to MBMS capable UEs that 1 bit on PDCCH with M-RNTI is not used. In this case, MBMS capable UEs read SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception. However, we feel that 1 bit on PDCCH is not so costly and therefore if the alternative 1 is accepted, UE uses the 1 bit on PDCCH to check change of SIB13 from Rel-9, in which case UE behaviours in Rel-9 and the future releases are consistent.

Alternative 2: Periodic reading of SIB13 content

If SIB13 dynamically changes, MBMS capable UE could periodically read SIB13 content. For this purpose, we could introduce a timer. Whenever the timer expires, UE reads SIB13. Whenever UE completes reading SIB13, UE re-starts the timer. One benefit of this scheme is that no signalling overhead is introduced in downlink. Instead of using a timer, the period for reading SIB13 can be used. The period for reading SIB13 could be aligned with modification period of MCCH because change of SIB13 mainly impacts MCCH transmissions.

The timer or the period for reading SIB13 can be signalled by SIB1 which signals SI scheduling information or by SIB2 which signals the MBSFN subframe configuration.

Proposal 3-1 for alternative 2: MBMS capable UE periodically reads SIB13 according to a timer or a period configured by the network.

Since SIB13 does not dynamically change in Rel-9, periodic reading of SIB13 seems to be not needed for Rel-9. For this reason, only if SIB13 dynamically changes in the future, the Rel-9 network should signal the timer or the period for reading SIB13, in which case Rel-9 UE reads SIB13 according to the timer or the period. Otherwise, the Rel-9 network does not need to signal the timer or the period for reading SIB13, in which case Rel-9 UE reads SIB13 as it reads Rel-8 SIBs except SIB10/11 because infrequent SIB13 change has only a minor impact on unicast UEs. That is beneficial because periodic reading of SIB13 could be sort of costly for UE power consumption.

Proposal 3-2 for alternative 2: If there is no timer or no period configured by the network, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).

Alternative 3: Periodic reading of the MBMS specific value tag in SIB1

Instead of periodic reading of SIB13, UE could periodically read the MBMS specific value tag in SIB1. The MBMS specific value tag is different than the existing value tag in SIB1 and so change of the MBMS specific value tag has no impact on unicast UEs. To avoid unnecessary wake-up of unicast UEs, change of the MBMS specific value tag should not trigger any paging with system information modification.

Like handling of non-MBMS value tag in SIB1, if SIB13 changes, the network increase the MBMS specific value tag. Whenever UE receives a new MBMS specific value tag, UE verifies whether the stored one and the new one are same or not. If they are different, UE considers SIB13 changed, stores the MBMS specific value tag, and then reads SIB13. Otherwise, UE does not read SIB13.

One benefit of periodic reading SIB1 is that UE could get change of non-MBMS SIBs as well as MBMS SIB by reading SIB1.

Proposal 3-1 for alternative 3: MBMS capable UE periodically reads the MBMS specific value tag in SIB1 according to a timer or a period configured by the network.

Similar to alternative 2, since SIB13 does not dynamically change in Rel-9, periodic reading of SIB1 seems to be not needed for Rel-9. For this reason, we propose that if no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception.

Proposal 3-2 for alternative 3: If no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).

Timing between SIB13 and PDCCH/MCCH

SIB13 carries information on each MBSFN area. If any MBSFN area information in SIB13 is added, modified, or removed, when the change in SIB13 is applied to PDCCH/MCCH is not clear.

PDCCH with M-RNTI and MCCH can change only at MCCH Modification Period (MP) boundaries. And PDCCH with M-RNTI is indicated one MP before MCCH transmission. Thus, if any MBSFN area information in SIB13 is added, modified, or removed, the change in SIB13 should be applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).

Proposal 4: UEs assume that changes in SIB13 are applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).

In addition, if SIB13 content is added, modified, or removed in the midst of a MP, new SIB13 content cannot be applied to PDCCH with M-RNTI in this MP because PDCCH with M-RNTI before transmission of new SIB13 content is based on old SIB13 content in this MP. Thus, if SIB13 content is added, modified or removed, the network should apply the change to PDCCH with M-RNTI in the next MP, not in this MP after changing SIB13 content.

Proposal 5: UE assumes that the recent update of SIB13 is applied to PDCCH with M-RNTI in the next MP after receiving the recent update of SIB13.

Conclusion

In summary, we propose the following proposals:

- Proposal 1: Change of SIB 13 does not change the value tag in SIB1.
- Proposal 2: SIB change is not indicated in paging.
- Proposal 3: one of the alternatives below is used for MBMS capable UEs to get SIB13 change.
 - o Alternative 1: MBMS capable UE from Rel-9 checks PDCCH with M-RNTI to know change of SIB13.
 - o Alternative 2: MBMS capable UE periodically reads SIB13 according to a timer or a period configured by the network.
 - In addition, if there is no timer or no period configured by the network, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).
 - o Alternative 3: MBMS capable UE periodically reads the MBMS specific value tag in SIB1 according to a timer or a period configured by the network.
 - In addition, if no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).
- Proposal 4: UEs assume that changes in SIB13 are applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).
- Proposal 5: UE assumes that the recent update of SIB13 is applied to PDCCH with M-RNTI in the next MP after receiving the recent update of SIB13.

Electronic Patent Application Fee Transmittal

Application Number:

Filing Date:

Title of Invention:

LTE MBMB SIB13 CHANGE

First Named Inventor/Applicant Name:

Young Dae LEE

Filer:

Andrew S. Park/Soyoun MOON

Attorney Docket Number:

UT09-1362

Filed as Large Entity

Provisional Filing Fees

Description

Fee Code

Quantity

Amount

**Sub-Total in
USD(\$)**

Basic Filing:

Provisional application filing

1005

1

220

220

Pages:

Claims:

Miscellaneous-Filing:

Petition:

Patent-Appeals-and-Interference:

Post-Allowance-and-Post-Issuance:

Extension-of-Time:

IPR2024-00608

Petitioners' Ex. 1007

Ex.1007.00026

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				220

Electronic Acknowledgement Receipt

EFS ID:	6360629
Application Number:	61256294
International Application Number:	
Confirmation Number:	7529
Title of Invention:	LTE MBMB SIB13 CHANGE
First Named Inventor/Applicant Name:	Young Dae LEE
Customer Number:	67487
Filer:	Andrew S. Park/Soyoun MOON
Filer Authorized By:	Andrew S. Park
Attorney Docket Number:	UT09-1362
Receipt Date:	29-OCT-2009
Filing Date:	
Time Stamp:	23:23:28
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 220
RAM confirmation Number	7549
Deposit Account	504198
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

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IPR2014-00608
Petitioners' Ex. 1007
Ex.1007.00028

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Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	UT09-1362_ADS.pdf	836997	no	6
			c234337344ec4561c7ba397b8c546616428c44a5		

Warnings:

Information:

2	Specification - Not in English	UT091362_SPEC.pdf	2257695	no	19
			2742025409b16c44067646f44cd56870c83c3767		

Warnings:

The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing

Information:

3	Fee Worksheet (PTO-875)	fee-info.pdf	29595	no	2
			ea3741047e1119426c6409e046e5f4bce55f7c53		

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Information:

Total Files Size (in bytes):	3124287
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AUTHORIZATION TO PERMIT ACCESS TO APPLICATION BY PARTICIPATING OFFICES

Send completed form to: Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

COMPLETE IF KNOWN

Application Number	61/256,294
Filing Date	
First Named Inventor	Young Dae LEE
Attorney Docket Number	UT09-1362
Title (Required)	LTE MBMB SIB13 CHANGE

The undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h).

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No fee will be charged under 37 CFR 1.19(b)(1) for providing a participating intellectual property office with an electronic copy of the above-identified application.

This form must be signed by an authorized party in accordance with 37 CFR 1.14(c).

/Andrew S. PARK/

10-29-2009

Signature

Date

Andrew S. PARK

82-2-2193-0001

Printed or Typed Name

Telephone Number

LTE MBMB SIB13 CHANGE

47841

Title

Registration Number, if applicable

This collection of information is required by 37 CFR 1.14(h). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process an application). Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt

EFS ID:	6360643
Application Number:	61256294
International Application Number:	
Confirmation Number:	7529
Title of Invention:	LTE MBMB SIB13 CHANGE
First Named Inventor/Applicant Name:	Young Dae LEE
Customer Number:	67487
Filer:	Andrew S. Park/Soyoun MOON
Filer Authorized By:	Andrew S. Park
Attorney Docket Number:	UT09-1362
Receipt Date:	29-OCT-2009
Filing Date:	
Time Stamp:	23:34:07
Application Type:	Provisional

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Authorization to access Appl. by Trilateral Office	UT09-1362_sb0039.pdf	222820 1a79c01c466aa75bfc9e937050b5365b6c94b919	no	2

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IPR2024-00608

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NUMBER	FILING or 371(c) DATE	GRPART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
61/256,294	10/29/2009		220	UT09-1362		

CONFIRMATION NO. 7529

67487
KBK & Associates
GANGNAM P.O. 1655
SEOUL, 135-616
KOREA, REPUBLIC OF

FILING RECEIPT



Date Mailed: 11/16/2009

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Young Dae LEE, Seongnam, KOREA, REPUBLIC OF;
Sung Duck CHUN, Anyang, KOREA, REPUBLIC OF;
Sun Hee KIM, Seoul, KOREA, REPUBLIC OF;
Seung June YI, Anyang, KOREA, REPUBLIC OF;
Sung Jun PARK, Ansan, KOREA, REPUBLIC OF;
Kyung Jun LEE, Anyang, KOREA, REPUBLIC OF;

Power of Attorney:

Andrew Park--47841

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 11/13/2009

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/256,294**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

Title

LTE MBMB SIB13 CHANGE

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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Docket No.: UT09-1362
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Young Dae LEE, et al.

Application No.: 61/256,294

Confirmation No.: 7529

Filed: October 29, 2009

Art Unit:

For: LTE MBMB SIB13 CHANGE

Examiner:

**REPLY TO LETTER RE NON-ENGLISH LANGUAGE
APPLICATION PAPERS IN A PROVISIONAL APPLICATION**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner:

We are enclosing herewith:

1. An English Translation of the Specification; and
2. A statement of Verification dated October 14, 2010.

Respectfully submitted,

Dated: October 14, 2010
Customer No. 67487

By: /Andrew S. Park/
Andrew S. PARK
Registration No.: 47,841
KBK & Associates

VERIFICATION

I, Hyunjung KIM(Name of translator), residing at 10F., Songam Bldg., #642-10, Yeoksam-dong, Gangnam-gu, Seoul, Republic of Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean and English languages and that the writings contained in the following pages are a correct English translation of the specification of U.S. Provisional Application No. 61/256,294

Date: October 14, 2010

Signature of translator: Kim . Hyunjung

**PROVISIONAL APPLICATION FOR UNITED STATES PATENT
IN THE NAMES OF**

Young Dae LEE, Sung Duck CHUN, Sun Hee KIM, Seung June YI,
Sung Jun PARK and Kyung Jun LEE

for

LTE MBMB SIB13 CHANGE

prepared by:

KBK & Associates

Customer Number: 67487

Attorney Docket Number: UT09-1362

Total Number of pages: 19 (including cover)

Title : PWS for Aggregated LTE carriers
Document for : Discussion and Decision

1 Prior Art

PWS is the Public Warning System in 3GPP which is used to broadcast a warning message to UEs. ETWS (Earthquake and Tsunami Warning System) in EU and Japan and CMAS (Commercial Mobile Alert System) in North America are part of PWS.

Details are described in Annex.

2 Problem of the prior art

If multiple downlink carriers are aggregated, PWS messages are broadcast from each downlink carrier. Hence, the same PWS messages will be duplicated on all downlink carriers which are aggregated.

To avoid duplicated transmission of PWS messages from all aggregated DL carriers, eNB may broadcast PWS messages only from one of the aggregated DL carriers, in particular from non-backward compatible carrier or extension carrier. However, UE staying at a DL carrier which does not broadcast PWS messages cannot receive the PWS messages.

3 Invented art

If multiple DL carriers e.g. DL CC#1, CC#2, CC#3 are aggregated, the network transmits PWS messages only from one of the DL carrier e.g. DL CC#1 that we call "PWS-CC" in this document.

In this case, the following options can help UE staying on CC#2 or CC#3 to receive the PWS messages. The CC that does not broadcast PWS messages is called "non-PWS-CC" in this document. Non-PWS CC could be either non-backward compatible CC or extension CC.

A PWS message is carried in one or more SIB from PWS-CC.

3.1 Reception of PWS indications before reception of PWS messages

PWS indication is used to inform UEs about a coming PWS message which will be transmitted in one or more SIBs.

The network will transmit PWS notifications on PWS-CC. Before the transmission of PWS notifications on PWS-CC, the network sends PWS notification indication. The PWS notification indication can be sent on PWS-CC and non-PWS-CC.

The PWS notification indication can be transmitted by one of the following ways:

1. By paging
2. By system information e.g. SIB Type 1
3. By PDCCH with a PWS specific RNTI (Radio Network Temporary Identity)
4. By a MAC control element on a common channel
5. By a RRC message on a common channel
6. By a dedicated signalling to a specific UE

Even if the PWS notification indication is not transmitted on SIB1 e.g. but transmitted in paging, SIB1 on PWS-CC can indicate that any PWS message is present on PWS-CC. Also, SIB1 on non-PWS-CC can indicate that any PWS message is present on PWS-CC. SIB1 on non-PWS-CC can also indicate which DL carrier is PWS-CC.

Thus, even if the PWS notification indication is not transmitted on SIB1 e.g. but transmitted in paging, UE can know if any PWS message is present by receiving SIB1 from either PWS-CC or non-PWS-CC.

Content of the PWS notification indication

The PWS notification indication can include an indication or a value tag informing UEs that a new PWS message is or will be transmitted from PWS-CC. If it is the value tag, when UE receives the value tag, UE stores the value tag. And then whenever UE receives a value tag, UE compares the stored value tag and the received value tag. If the stored value tag and the received value tag are different, UE considers a new PWS message to be transmitted from PWS-CC.

Furthermore, if the PWS notification indication is transmitted on non-PWS-CC, the PWS notification indication can indicate which DL CC(s) among all of the aggregated CCs will transmit a new PWS message (i.e. the DL CC index for a new PWS message). In this case, UE can receive the new PWS message from the indicated DL PWS-CC(s) e.g. during any of DRX periods.

Where UE receives the PWS notification indication

One or more DL carriers will be configured for a UE. Then, UE would receive the configured DL carriers.

UE receives the PWS notification indication from either PWS-CC or one of non-PWS-CC.

If PWS-CC is not configured and only non-PWS-CC(s) are configured for the UE, UE can receive PWS notification indication from one of the configured non-PWS-CCs. However, even if PWS-CC is not configured and only non-PWS-CC(s) are configured for the UE, UE could receive PWS notification indication from PWS-CC during any of DRX periods.

If PWS-CC is configured for the UE, UE can receive PWS notification indication from the configured PWS-CC.

Alternatively, regardless of the configured DL carriers for UE, system information from each DL CC can indicate which DL CC(s) among all of the aggregated CCs will transmit the PWS notification indication. In this case, UE can receive PWS notification indication from the indicated DL CC(s) e.g. during any of DRX periods. In addition, if system information from a certain DL CC does not indicate which DL CC(s) among all of the aggregated CCs will transmit the PWS notification indication, UE assumes that the PWS notification indication is transmitted on the DL CC and then receives the PWS notification indication on the DL CC.

3.2 Reception of PWS messages

According to section 3.1, UE receives the new PWS message based on the received PWS notification indication.

If UE assumes that a new PWS message will be transmitted from PWS-CC by receiving the indication or the value tag, UE receives the new PWS message on PWS-CC.

UE can know one specific PWS-CC or the list of PWS-CC(s) among the aggregated CCs by receiving system information e.g. SIB1 in a cell.

If system information indicates the list of PWS-CCs, which means there are more than one PWS-CC among the aggregated CCs, the PWS notification indication can indicate which DL CC(s) among all of the aggregated CCs will transmit a new PWS message (i.e. the DL CC index for a new PWS message). In this case, UE can receive the new PWS message from the indicated DL PWS-CC(s) e.g. during any of DRX periods.

Furthermore, if the PWS notification indication is transmitted on PWS-CC, the PWS notification indication transmitted on PWS-CC may not indicate the DL CC index for a new PWS message. If the PWS notification indication transmitted on PWS-CC does not indicate the DL CC index for a new PWS message, UE assumes that the new PWS message is transmitted on the DL CC where the PWS notification indication was transmitted and then receives the new PWS message on that DL CC.

Else if system information indicates only one specific PWS-CC, UE can receive the new PWS message on the PWS-CC that the system information indicates.

Else if system information does not indicate any PWS-CC, UE assumes that the new PWS message is transmitted on the DL CC where the system information was transmitted and then receives the new PWS message on that DL CC.

Discard of Message ID/SN and message segment

When UE receives a PWS message which includes a message ID and a serial number (SN), the UE stores the recently received message ID and SN and if the PWS message is not completely received, the UE also store a received segment of the PWS message. Then, whenever a cell changes, UE discard them.

However, if UE moves between DL carriers which are aggregated, UE dose not discard the stored message ID/SN or the stored segment of the PWS message.

Title : Implicit Release of SPS for Aggregated LTE carrier
Document for : Discussion and Decision

1 Prior Art

The Semi-Persistent Scheduling (SPS) for uplink or downlink is configured by RRC. SPS is mainly used for VoIP for which the data packets are periodically transmitted and small and semi-static in size. Semi-Persistent Scheduling C-RNTI is used as unique identification for semi-persistent scheduling and is indicated on PDCCH for SPS control or SPS data transmission.

E-UTRAN can allocate semi-persistent downlink resources for the first HARQ transmissions to UEs:

- RRC defines the periodicity of the semi-persistent downlink grant;
- PDCCH indicates whether the downlink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

When required, retransmissions are explicitly signalled via the PDCCH(s). In the sub-frames where the UE has semi-persistent downlink resource, if the UE cannot find its C-RNTI on the PDCCH(s), a downlink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI is assumed. Otherwise, in the sub-frames where the UE has semi-persistent downlink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the semi-persistent allocation for that TTI and the UE does not decode the semi-persistent resources.

In addition, E-UTRAN can allocate a semi-persistent uplink resource for the first HARQ transmissions and potentially retransmissions to UEs:

- RRC defines the periodicity of the semi-persistent uplink grant;
- PDCCH indicates whether the uplink grant is a semi-persistent one i.e. whether it can be implicitly reused in the following TTIs according to the periodicity defined by RRC.

In the sub-frames where the UE has semi-persistent uplink resource, if the UE cannot find its C-RNTI on the PDCCH(s), an uplink transmission according to the semi-persistent allocation that the UE has been assigned in the TTI can be made. The network performs decoding of the pre-defined PRBs according to the pre-defined MCS. Otherwise, in the sub-frames where the UE has semi-persistent uplink resource, if the UE finds its C-RNTI on the PDCCH(s), the PDCCH allocation overrides the persistent allocation for that TTI and the UE's transmission follows the PDCCH allocation, not the semi-persistent allocation. Retransmissions are either implicitly allocated in which case the UE uses the semi-persistent uplink allocation, or explicitly allocated via PDCCH(s) in which case the UE does not follow the semi-persistent allocation.

2 Problem of the prior art

Multiple carriers can be aggregated. Then, UE can receive higher-rate data or transmits higher-rate data through multiple aggregated Component Carriers (CC). However, this is mainly used for higher-rate service. Therefore, it seems unnecessary that VoIP service by using SPS is transmitted over more than two carriers.

On the other hand, the network can reconfigure the SPS from one CC #1 to another CC #2. In that case, the network should set up the new SPS configuration in CC #2 and release the old SPS configuration in CC #1, which cause two different procedures.

3 Invented art

To simplify SPS reconfiguration from one CC to another CC (either in uplink or in downlink), we provide several options.

Option 1: Implicit release of RRC SPS configuration in one CC

When UE RRC has the SPS configuration such as SPS interval in CC #1, if eNB RRC configures another SPS in CC #2 for the UE (and if eNB does not explicitly indicate keeping the SPS configuration in CC #1), the UE RRC implicitly release the SPS configuration in CC #1.

Example 1a:

1. UE L1/L2 receives data from SPS resource on DL CC #1 according to the old SPS configuration given by eNB RRC
2. UE RRC receives a new SPS configuration which is given by eNB RRC and is applied to DL CC #2.
3. UE RRC implicitly releases the old SPS configuration on DL CC #1 and stops receiving any SPS data on DL CC #1.
4. UE RRC applies the new SPS configuration to DL CC #2.
5. UE L1/L2 receives data from SPS resource on DL CC #2 according to the new SPS configuration given by eNB RRC.

Furthermore, when UE RRC has the SPS configuration for CC #1, if eNB RRC indicates CC #2 for SPS without detailed SPS configuration such as SPS interval i.e. eNB RRC signals an empty SPS configuration with CC #2, the UE applies the SPS configuration to CC #2, instead of CC #1.

Example 1b:

1. UE L1/L2 receives data from SPS resource on DL CC #1 according to the old SPS configuration given by eNB RRC
2. UE RRC receives an empty SPS configuration with a CC index indicating DL CC #2 which is given by eNB RRC without detailed SPS configuration.
3. UE L1/L2 stops receiving any SPS data on DL CC #1.
4. UE RRC applies the SPS configuration to DL CC #2 instead of DL CC #1.
5. UE L1/L2 receives data from SPS resource on DL CC #2 according to the SPS configuration given by eNB RRC.

Option 2: Implicit release of initiated(active) SPS resource in one CC

eNB may configure more than one CC for SPS and so UE could receive/transmit SPS data through one CC or the other CC. The same RRC SPS configuration such as SPS interval is applied to either one CC or the other CC.

When PDCCH with SPS-CRNTI initiates/re-initiates a DL assignment or a UL grant for SPS transmission, the PDCCH also indicates which CC a radio resource (i.e. the DL assignment or the UL grant) is initiated/re-initiated for SPS transmission on (i.e. a CC index). If PDCCH with SPS-CRNTI initiates/re-initiates a radio resource for SPS transmission on CC #2 while another radio resource is still active for SPS transmission on CC #1 with a RRC SPS configuration, the UE corresponding to SPS-CRNTI implicitly releases the radio resource for SPS transmission on CC #1 and initiates/re-initiates the radio resource for SPS transmission on CC #2 while keeping the same RRC SPS configuration.

Example 2a:

1. UE MAC receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE MAC receives PDCCH with SPS-CRNTI and a CC index which initiates/re-initiates a SPS resource which was periodically assigned on CC #2 for SPS transmission.
3. UE MAC implicitly releases the SPS resource which was periodically assigned on DL CC #1 and stops receiving data from the SPS resource on DL CC #1.
4. UE MAC receives data from the SPS resource which was periodically assigned on DL CC #2 according to the initiation/re-initiation by the PDCCH with SPS-CRNTI and the CC index indicating CC #2.

Sub-option 2-1: SPS Re-transmission on another CC

Furthermore, when PDCCH with SPS-CRNTI indicates a DL assignment or a UL grant for SPS retransmission, the CC index on the PDCCH also indicates which CC the DL assignment or the UL grant is used for the SPS retransmission on. Even if SPS is released(deactivated) on the CC that the PDCCH indicates for SPS retransmission,

For instance, in the example 2a, even if SPS is release(deactivated) on DL CC #1, when PDCCH with SPS-CRNTI indicates DL CC #1 as well as a SPS resource for SPS retransmission, the UE temporarily receives SPS retransmission from the SPS resource on DL CC #1 and turns back to DL CC #2 for SPS (re)transmission.

Example 2b:

1. UE receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE receives PDCCH with SPS-CRNTI and a CC index which indicates a DL assignment for SPS retransmission on DL CC #2
3. UE receives data on the SPS resource assigned by the DL assignment for SPS retransmission, through the CC indicated by the CC index i.e. DL CC #2.
4. UE turns back to DL CC #1 to receives SPS transmission or re-transmission.

Sub-option 2-2: Explicit SPS release for a specific CC

In addition, when PDCCH with SPS-CRNTI indicates SPS release, the CC index on the PDCCH also indicates which CC the (re)initiated DL assignment or the (re)initiated UL grant is released for the SPS on.

Example 2b:

1. UE receives data from a SPS resource which was periodically assigned on DL CC #1
2. UE receives PDCCH with SPS-CRNTI and a CC index which indicates SPS release for the the (re)initiated DL assignment for SPS transmission on DL CC #1
3. UE clears the the (re)initiated DL assignment for SPS transmission for the CC indicated by the CC index i.e. DL CC #1 and UE stops receiving data on the SPS resource through the CC indicated by the CC index.

Annex: Detailed Prior Art

3.1 5.3 DL-SCH data transfer

3.1.1 5.3.1 DL Assignment reception

Downlink assignments transmitted on the PDCCH indicate if there is a transmission on the DL-SCH for a particular UE and provide the relevant HARQ information.

When the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI during which it monitors PDCCH:

- if a downlink assignment for this TTI has been received on the PDCCH for the UE's C-RNTI, or Temporary C-RNTI:
 - if this is the first downlink assignment for this Temporary C-RNTI:
 - consider the NDI to have been toggled.
 - if the downlink assignment is for UE's C-RNTI and if the previous downlink assignment indicated to the HARQ entity of the same HARQ process was either a downlink assignment received for the UE's Semi-Persistent Scheduling C-RNTI or a configured downlink assignment:
 - consider the NDI to have been toggled regardless of the value of the NDI.

- indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI not to have been toggled;
 - indicate the presence of a downlink assignment and deliver the associated HARQ information to the HARQ entity for this TTI.
 - else, if the NDI in the received HARQ information is 0:
 - if PDCCH contents indicate SPS release:
 - clear the configured downlink assignment (if any);
 - if *timeAlignmentTimer* is running:
 - indicate a positive acknowledgement for the downlink SPS release to the physical layer.
 - else:
 - store the downlink assignment and the associated HARQ information as configured downlink assignment;
 - initialise (if not active) or re-initialise (if already active) the configured downlink assignment to start in this TTI and to recur according to rules in subclause 5.10.1;
 - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
 - consider the NDI bit to have been toggled;
 - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.
- else, if a downlink assignment for this TTI has been configured and there is no measurement gap in this TTI and this TTI is not an MBSFN subframe:
 - instruct the physical layer to receive, in this TTI, transport block on the DL-SCH according to the configured downlink assignment and to deliver it to the HARQ entity;
 - set the HARQ Process ID to the HARQ Process ID associated with this TTI;
 - consider the NDI bit to have been toggled;
 - indicate the presence of a configured downlink assignment and deliver the stored HARQ information to the HARQ entity for this TTI.

For configured downlink assignments, the HARQ Process ID associated with this TTI is derived from the following equation:

HARQ Process ID = [floor(CURRENT_TTI/(Downlink Semi-Persistent Scheduling Interval))] modulo Number of Configured SPS Processes,

where CURRENT_TTI=[(SFN * 10) + subframe number], Downlink Semi-Persistent Scheduling Interval is the periodicity of semi-persistent scheduling signalled via RRC and Number of Configured SPS Processes is the number of HARQ processes allocated for semi-persistent scheduling signalled via RRC.

When the UE needs to read BCCH, the UE may, based on the scheduling information from RRC:

- if a downlink assignment for this TTI has been received on the PDCCH for the SI-RNTI;
- if the redundancy version is not defined in the PDCCH format:
 - the redundancy version of the received downlink assignment for this TTI is determined by $RV_k = \text{ceiling}(3/2 * k) \text{ modulo } 4$, where k depends on the type of system information message: for *SystemInformationBlockType1* message,

$k = (\text{SFN}/2) \text{ modulo } 4$, where SFN is the system frame number; for *SystemInformation* messages, $k=i \text{ modulo } 4$, $i = 0, 1, \dots, n_s^w - 1$, where i denotes the subframe number within the SI window n_s^w ;

- indicate a downlink assignment and redundancy version for the dedicated broadcast HARQ process to the HARQ entity for this TTI.

3.1.2 5.3.2 HARQ operation

3.1.2.1 5.3.2.1 HARQ Entity

There is one HARQ entity at the UE which maintains a number of parallel HARQ processes. Each HARQ process is associated with a HARQ process identifier. The HARQ entity directs HARQ information and associated TBs received on the DL-SCH to the corresponding HARQ processes (see subclause 5.3.2.2).

The number of DL HARQ processes is specified in [2], clause 7.

When the physical layer is configured for spatial multiplexing [2], one or two TBs are expected per subframe and they are associated with the same HARQ process. Otherwise, one TB is expected per subframe.

The UE shall:

- If a downlink assignment has been indicated for this TTI:
 - allocate the TB(s) received from the physical layer and the associated HARQ information to the HARQ process indicated by the associated HARQ information.
- If a downlink assignment has been indicated for the broadcast HARQ process:
 - allocate the received TB to the broadcast HARQ process.

NOTE: In case of BCCH a dedicated broadcast HARQ process is used.

3.1.2.2 5.3.2.2 HARQ process

For each subframe where a transmission takes place for the HARQ process, one or two (in case of spatial multiplexing) TBs and the associated HARQ information are received from the HARQ entity.

For each received TB and associated HARQ information, the HARQ process shall:

- if the NDI, when provided, has been toggled compared to the value of the previous received transmission corresponding to this TB; or
- if the HARQ process is equal to the broadcast process and if this is the first received transmission for the TB according to the system information schedule indicated by RRC; or
- if this is the very first received transmission for this TB (i.e. there is no previous NDI for this TB):
 - consider this transmission to be a new transmission.
- else:
 - consider this transmission to be a retransmission.

The UE then shall:

- if this is a new transmission:
 - replace the data currently in the soft buffer for this TB with the received data.
- else if this is a retransmission:
 - if the data has not yet been successfully decoded:
 - combine the received data with the data currently in the soft buffer for this TB.

- if the TB size is different from the last valid TB size signalled for this TB:
 - the UE may replace the data currently in the soft buffer for this TB with the received data.
- attempt to decode the data in the soft buffer for this TB;
- if the data in the soft buffer was successfully decoded for this TB:
 - if the HARQ process is equal to the broadcast process:
 - deliver the decoded MAC PDU to upper layers.
 - else if this is the first successful decoding of the data in the soft buffer for this TB:
 - deliver the decoded MAC PDU to the disassembly and demultiplexing entity.
 - generate a positive acknowledgement (ACK) of the data in this TB.
- else:
 - generate a negative acknowledgement (NACK) of the data in this TB.
- if the HARQ process is associated with a transmission indicated with a Temporary C-RNTI and the Contention Resolution is not yet successful (see subclause 5.1.5); or
- if the HARQ process is equal to the broadcast process; or
- if *timeAlignmentTimer* is stopped or expired:
 - do not indicate the generated positive or negative acknowledgement to the physical layer.
- else:
 - indicate the generated positive or negative acknowledgement for this TB to the physical layer.

The UE shall ignore NDI received in all downlink assignments on PDCCH for its Temporary C-RNTI when determining if NDI on PDCCH for its C-RNTI has been toggled compared to the value in the previous transmission.

3.1.3 5.3.3 Disassembly and demultiplexing

The UE shall disassemble and demultiplex a MAC PDU as defined in subclause 6.1.2.

3.2 5.4 UL-SCH data transfer

3.2.1 5.4.1 UL Grant reception

In order to transmit on the UL-SCH the UE must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently. To perform requested transmissions, the MAC layer receives HARQ information from lower layers.

When *timeAlignmentTimer* is running and the UE has a C-RNTI, Semi-Persistent Scheduling C-RNTI, or Temporary C-RNTI, the UE shall for each TTI :

- if an uplink grant for this TTI has been received on the PDCCH for the UE's C-RNTI or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
 - if the uplink grant is for UE's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the UE's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:
 - consider the NDI to have been toggled regardless of the value of the NDI.
- deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.

- else, if an uplink grant for this TTI has been received on the PDCCH for the UE's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI not to have been toggled;
 - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
 - else if the NDI in the received HARQ information is 0:
 - if PDCCH contents indicate SPS release:
 - clear the configured uplink grant (if any).
 - else:
 - store the uplink grant and the associated HARQ information as configured uplink grant;
 - initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI and to recur according to rules in subclause 5.10.2;
 - consider the NDI bit to have been toggled;
 - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if an uplink grant for this TTI has been configured:
 - consider the NDI bit to have been toggled;
 - deliver the configured uplink grant, and the associated HARQ information to the HARQ entity for this TTI.

NOTE: The period of configured uplink grants is expressed in TTIs.

NOTE: If the UE receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions in the same UL subframe, the UE may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the UE processes the grant but does not transmit on UL-SCH.

3.2.2 5.4.2 HARQ operation

3.2.2.1 5.4.2.1 HARQ entity

There is one HARQ entity at the UE, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for HARQ the feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes is specified in [2], clause 8.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process.

When TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e the TTI corresponding to TTI_BUNDLE_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle.

For transmission of Msg3 during Random Access (see section 5.1.5) TTI bundling does not apply.

For each TTI, the HARQ entity shall:

- identify the HARQ process associated with this TTI;

- if an uplink grant has been indicated for this TTI:
 - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
 - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or
 - if the uplink grant was received in a Random Access Response:
 - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
 - obtain the MAC PDU to transmit from the Msg3 buffer.
 - else:
 - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
 - deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
 - instruct the identified HARQ process to trigger a new transmission.
 - else:
 - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
 - instruct the identified HARQ process to generate an adaptive retransmission.
- else, if the HARQ buffer of the HARQ process corresponding to this TTI is not empty:
 - instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission UE shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

3.2.2.2 5.4.2.2 HARQ process

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable *CURRENT_TX_NB*, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable *HARQ_FEEDBACK*, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, *CURRENT_TX_NB* shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable *CURRENT_IRV* is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt.

The UE is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set *HARQ_FEEDBACK* to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set *CURRENT_TX_NB* to 0;

- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
- if the HARQ entity requests an adaptive retransmission:
 - store the uplink grant received from the HARQ entity;
 - set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
 - set HARQ_FEEDBACK to NACK;
 - generate a transmission as described below.
- else if the HARQ entity requests a non-adaptive retransmission:
 - if HARQ_FEEDBACK = NACK:
 - generate a transmission as described below.

NOTE: When receiving a HARQ ACK alone, the UE keeps the data in the HARQ buffer.

NOTE: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- if there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer in this TTI:
 - instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
 - increment CURRENT_IRV by 1;
- if there is a measurement gap at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
 - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions - 1:
 - flush the HARQ buffer;

3.3 5.10 Semi-Persistent Scheduling

When Semi-Persistent Scheduling is enabled by RRC, the following information is provided [8]:

- Semi-Persistent Scheduling C-RNTI;
- Uplink Semi-Persistent Scheduling interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;
- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;
- Downlink Semi-Persistent Scheduling interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

3.3.1 5.10.1 Downlink

After a Semi-Persistent downlink assignment is configured, the UE shall consider that the assignment recurs in each subframe for which:

- $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalDL}] \text{ modulo } 10240$, for all $N > 0$.

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured downlink assignment were (re-)initialised.

3.3.2 5.10.2 Uplink

After a Semi-Persistent Scheduling uplink grant is configured, the UE shall:

- if *twoIntervalsConfig* is enabled by upper layer:
 - set the *Subframe_Offset* according to Table 7.4-1.
- else:
 - set *Subframe_Offset* to 0.
- consider that the grant recurs in each subframe for which:
 - $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalUL} + \text{Subframe_Offset} * (N \text{ modulo } 2)] \text{ modulo } 10240$, for all $N > 0$.

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured uplink grant were (re-)initialised.

The UE shall clear the configured uplink grant immediately after *implicitReleaseAfter* [8] number of consecutive new MAC PDUs each containing zero MAC SDUs have been provided by the Multiplexing and Assembly entity, on the Semi-Persistent Scheduling resource.

NOTE: Retransmissions for Semi-Persistent Scheduling can continue after clearing the configured uplink grant.

3.4 5.11 Handling of unknown, unforeseen and erroneous protocol data

When a MAC entity receives a MAC PDU for the UE's C-RNTI or Semi-Persistent Scheduling C-RNTI, or by the configured downlink assignment, containing reserved or invalid values, the MAC entity shall:

- discard the received PDU.

1 Introduction

In DC-HSUPA, unlike primary carrier, secondary carrier is dynamically activated or de-activated by NodeB. but, it has not been discussed about a procedure of UE behaviour when secondary carrier is re-activated from de-activation.

Accordingly, this document will discuss on UE behaviour after secondary carrier is re-activated from de-activation.

2 Discussion

2.1 Flush of HARQ process buffer on secondary carrier

When secondary carrier of UE is de-activated, it is possible that there exists data to be transmitted in HARQ buffer. For instance, when secondary carrier is de-activated after NodeB receives data through the secondary carrier from the UE and transmits HARQ ACK, if ACK-to-NACK takes place in the UE's side, the UE may not discard the data from the HARQ buffer. After that, if the secondary carrier of the UE is re-activated by Node B, the UE would try to retransmit the remaining data in the HARQ buffer since the HARQ buffer of the UE is not empty. Therefore, when the secondary carrier is de-activated, the UE can prevent unnecessary transmission by flushing the HARQ buffer.

Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier when secondary carrier is de-activated (or re-activated).

2.2 Initial variables on secondary carrier

According to the current agreement, UE does not initialize the value of Serving Grant when secondary carrier is de-activated. Accordingly, when the secondary carrier is re-activated, the UE uses the value of the Serving Grant which was determined when the secondary carrier is de-activated. In this case, it is possible for the UE to falsely consider as if the UE received Serving Grant although the UE didn't receive the Serving Grant from NodeB.

Therefore, similar to the process in which the secondary carrier is initially activated, the UE needs to have a process to initialize a variable related to the Serving Grant Update Function or to initialize a timer value in the case where the secondary carrier is re-activated.

Proposal 2: The UE shall initialize variables and timers related to serving grant update function when secondary carrier is re-activated (or de-activated).

3 Conclusion

For the correct operation of secondary carrier, the followings are proposed at secondary carrier de-activation or re-activation:

Proposal 1: The UE shall flush HARQ process buffer corresponding to the secondary carrier.

Proposal 2: The UE shall initialize variables and timers for serving grant update function.

A text proposal is attached in section 4.

4 Appendix

11.8.1.3.2 Handling at start of E-DCH transmission

In CELL_DCH state when E-DCH transmission is started or Secondary Uplink Frequency is re-activated by lower layer, the UE shall on that carrier:

- activate all HARQ processes;
- if the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:
 - update the state variables and timers according to subclause 11.8.1.3.5.
- else:
 - initialise the state variable Serving_Grant to Zero_Grant;
 - initialise the state variable Primary_Grant_Available to "False";
 - initialise the state variable Stored_Secondary_Grant to "Zero_Grant".
- initialise the state variables reference_ETPR and reference_ETPR2 to "Minimum_Grant";
- initialise the state variable Maximum_Serving_Grant to the highest possible value (i.e. index 37 in table 9.2.5.2.1.1 or 9.2.5.2.1.2 as configured by higher layers).

11.8.1.10 De-activation on Secondary Uplink Frequency

If Secondary Uplink Frequency is de-activated by lower layer, the UE shall:

- deactivate all HARQ processes corresponding to secondary carrier
- flush all buffers corresponding to secondary carrier;

Or

11.8.1.10 De-activation on Secondary Uplink Frequency

If Secondary Uplink Frequency is de-activated by lower layer, the UE shall:

- deactivate all HARQ processes and flush all buffers corresponding to secondary carrier;

Title : SIB13 Change for LTE MBMS
Document for : Discussion and Decision

Introduction

In this document, we discuss how to handle SIB13 change for LTE MBMS.

Value Tag in SIB1

In the last meeting, it was identified in [1] that if MBSFN areas dynamically change, cells will be added to or removed from an MBSFN area in short intervals, in which case SIB13 content would change quite often. This might lead unicast UEs to wake up frequently and unnecessarily for paging.

To limit impact on unicast UEs, it was proposed in [2] that change of SIB 13 does not change the value tag in SIB1. We also support this proposal because, if change of SIB 13 changes the value tag in SIB1, unicast UEs will wake up frequently and unnecessarily.

Proposal 1: change of SIB 13 does not change the value tag in SIB1.

How to indicate SIB13 change

It was also proposed in [2] that change of SIB 13 for MBMS is indicated in a paging message, similar to change of SIB10, SIB11 and SIB12 for PWS. However, we see some differences between MBMS SIB and PWS SIBs.

First of all, PWS SIBs are used for emergency situations and so change of PWS SIBs may occur once a year. However, MBMS SIB is used for normal MBMS services. If MBMS is deployed in the network, MBMS SIB changes occur more often. That means if SIB13 change is indicated in paging, unnecessary wake-up of unicast UEs would happen more frequently for a whole life of UEs.

Secondly, even though PWS is optional, reception of PWS SIBs would be required for most of UEs in some regions due to regulation. However, reception of MBMS is optional and not a regulatory issue. Thus, we assume that indication of MBMS SIB change in paging would cause more occurrence of unnecessary UE wake-up than indication of PWS SIB change in paging.

Due to the reasons above, we propose not to accept indication of SIB13 change in paging. Instead, we provide alternatives for limiting impact on unicast UEs. We propose to accept one of the alternatives below.

Proposal 2: we propose not to indicate SIB change in paging.

Alternative 1: SIB13 change indication on PDCCH with M-RNTI

MBMS UE receives M-RNTI on PDCCH to identify whether a service it is interested to receive is started or ongoing in a cell. In addition to M-RNTI on PDCCH, MBSFN area ID is indicated on PDCCH. Even though we did not decide how many bits will be used for the short indication of MBSFN area on PDCCH, we think that 1 bit on PDCCH with M-RNTI could be sufficient to indicate change of SIB13. (If 2 or more bits on PDCCH remain unused, they could be used as a MBMS specific value tag for indicating SIB13 change.)

In fact, MBSFN area ID on PDCCH is linked to the list of MBSFN areas in SIB13. If a MBSFN area is added or removed from the list in SIB13, meaning of the short indication of MBSFN area on PDCCH can be changed. Thus, if UE does not find out SIB13 change, UE could misunderstand the short indication of MBSFN area on PDCCH and so may receive incorrect MBSFN subframe for reading MCCH. In this sense, SIB13 change indication on PDCCH with M-RNTI could be beneficial because UE can know that meaning of the short indication of MBSFN area on PDCCH is changed at the same time when it knows SIB13 change indication.

Use of 1 bit on PDCCH could be a drawback of this scheme. However, it seems to be not painful. And someone could argue that reading PDCCH for MBMS notification is optional for UE. But, we think that it is not costly for MBMS capable UEs.

Proposal 3 for alternative 1: MBMS capable UE from Rel-9 checks PDCCH with M-RNTI to know change of SIB13.

One thing to say is that since SIB13 does not dynamically change in Rel-9, 1 bit on PDCCH with M-RNTI seems to be not needed for Rel-9. Thus, if dynamic change of MBSFN areas is not used, the network could indicate to MBMS capable UEs that 1 bit on PDCCH with M-RNTI is not used. In this case, MBMS capable UEs read SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception. However, we feel that 1 bit on PDCCH is not so costly and therefore if the alternative 1 is accepted, UE uses the 1 bit on PDCCH to check change of SIB13 from Rel-9, in which case UE behaviours in Rel-9 and the future releases are consistent.

Alternative 2: Periodic reading of SIB13 content

If SIB13 dynamically changes, MBMS capable UE could periodically read SIB13 content. For this purpose, we could introduce a timer. Whenever the timer expires, UE reads SIB13. Whenever UE completes reading SIB13, UE re-starts the timer. One benefit of this scheme is that no signalling overhead is introduced in downlink. Instead of using a timer, the period for reading SIB13 can be used. The period for reading SIB13 could be aligned with modification period of MCCH because change of SIB13 mainly impacts MCCH transmissions.

The timer or the period for reading SIB13 can be signalled by SIB1 which signals SI scheduling information or by SIB2 which signals the MBSFN subframe configuration.

Proposal 3-1 for alternative 2: MBMS capable UE periodically reads SIB13 according to a timer or a period configured by the network.

Since SIB13 does not dynamically change in Rel-9, periodic reading of SIB13 seems to be not needed for Rel-9. For this reason, only if SIB13 dynamically changes in the future, the Rel-9 network should signal the timer or the period for reading SIB13, in which case Rel-9 UE reads SIB13 according to the timer or the period. Otherwise, the Rel-9 network does not need to signal the timer or the period for reading SIB13, in which case Rel-9 UE reads SIB13 as it reads Rel-8 SIBs except SIB10/11 because infrequent SIB13 change has only a minor impact on unicast UEs. That is beneficial because periodic reading of SIB13 could be sort of costly for UE power consumption.

Proposal 3-2 for alternative 2: If there is no timer or no period configured by the network, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).

Alternative 3: Periodic reading of the MBMS specific value tag in SIB1

Instead of periodic reading of SIB13, UE could periodically read the MBMS specific value tag in SIB1. The MBMS specific value tag is different than the existing value tag in SIB1 and so change of the MBMS specific value tag has no impact on unicast UEs. To avoid unnecessary wake-up of unicast UEs, change of the MBMS specific value tag should not trigger any paging with system information modification.

Like handling of non-MBMS value tag in SIB1, if SIB13 changes, the network increase the MBMS specific value tag. Whenever UE receives a new MBMS specific value tag, UE verifies whether the stored one and the new one are same or not. If they are different, UE considers SIB13 changed, stores the MBMS specific value tag, and then reads SIB13. Otherwise, UE does not read SIB13.

One benefit of periodic reading SIB1 is that UE could get change of non-MBMS SIBs as well as MBMS SIB by reading SIB1.

Proposal 3-1 for alternative 3: MBMS capable UE periodically reads the MBMS specific value tag in SIB1 according to a timer or a period configured by the network.

Similar to alternative 2, since SIB13 does not dynamically change in Rel-9, periodic reading of SIB1 seems to be not needed for Rel-9. For this reason, we propose that if no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception.

Proposal 3-2 for alternative 3: If no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).

Timing between SIB13 and PDCCH/MCCH

SIB13 carries information on each MBSFN area. If any MBSFN area information in SIB13 is added, modified, or removed, when the change in SIB13 is applied to PDCCH/MCCH is not clear.

PDCCH with M-RNTI and MCCH can change only at MCCH Modification Period (MP) boundaries. And PDCCH with M-RNTI is indicated one MP before MCCH transmission. Thus, if any MBSFN area information in SIB13 is added, modified, or removed, the change in SIB13 should be applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).

Proposal 4: UEs assume that changes in SIB13 are applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).

In addition, if SIB13 content is added, modified, or removed in the midst of a MP, new SIB13 content cannot be applied to PDCCH with M-RNTI in this MP because PDCCH with M-RNTI before transmission of new SIB13 content is based on old SIB13 content in this MP. Thus, if SIB13 content is added, modified or removed, the network should apply the change to PDCCH with M-RNTI in the next MP, not in this MP after changing SIB13 content.

Proposal 5: UE assumes that the recent update of SIB13 is applied to PDCCH with M-RNTI in the next MP after receiving the recent update of SIB13.

Conclusion

In summary, we propose the following proposals:

- Proposal 1: Change of SIB 13 does not change the value tag in SIB1.
- Proposal 2: SIB change is not indicated in paging.
- Proposal 3: one of the alternatives below is used for MBMS capable UEs to get SIB13 change.
 - o Alternative 1: MBMS capable UE from Rel-9 checks PDCCH with M-RNTI to know change of SIB13.
 - o Alternative 2: MBMS capable UE periodically reads SIB13 according to a timer or a period configured by the network.
 - In addition, if there is no timer or no period configured by the network, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).
 - o Alternative 3: MBMS capable UE periodically reads the MBMS specific value tag in SIB1 according to a timer or a period configured by the network.
 - In addition, if no MBMS specific value tag is contained in SIB1, MBMS capable UE reads SIB13 as it reads normal Rel-8 SIBs i.e. no special handling of SIB13 reception (mainly for Rel-9 UEs).
- Proposal 4: UEs assume that changes in SIB13 are applied to PDCCH with M-RNTI one MP before being applied to MCCH(s).
- Proposal 5: UE assumes that the recent update of SIB 13 is applied to PDCCH with M-RNTI in the next MP after receiving the recent update of SIB 13.

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