



3GPP_TSG_RAN_WG2 Archives

August 2016, Week 5

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Subject: [\[95#07\]LTE/Latency reduction](#) CR to 36.321 Ericsson

From: Henrik Enbuske <[log in to unmask](#)>

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Parts/Attachments: [text/plain](#) (955 bytes) , [text/html](#) (43 kB) , [draft_36321_CR0920_\(Rel-14\)_R2-165767](#) - (58 kB)



Dear all,

Again, thank you all for your efforts in the RAN2 meeting, and I hope you all have returned home safely.
With this email I'd like to kick-off the below email discussion:

[95#07]LTE/Latency reduction] – CR to 36.321 – Ericsson
- Include possible agreements as a result of RAN1 LS
Intended outcome: Agreed CR for RAN
Deadline: Thursday 01/09/2016

Attached is a clean draft based on the outcome of the offline discussion in RAN2#95.

Remarks:

- As a result of the LS from RAN1, a sentence has been added in 5.4.3.1 (highlighted) as a proposed solution on how the UE shall handle periodic CSI.
- This draft includes the RVO setting as no new agreements have been made, and as a result of this being an open issue this email discussion needs to decide on this point.

The RAN1 LS can be found in R2-164554

I look forward to companies' views, comments and suggestions, if any.

Cheers,
/Henrik

[ATOM](#)[RSS1](#)[RSS2](#)

CHANGE REQUEST

CR-Form-v11.1

36.321 CR 0920 rev - Current version: 13.2.0

For **HELP** on using this form: comprehensive instructions can be found at
<http://www.3gpp.org/Change-Requests>.

Proposed change affects: UICC apps ☐ ME ☒ Radio Access Network ☒ Core Network ☐

Title:	Introduction of L2 latency reduction techniques		
Source to WG:	Ericsson		
Source to TSG:	R2		
Work item code:	LTE_LATRED_L2	Date:	2016-08-28
Category:	B	Release:	Rel-14
Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:	
F (correction)		Rel-8 (Release 8)	
A (mirror corresponding to a change in an earlier release)		Rel-9 (Release 9)	
B (addition of feature),		Rel-10 (Release 10)	
C (functional modification of feature)		Rel-11 (Release 11)	
D (editorial modification)		Rel-12 (Release 12)	
Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		Rel-13 (Release 13)	
		Rel-14 (Release 14)	

Reason for change:	Introduction of L2 latency reduction techniques.
Summary of change:	1. Skip transmission if no data (only padding BSR) in case of dynamic grant (skipUplinkTxDynamic) - (RAN2#93bis: "It is assumed that the UE behaviour of muting for SPS or dynamic grants will be the same. Separate configuration of skipping for SPS and dynamic grant will be introduced.") 2. Skip transmission if no data (only padding BSR) in case of SPS grant (skipUplinkTxSPS) - (RAN2#93bis: "It is assumed that the UE behaviour of muting for SPS or dynamic grants will be the same. Separate configuration of skipping for SPS and dynamic grant will be introduced.") 3. As SPS activation cofirmation, trigger MAC CE. - (RAN2#94: "The new MAC CE will also be used for SPS activation feedback. The same MAC CE is used (i.e. same LCHID)") 4. As SPS release confirmation, trigger MAC CE. - (RAN2#94: "New MAC CE for SPS deactivation feedback when skipping padding feature is configured. No scheduling request is triggered. - SPS resource is cleared after first transmission of the new MAC CE. Retransmission of MAC CE can continue after clearing the configured UL grant. ")

5. Disables *implicitReleaseAfter* when skip transmission is configured.
 - (RAN2#93bis: "If the UE is configured with SPS and UL skipping, then implicit release is not supported. How this is captured in the specs is FFS")
6. Introduced Non-adaptive retransmission on SPS resources (prioritized over new data transmission)
 - (RAN2#94: "Allow and prioritize non-adaptive retransmissions on SPS resources")
7. Non-adaptive retransmissions are based on RV0 for uplink skipping on SPS.
 (RAN2#94 working assumption: "Non-adaptive retransmissions are done based on RV0. FFS if anything additional is needed")

 RAN2#95: "Pending RAN1 confirmation, fixed RV is done when uplink skipping for SPS is configured and applicable to all related non-adaptive retransmissions. For dynamic grant skipping legacy RV behaviour applies."
8. Grant handling in TDD

 RAN2#94: "If one UL SPS subframe calculated according to the SPS occasion calculation formula is a downlink subframe or a special subframe, the UE will skip this UL SPS occasion"
9. RAN2#95: "For UL skipping, the UE configured with periodic BSR only transmit when the UE buffer is non-empty"
10. RAN2#95: An UL grant triggering Aperiodic CSI transmission is considered as a regular dynamic UL grant. UL skipping does not apply in this case

Consequences if not approved: Feature of skipping padding transmissions is not supported.

Clauses affected: 5.4.1, 5.4.2.1, 5.4.2.2, 5.4.3.1, 5.10.2, 6.1.3.10

	Y	N		
Other specs affected: (show related CRs)	☐	☐	Other core specifications	TS/TR ... CR ...
	☐	☐	Test specifications	TS/TR ... CR ...
	☐	☐	O&M Specifications	TS/TR ... CR ...

Other comments:

5.4.1 UL Grant reception

In order to transmit on the UL-SCH the MAC entity 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 the physical layer is configured for uplink spatial multiplexing, the MAC layer can receive up to two grants (one per HARQ process) for the same TTI from lower layers.

If the MAC entity has a C-RNTI, a Semi-Persistent Scheduling C-RNTI, or a Temporary C-RNTI, the MAC entity shall for each TTI and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this TTI:

- if an uplink grant for this TTI and this Serving Cell has been received on the PDCCH for the MAC entity'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 MAC entity'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 MAC entity's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:
 - consider the NDI to have been toggled for the corresponding HARQ process 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 this Serving Cell is the SpCell and if an uplink grant for this TTI has been received for the SpCell on the PDCCH of the SpCell for the MAC entity's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI for the corresponding HARQ process 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:
 - if the MAC entity is configured with *skipUplinkTxSPS*:
 - trigger an SPS confirmation;
 - if an uplink grant for this TTI has been configured:
 - consider the NDI bit for the corresponding HARQ process to have been toggled;
 - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI;
 - else:
 - clear the configured uplink grant (if any).
- else:
 - if the MAC entity is configured with *skipUplinkTxSPS*:
 - trigger an SPS confirmation;
 - 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;
 - if UL HARQ operation is asynchronous, set the HARQ Process ID to the HARQ Process ID associated with this TTI;

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- consider the NDI bit for the corresponding HARQ process to have been toggled;
 - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if this Serving Cell is the SpCell and an uplink grant for this TTI has been configured for the SpCell:
- if UL HARQ operation is asynchronous, set the HARQ Process ID to the HARQ Process ID associated with this TTI;
 - consider the NDI bit for the corresponding HARQ process 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 MAC entity receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions on the SpCell in the same UL subframe, the MAC entity 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 MAC entity processes the grant but does not transmit on UL-SCH. When a configured uplink grant is indicated during a Sidelink Discovery gap for reception and indicates an UL-SCH transmission during a Sidelink Discovery gap for transmission with a SL-DCH transmission, the MAC entity processes the grant but does not transmit on UL-SCH.

For configured uplink grants, the HARQ Process ID associated with this TTI is derived from the following equation for asynchronous UL HARQ operation:

$$\text{HARQ Process ID} = [\text{floor}(\text{CURRENT_TTI} / \text{semiPersistSchedIntervalUL})] \bmod \text{numberOfConfULSPS-Processes},$$

where $\text{CURRENT_TTI} = [(\text{SFN} * 10) + \text{subframe number}]$ and it refers to the subframe where the first transmission of a bundle takes place.

Next change

5.4.2.1 HARQ entity

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

The number of parallel HARQ processes per HARQ entity is specified in [2], clause 8. NB-IoT has one UL HARQ process.

When the physical layer is configured for uplink spatial multiplexing [2], there are two HARQ processes associated with a given TTI. Otherwise there is one HARQ process associated with a given TTI.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process(es) 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(es).

In asynchronous HARQ operation, a HARQ process is associated with a TTI based on the received UL grant except for UL grant in RAR. Except for NB-IoT, each asynchronous HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RAR, HARQ process identifier 0 is used. HARQ feedback is not applicable for asynchronous UL HARQ.

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. TTI bundling is not supported when the MAC entity is configured with one or more SCells with configured uplink.

Uplink HARQ operation is asynchronous for NB-IoT UEs, BL UEs or UEs in enhanced coverage except for the repetitions within a bundle.

For NB-IoT UEs, BL UEs or UEs in enhanced coverage, the parameter UL_REPETITION_NUMBER provides the number of transmission repetitions within a bundle. For each bundle, UL_REPETITION_NUMBER is set to a value provided by lower layers. 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 are triggered without waiting for feedback from previous transmissions according to UL_REPETITION_NUMBER. An uplink grant corresponding to a new transmission or a retransmission of the bundle is only received after the last repetition of the bundle. A retransmission of a bundle is also a bundle.

TTI bundling is not supported for RN communication with the E-UTRAN in combination with an RN subframe configuration.

For transmission of Msg3 during Random Access (see subclause 5.1.5) TTI bundling does not apply. For NB-IoT UEs, BL UEs or UEs in enhanced coverage, uplink repetition bundling is used for transmission of Msg3.

For each TTI, the HARQ entity shall:

- identify the HARQ process(es) associated with this TTI, and for each identified HARQ process:
 - if an uplink grant has been indicated for this process and 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 if the MAC entity is configured with semiPersistSchedIntervalUL shorter than sf10 and if the uplink grant is a configured grant, and if the HARQ buffer of the identified HARQ process is not empty and if HARQ_FEEDBACK of the identified HARQ process is NACK:
 - instruct the identified HARQ process to generate a non-adaptive retransmission.
 - else:
 - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity, if any;
 - if a MAC PDU to transmit has been obtained:
 - 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 this HARQ process is not empty:

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- 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 the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

Next change

5.4.2.2 HARQ process

Each HARQ process is associated with a HARQ buffer.

For synchronous HARQ, 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. For BL UEs or UEs in enhanced coverage see subclause 8.6.1 in [2] for the sequence of redundancy versions and redundancy version determination. For NB-IoT UEs see subclause 16.5.1.2 in [2] for the sequence of redundancy versions and redundancy version determination.

For NB-IoT UEs, BL UEs or UEs in enhanced coverage for `UL_REPETITION_NUMBER` for Mode B operation, the same redundancy version is used multiple times before cycling to the next redundancy version as specified in Subclause 16.5.1.2, 8.6.1 and 7.1.7.1 in [2].

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.

For synchronous HARQ, the MAC entity 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:

- if UL HARQ operation is synchronous:
 - set `CURRENT_TX_NB` to 0;
 - set `HARQ_FEEDBACK` to NACK;
 - set `CURRENT_IRV` to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- generate a transmission as described below.

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

- if UL HARQ operation is synchronous:
 - 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;
 - if UL HARQ operation is synchronous:
 - set HARQ_FEEDBACK to NACK;
 - generate a transmission as described below.
- else if the HARQ entity requests a non-adaptive retransmission:
 - if UL HARQ operation is asynchronous or HARQ_FEEDBACK = NACK:
 - if the MAC entity is configured with skipUplinkTxSPS and the uplink grant of the initial transmission of this HARQ process was a configured grant:
 - set CURRENT_IRV to 0;
 - generate a transmission as described below.

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

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

NOTE: For asynchronous HARQ operation, UL retransmissions are triggered only by adaptive retransmission grants, except for retransmissions within a bundle.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- if Sidelink Discovery Gaps for Transmission are not configured by upper layers, and 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; or
- if Sidelink Discovery Gaps for Transmission are configured by upper layers, and 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, and there is no Sidelink Discovery Gap for Transmission in this TTI; or
- if Sidelink Discovery Gaps for Transmission are configured by upper layers, and 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, and there is a Sidelink Discovery Gap for Transmission, and there is no configured grant for transmission on SL-DCH 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 UL HARQ operation is synchronous and there is a measurement gap or Sidelink Discovery Gap for Reception 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, if UL HARQ operation is synchronous the HARQ process then shall:

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

Next change

5.4.3 Multiplexing and assembly

5.4.3.1 Logical channel prioritization

The Logical Channel Prioritization procedure is applied when a new transmission is performed.

RRC controls the scheduling of uplink data by signalling for each logical channel: *priority* where an increasing *priority* value indicates a lower priority level, *prioritisedBitRate* which sets the Prioritized Bit Rate (PBR), *bucketSizeDuration* which sets the Bucket Size Duration (BSD). For NB-IoT, *prioritisedBitRate*, *bucketSizeDuration* and the corresponding steps of the Logical Channel Prioritisation procedure (i.e., Step 1 and Step 2 below) are not applicable.

The MAC entity shall maintain a variable B_j for each logical channel j . B_j shall be initialized to zero when the related logical channel is established, and incremented by the product $PBR \times TTI$ duration for each TTI, where PBR is Prioritized Bit Rate of logical channel j . However, the value of B_j can never exceed the bucket size and if the value of B_j is larger than the bucket size of logical channel j , it shall be set to the bucket size. The bucket size of a logical channel is equal to $PBR \times BSD$, where PBR and BSD are configured by upper layers.

The MAC entity shall perform the following Logical Channel Prioritization procedure when a new transmission is performed:

- The MAC entity shall allocate resources to the logical channels in the following steps:
 - Step 1: All the logical channels with $B_j > 0$ are allocated resources in a decreasing priority order. If the PBR of a logical channel is set to “infinity”, the MAC entity shall allocate resources for all the data that is available for transmission on the logical channel before meeting the PBR of the lower priority logical channel(s);
 - Step 2: the MAC entity shall decrement B_j by the total size of MAC SDUs served to logical channel j in Step 1;

NOTE: The value of B_j can be negative.

- Step 3: if any resources remain, all the logical channels are served in a strict decreasing priority order (regardless of the value of B_j) until either the data for that logical channel or the UL grant is exhausted, whichever comes first. Logical channels configured with equal priority should be served equally.
- The UE shall also follow the rules below during the scheduling procedures above:
 - the UE should not segment an RLC SDU (or partially transmitted SDU or retransmitted RLC PDU) if the whole SDU (or partially transmitted SDU or retransmitted RLC PDU) fits into the remaining resources of the associated MAC entity;
 - if the UE segments an RLC SDU from the logical channel, it shall maximize the size of the segment to fill the grant of the associated MAC entity as much as possible;
 - the UE should maximise the transmission of data.
 - if the MAC entity is given an UL grant size that is equal to or larger than 4 bytes while having data available for transmission, the MAC entity shall not transmit only padding BSR and/or padding (unless the UL grant size is less than 7 bytes and an AMD PDU segment needs to be transmitted).

The MAC entity shall not transmit data for a logical channel corresponding to a radio bearer that is suspended (the conditions for when a radio bearer is considered suspended are defined in [8]).

If the MAC PDU includes only the MAC CE for padding BSR or periodic BSR with zero MAC SDUs and there is no aperiodic CSI requested for this TTI, the MAC entity shall not generate the MAC PDU to the HARQ entity in the following cases:

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- in case the MAC entity is configured with skipUplinkTxDynamic and the grant indicated to the HARQ entity was addressed to a C-RNTI; or
- in case the MAC entity is configured with skipUplinkTxSPS and the grant indicated to the HARQ entity is a configured uplink grant;

For the Logical Channel Prioritization procedure, the MAC entity shall take into account the following relative priority in decreasing order:

- MAC control element for C-RNTI or data from UL-CCCH;
- MAC control element for SPS confirmation;
- MAC control element for BSR, with exception of BSR included for padding;
- MAC control element for PHR, Extended PHR, or Dual Connectivity PHR;
- MAC control element for Sidelink BSR, with exception of Sidelink BSR included for padding;
- data from any Logical Channel, except data from UL-CCCH;
- MAC control element for BSR included for padding;
- MAC control element for Sidelink BSR included for padding.

NOTE: When the MAC entity is requested to transmit multiple MAC PDUs in one TTI, steps 1 to 3 and the associated rules may be applied either to each grant independently or to the sum of the capacities of the grants. Also the order in which the grants are processed is left up to UE implementation. It is up to the UE implementation to decide in which MAC PDU a MAC control element is included when MAC entity is requested to transmit multiple MAC PDUs in one TTI. When the UE is requested to generate MAC PDU(s) in two MAC entities in one TTI, it is up to UE implementation in which order the grants are processed.

5.4.3.2 Multiplexing of MAC Control Elements and MAC SDUs

The MAC entity shall multiplex MAC control elements and MAC SDUs in a MAC PDU according to subclauses 5.4.3.1 and 6.1.2.

Next change

5.10.2 Uplink

After a Semi-Persistent Scheduling uplink grant is configured, the MAC entity 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 sequentially that the N^{th} grant occurs in the subframe for which:

- $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalUL} + \text{Subframe_Offset} * (N \bmod 2)] \bmod 10240$.

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.

For TDD, if the N^{th} grant occurs in a downlink subframe or a special subframe, it is considered as invalid.

If the MAC entity is not configured with *skipUplinkTxSPS*, the MAC entity 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.

If SPS confirmation has been triggered and not cancelled:

- if the MAC entity has UL resources allocated for new transmission for this TTI:
 - instruct the Multiplexing and Assembly procedure to generate an SPS confirmation MAC Control Element as defined in subclause 6.1.3.xx;
 - cancel the triggered SPS confirmation.

The MAC entity shall clear the configured uplink grant immediately after first transmission of SPS confirmation MAC Control Element triggered by the SPS release.

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

For BL UEs or UEs in enhanced coverage $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ refer to SFN and subframe of the first transmission of PUSCH where configured uplink grant was (re-)initialized.

Next change

6.1.3.xx SPS confirmation MAC Control Element

The SPS confirmation MAC control element is identified by a MAC PDU subheader with LCID as specified in table 6.2.1-2.

It has a fixed size of zero bits.

Next change

Table 6.2.1-2 Values of LCID for UL-SCH

Index	LCID values
00000	CCCH
00001-01010	Identity of the logical channel
01011	CCCH
01100- 10101	Reserved
10101	SPS confirmation
10110	Truncated Sidelink BSR
10111	Sidelink BSR
11000	Dual Connectivity Power Headroom Report
11001	Extended Power Headroom Report
11010	Power Headroom Report
11011	C-RNTI
11100	Truncated BSR
11101	Short BSR
11110	Long BSR
11111	Padding