**3GPP TSG RAN WG1 #107-e R1-211xxxx**

**e-Meeting, November 11th – 19th, 2021**

**Agenda item:** 8.16.3

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** [draft] Summary on UE features for enhanced IIoT and URLLC

**Document for:** Discussion and Decision

# **Introduction**

This document summarizes contributions submitted to AI 8.16.3 regarding UE features for enhanced IIoT and URLLC and captures the following email discussion.

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| [107-e-R17-UE-features-eIIoT-URLLC-01] Email discussion UE features for enhanced IIoT and and URLLC – Shinya (DOCOMO)   * 1st check point: November 15 * Final check point: November 19 |

In the updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e [1], there are following feature groups for enhanced IIoT and URLLC.

* 25-1 SPS HARQ-ACK deferral in case of TDD collision
* 25-2 Repetitions for PUCCH format 0, and 2 over multiple slots with K = 2, 4, 8
* 25-3 Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with configured K = 2, 4, 8
* 25-3a Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication
* 25-4 One-shot HARQ ACK feedback triggered by DCI format 1\_2
* 25-5 PHY priority handling for one-shot HARQ ACK feedback
* 25-6 Enhanced type 3 HARQ-ACK codebook feedback
* 25-7 Triggered HARQ-ACK codebook re-transmission
* 25-8 Semi-static HARQ-ACK codebook for sub-slot PUCCH
* 25-9 Semi-static PUCCH cell switching
* 25-10 PUCCH cell switching based on dynamic indication
* 25-11 4-bits subband CQI
* 25-12 UE initiating a semi-static channel occupancy with configurations dependent on gNB semi-static channel access configurations
* 25-13 UE initiating a semi-static channel occupancy with independent configurations from gNB semi-static channel access configurations
* [25-14] PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH
* [25-15] PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH
* 25-16 HARQ-ACK with different priorities multiplexing using a PUCCH
* 25-17 HARQ-ACK piggybacked on a PUSCH of a different priority
* 25-18 Parallel PUCCH and PUSCH transmission across CCs in inter-band CA

The issues to be discussed are tagged and colour coded with High priority, Medium priority, or Low priority, considering RAN2 impact especially for capability signaling design.

Companies are requested to check the proposals tagged FL1 for the discussion in the GTW session on Nov 11th.

# **25-1: SPS HARQ-ACK deferral in case of TDD collision**

In [1], FG 25-1 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-1 | SPS HARQ-ACK deferral in case of TDD collision | 1. Idenfify HARQ-ACK bits of active SPS configurations for deferral in the initial PUCCH slot  2. Determination of the target PUCCH slot for SPS HARQ-ACK deferral  3. Multiplexing and transmission of deferred SPS HARQ-ACK information in the target PUCCH slot  FFS whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK | 5-18 | Yes | N/A |  | Per UE | No  (TDD only) | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. There is a typo “Idenfify” in the column of components. 2. For the type, we are fine with per UE. Looking at the SPS HARQ-ACK deferral mechanism itself, the motivation to support finer granularity e.g. per band or FSPC, is not clear to us. 3. For the FFS whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK, it seems better to introduce a separate feature group 25-1a. According to the agreement, in case the UE is expected to receive PDSCH of a certain HARQ process ID, the deferred SPS HARQ bit(s) of this HARQ Process ID are dropped. However, depending on the gap between the PDSCH and the resource to transmit the deferred SPS HARQ bit(s), there might be no sufficient time for UE to drop the deferred HARQ-ACK, or it will require UE with higher capability to be able to always drop the HARQ-ACK. However, we are open to discuss it.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-1a | Handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK | Handle the collision for the same HARQ process due to deferred SPS HARQ-ACK | 25-1 | Yes | N/A |  | Per UE | No (TDD only) | No | N/A |  | Optional with capability signaling | |
| [4] | vivo | **FG 25-1**  Prerequisite FG  In Rel-15, *downlinkSPS* is configured per UE corresponding to FG 5-18 since only one SPS configuration is supported per cell group. In Rel-16, *sps-r16* is defined per band i.e., FG12-2 indicates whether the UE support of up to 8 configured SPS configurations in a BWP of a serving cell and up to 32 configured SPS configurations in a cell group. So, we think prerequisite feature groups should include both FG 5-18 or FG12-2.  whether/how to separate the capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK  According to the agreement on SPS HARQ-ACK deferral, when UE receives a PDSCH of a certain HARQ Process ID, the deferred SPS HARQ bit(s) for this HARQ Process ID would be dropped. Some companies have the concern that the check on the potential collision and doing the dropping would bring additional complexity. The separate UE capability is required. From UE complexity perspective, we are fine to separate the capability for handling of the collision for the same HARQ process ID due to deferred SPS HARQ-ACK. Additional UE FG, i.e., FG 25-1a, can be introduced for UE with capability to handle the collision for the same HARQ process ID due to deferred SPS HARQ-ACK. For UE only supporting 25-1 but not 25-1a, it is not expected to handle the collision for the same HARQ process due to deferred SPS HARQ-ACK, which means gNB should avoid such collision.  Type  The prerequisite feature groups of FG 25-1 is FG 5-18 and FG 12-2. Considering type of FG 12-2 is per Band, type of FG 25-1 should be at least per band.  ***Proposal 1: For FG25-1, prerequisite feature groups should include FG 5-18 or FG12-2. FG 25-1a can be introduced for UE with capability to handle the collision for the same HARQ process due to deferred SPS HARQ-ACK.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-1 | SPS HARQ-ACK deferral in case of TDD collision | 1.  Idenfify HARQ-ACK bits of active SPS configurations for deferral in the initial PUCCH slot  2.  Determination of the target PUCCH slot for SPS HARQ-ACK deferral  3. Multiplexing and transmission of deferred SPS HARQ-ACK information in the target PUCCH slot  ~~FFS whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK~~ | ~~5-18~~5-18or12-2 | Yes | N/A |  | Per ~~UEBand~~ | No | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-1a | Handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK | Handle the collision for the same HARQ process due to deferred SPS HARQ-ACK | 25-1 | Yes | N/A |  | Per ~~UEBand~~ | No | No | N/A | For UE only supporting 25-1 but not 25-1a, it is not expected to handle the collision for the same HARQ process due to deferred SPS HARQ-ACK, which means gNB should avoid such collision. | Optional with capability signaling | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-1:**   + No need for separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK |
| [6] | Ericsson | * **Companies are encouraged to provide views on whether the type of FG 25-1 should be per UE or per band or per FSPC**  |  |  | | --- | --- | | Ericsson | Per UE. It is not clear to show band differentiation would impact the feature and the corresponding testing. Also, considering RAN2 recommendation, FSPC should be avoided as much as possible (R2-2002378) |  1. Adopt “Per UE” type for FG 25-1. |
| [7] | OPPO | There is an FFS on whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK. To our understanding, UE only needs to drop the earlier SPS HARQ-ACK for a certain HARQ process, the behavior is not much different with the current behavior which UE flashes the HARQ buffer when new data of the same HARQ process arrives. With the above understanding, this feature seems not complex UE implementation. Therefore, we prefer not to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK, instead, adding some description to the component part is enough.  ***Proposal 1: For FG 25-1, it is preferred not to separate capability for handling of same HARQ process collision due to deferred SPS HARQ-ACK. Add description for handling of HARQ process collision in Components of FG 25-1:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-1 | SPS HARQ-ACK deferral in case of TDD collision | 1.  Idenfify HARQ-ACK bits of active SPS configurations for deferral in the initial PUCCH slot  2.  Determination of the target PUCCH slot for SPS HARQ-ACK deferral  3. Multiplexing and transmission of deferred SPS HARQ-ACK information in the target PUCCH slot  **4. In case UE is expected to receive PDSCH of a certain HARQ process ID, the deferred SPS HARQ bit(s) for this HARQ process ID are dropped.** | 5-18 | Yes | N/A |  | Per UE | **TDD only** | No | N/A |  | Optional with capability signaling | |
| [8] | Intel Corporation | * 25-1 SPS HARQ-ACK deferral in case of TDD collision:   + Regarding the FFS whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK, we think this feature may require further discussion. As per agreements, a UE may need to drop deferred HARQ-ACK bits when those overlap with a new period and the same HARQ process. This is not part of the regular deferral procedure. At the same time, if the gNB would not have much flexibility to avoid it by scheduling/implementation, then this feature may need to be mandatory for the UE support SPS HARQ-ACK deferral. The slight preference is to not introduce such a capability. |
| [9] | Samsung | It is not clear what main motivation separate capability provides for the case of handling of the collision due to same HARQ process. This is because similar UE behavior is already considered under 25-1 where HARQ-ACK information for a certain HARQ process ID should be dropped if deferral timing exceeds maximum configured deferral value. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-1:   + Type:     - Per-band preferred. A stronger use case is with Rel-16 multiple SPS configurations (12-2) rather than 5-18. Since 12-2 is per band, per band is also preferred for 25-1. |
| [11] | NTT DOCOMO, INC. | * FG 25-1: SPS HARQ-ACK deferral in case of TDD collision   + Regarding the FFS whether to separate capability for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK, the additional UE behavior would be to check HARQ process collision and to drop the collided deferred SPS HARQ, which would not require much complexity compared to the different HARQ process case. Thus, we don’t think the separate capability is needed.   + Type should be per UE   + The prerequisite feature groups are FG 5-18 or FG 12-2 to cover multiple SPS configurations case |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  With regards to the Feature 25-1 (SPS HARQ Deferral in TDD), the feature is not necessary at FDD. Prerequisite for this feature is SPS support - feature 5-18-whose RRC Parent IE is *Phy-ParametersCommon* and therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 2:* Feature 25-1 (SPS HARQ Deferral in TDD collision) is for TDD only. Furthermore, it should a per Feature Set Per Component Carrier (FSPC) feature rather than a per UE feature.** |

## **Discussion**

**[FL1] High priority proposal 2-1:**

* **Add a component for handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK in FG25-1 (i.e., no separate FG for this capability)**
  + Support: Nokia, NSB, OPPO, [Intel], Samsung, DOCOMO
    - The behavior is not much different with the current behavior which UE flashes the HARQ buffer when new data of the same HARQ process arrives
    - similar UE behavior is already considered under 25-1 where HARQ-ACK information for a certain HARQ process ID should be dropped if deferral timing exceeds maximum configured deferral value.
    - gNB would not have much flexibility to avoid it by scheduling/implementation
  + Not support: Huawei, HiSilicon, vivo
    - Depending on the gap between the PDSCH and the resource to transmit the deferred SPS HARQ bit(s), there might be no sufficient time for UE to drop the deferred HARQ-ACK, or it will require UE with higher capability to be able to always drop the HARQ-ACK

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| Company | Comment |
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**Medium priority question 2-2:**

* **Companies are encouraged to provide views on whether the type of FG 25-1 should be per UE or per band or per FSPC**
  + Per UE: Huawei, HiSilicon, Ericsson, DOCOMO
  + Per band: vivo, Apple
  + Per FSPC: Qualcomm

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| Company | Comment |
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**Low priority question 2-3:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FG 25-1**

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| Company | Comment |
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**Low priority question 2-4:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 25-1 which do not have capability signaling impacts**

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| Company | Comment |
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# **25-2 to 25-3a: PUCCH Repetition enhancements**

In [1], FGs 25-2 to 25-3a are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-2 | Repetitions for PUCCH format 0, and 2 over multiple slots with K = 2, 4, 8 | Repetitions for PUCCH format 0 and 2 over multiple slots with K = 2, 4, 8 | 4-23 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-3 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with configured K = 2, 4, 8 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with RRC configured repetition factor K = 2, 4, 8  FFS whether to separate the capability per UCI type | 4-23  11-3 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-3a | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots based on dynamic repetition indication.  FFS whether to separate the capability per UCI type | 25-3  30-5 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | 1. FG 25-2: Fine with the current version, including the cells in yellow. 2. FG 25-3:    1. Change “Per UE” to “Per FS” to align with the granularity of the prerequisite.    2. Fine to introduce independent UE capabilities for different UCI types. For example, it seems no strong motivation to support sub-slot repetition for CSI reporting for URLLC. Separating the capability per UCI type leaves more flexibility at the UE side. 3. FG 25-3a:    1. Change “Per UE” to “Per FS” to align with the granularity of the prerequisite.    2. Remove 30-5 from coverage as the prerequisite. Sub-slot based repetition can apply same mechanism that designed for slot based repetition in terms of dynamic number indication, but as to the UE capability no strong dependency.    3. Remove the FFS whether to separate the capability per UCI type, since it is agreed that “*Dynamic PUCCH repetition factor indication for SR or P/SP-CSI on PUCCH is not supported in Rel-17.*”, the FFS in FG 25-3a should be removed. In addition, add a note in the note column to clarify that the FG 25-3a is only applied for HARQ-ACK transmission. An example is given as below:  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-3a | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots based on dynamic repetition indication. | 25-3  ~~30-5~~ | Yes | N/A |  | Per FS | N/A | N/A | N/A | Note: Sub-slot based PUCCH repetition with dynamic repletion indication is only applied to HARQ-ACK transmission. | Optional with capability signaling | |
| [4] | vivo | **FG 25-3 & 25-3a**  According to the latest agreements, sub-slot based PUCCH repetitions of all UCI types (incl. HARQ, SR & CSI) have been supported. Thus, FFS can be deleted.  Since prerequisite feature groups of FG 25-3 include both FG 11-3 and FG 4-23 and the type of FG 11-3 is Per *FeatureSetUplink*, we think the type of FG 25-3 should be per FS.  Similarly, since prerequisite feature groups of FG 25-3a include both FG 25-3 and FG 30-5 and the type of FG 25-3 should be Per FS as discussed above, the type of FG 25-3a should also be per FS.  ***Proposal 2: For FG 25-3, the type should be Per FS. FFS part can be deleted.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-3 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with configured K = 2, 4, 8 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with RRC configured repetition factor K = 2, 4, 8  ~~FFS whether to separate the capability per UCI type~~ | 4-23  11-3 | Yes | N/A |  | Per ~~UE~~FS | No | No | N/A |  | Optional with capability signaling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-3a | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots based on dynamic repetition indication.  ~~FFS whether to separate the capability per UCI type~~ | 25-3  30-5 | Yes | N/A |  | Per ~~UE~~FS | No | No | N/A |  | Optional with capability signaling | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-3**:   + No need for separate capabilities per UCI type * **25-3a:**    + The pre-requisite feature group from Cov. Enh. WI of the dynamic PUCCH repetition indication should be 30-5.   + No need for separate capabilities per UCI type |
| [6] | Ericsson | * **Companies are encouraged to provide views on whether to split FG 25-3 and 25-3a per UCI type supported with sub-slot repetitions**  |  |  | | --- | --- | | DOCOMO | We don’t think separate capabilities are needed for FG25-3 and 25-3a. Firstly, it has not been agreed that sub-slot based PUCCH repetition is supported for UCI types other than HARQ-ACK. Secondly, even if the UCI types are also supported, there should be no additional UE complexity because the same UE behavior on sub-slot based PUCCH repetition is applied to any UCI types. On the other hand, if only HARQ-ACK is supported in the end, it is fine to just add a note that it is only applicable to PUCCH carrying HARQ-ACK. | | Nokia, NSB | No need to split the FGs. In addition 25-3a could be removed assuming a UE indicating support for dynamic PUCCH repetition indication (30-5) and sub-slot based PUCCH repetition (25-3) would then also support dynamic repetition indication for sub-slot based PUCCH (25-3a). | | Ericsson | Agree with others. No need for split FGs. |  1. Do not split FG 25-3 and 25-3a per UCI type.  * **Companies are encouraged to provide views on whether the type of FGs 25-2 to 25-3a should be per UE or per FS or per FSPC**  |  |  | | --- | --- | | Ericsson | Per UE.  Same comment as before: It is not clear how band differentiation would impact the feature and the corresponding testing. Also, considering RAN2 recommendation, FSPC should be avoided as much as possible (R2-2002378) |  1. Adopt “Per UE” type for FG 25-3 and 25-3a. 2. For FG 25-2, remove prerequisite of 4-23. FG 4-23 is for PF1/3/4, not for PF0/2 3. For FG 25-3, remove prerequisite of 4-23. FG 4-23 is for slot based repetition, and not necessary condition for sub-slot based repetition |
| [7] | OPPO | There is an FFS on whether to separate the capability per UCI type for FG 25-3 and 25-3a. It has been agreed in last RAN1 meeting that RAN1 support sub-slot based PUCCH repetition configured with *nrofSlots* for all UCI types, while dynamic PUCCH repetition factor indication is not supported for SR or P/SP-CSI. So at least capability splitting for FG 25-3a does not need to be further discussed and further clarification that FG-3a is only supported for HARQ-ACK is needed. For FG 25-3, even though RAN1 finally supports different UCI type for sub-slot PUCCH repetition configured with *nrofSlots*, we do not see the need to split the FGs since no additional UE implementation complexity is observed for supporting different UCI type from our side.  **Agreement**  To align with Rel-16 slot-based PUCCH repetition operation, support sub-slot based PUCCH repetition configured with / using *nrofSlots* (i.e., not using dynamic indication) of all UCI types (incl. HARQ, SR & CSI).  **Agreement**  For sub-slot based PUCCH repetition, the following agreement from Cov. Enh. WI for slot-based PUCCH repetition is adopted also for sub-slot based PUCCH repetition:   |  | | --- | | *Agreement: Dynamic PUCCH repetition factor indication for SR or P/SP-CSI on PUCCH is not supported in Rel-17.* |   ***Proposal 2: No need to split FG 25-3 per UCI type.***  ***Proposal 3: Add description of dynamic PUCCH repetition factor indication is only supported for HARQ-ACK in Components of FG 25-3a:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-3a | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots based on dynamic repetition indication.  **Note: dynamic PUCCH repetition factor indication is only supported for HARQ-ACK** | 25-3  30-5 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | |
| [8] | Intel Corporation | * 25-3 Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH sub-slots with configured K = 2, 4, 8   + Regarding the FFS whether to separate the capability per UCI type, RAN1 agreed that PUCCH repetitions over sub-slots for semi-static repetition factor is supported for all UCI types. In our view, separate capability for some types may still be needed, e.g., for those which are not specifically requiring sub-slot repetitions, e.g. P/SP-CSI. * 25-3a Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication   + Regarding the FFS whether to separate the capability per UCI type, we don’t think it is required since as per agreements only HARQ-ACK UCI type supports it.   + Regarding the pre-requisite of 30-5 (dynamic slot-based repetition), we still think it should be removed. In our view, there is no direct relation with CovEnh feature. Slot-based repetitions target coverage improvement, while sub-slot based repetitions target better latency-reliability tradeoff. In that sense, a URLLC UE may choose to implement sub-slot based repetitions without support slot-based repetitions. * New 25-x1 feature, support inter-sub-slot frequency hopping for PUCCH repetitions over 7-OS sub-slots   + Since FH was agreed in RAN1#106bis-e, the feature supporting it needs to be defined. Note, that as proposed in our HARQ tdoc [1], it needs to be separate for 7-OS sub-slots and 2-OS sub-slots. * New 25-x2 feature, support inter-sub-slot frequency hopping for PUCCH repetitions over 2-OS sub-slots   + Since FH was agreed in RAN1#106bis-e, the feature supporting it needs to be defined. Note, that as proposed in our HARQ tdoc [1], it needs to be separate for 7-OS sub-slots and 2-OS sub-slots. |
| [9] | Samsung | It is preferable that 25-3 supports all UCI types without separating.  It is preferable that 25-3a supports all UCI types without separating. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-2:   + Prerequisite feature groups:     - Rel-15 feature is for PF 1/3/4, the dependence should be removed   + Type:     - Note the support of 25-2 does not have any merit other than avoiding fragmentation of specification, so 25-2 should follow 25-3’s designation for “Type”. * 25-3:   + Type:     - Since sub-slot URLLC feature in Rel-16 (11-3) is per FS, this should be per FS * 25-3a:   + Type:     - Since sub-slot URLLC feature in Rel-16 (11-3) is per FS, this should be per FS |
| [11] | NTT DOCOMO, INC. | * FG 25-2: Repetitions for PUCCH format 0, and 2 over multiple slots with K = 2, 4, 8   + Type should be per UE   + FG 4-23 can be removed from the prerequisite feature groups. UE could report FG 25-2 without dependency with FG 4-23. * FG 25-3: Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with configured K = 2, 4, 8   + Regarding the FFS whether to separate the capability per UCI type, we don’t think separate capabilities are needed for FG25-3. Although all UCI types are supported for sub-slot based PUCCH repetition, there should be no additional UE complexity because the same UE behavior on sub-slot based PUCCH repetition is applied to any UCI type.   + Type should be per UE   + FGs 4-23 and 11-3 can be kept as prerequisite feature groups * FG 25-3a: Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication   + Regarding the FFS whether to separate the capability per UCI type, we don’t think separate capabilities are needed for FG25-3a. Although all UCI types are supported for sub-slot based PUCCH repetition, there should be no additional UE complexity because the same UE behavior on sub-slot based PUCCH repetition is applied to any UCI types.   + Type should be per UE   + FGs 25-3 and 30-5 can be kept as prerequisite feature groups |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  With regards to 25-2 - Repetitions for PUCCH Format 0 and 2 over multiple slots-it would be useful to clarify that the HARQ Codebook is slot-based.The prerequisite for 25-2 is 4-23 – support for PUCCH repetitions- whose RRC Parent IE is *Phy-ParametersCommon* and therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 3:* For feature 25-2 (Repetitions for PUCCH Format 0 and 2 over multiple slots) a clarification needs to be made that the feature is for slot-based codebook. Furthermore, the feature should be supported per Feature Set Per Component Carrier (FSPC) rather than per UE.**  With regards to 25-3 - Repetitions for PUCCH Format 0, 1, 2, 3, 4 over multiple sub-slots-the prerequisites for 25-2 are:   * 4-23 – support for PUCCH repetitions - whose RRC Parent IE is *Phy-ParametersCommon* and * feature 11-3 - support for more than 1 PUCCH HARQ within a slot - whose RRC Parent IE is a *FeatureSetUplink-v1610* feature.   Therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 4:* For feature 25-3 (Repetitions for PUCCH Format 0, 1, 2, 3, 4 over multiple sub-slots) the feature should be supported per Feature Set Per Component Carrier (FSPC).** |
| [13] | MediaTek | In R15/R16, the UE reports the maximum number of PUCCHs per slot that is supported by the UE. The R17 UELLC/IIoT features listed below will be used to report the capability of supporting new PUCCH repetitions schemes. However, reporting these features for PUCCH repetitions shouldn’t imply an increase of the number of PUCCHs per slot that supported by the UE.   1. ***Reporting FG25-2, 25-3 and 25-3a doesn’t imply an increase in the maximum number of PUCCHs per slot that supported by the UE.*** |

## **Discussion**

**[FL1] High priority proposal 3-1:**

* **FG 25-3 is not split per UCI type**
  + Support: vivo, Nokia, NSB, Ericsson, OPPO, Samsung, DOCOMO
    - sub-slot based PUCCH repetitions of all UCI types (incl. HARQ, SR & CSI) have been supported
    - no additional UE complexity
  + Not support: Huawei, HiSilicon, Intel
    - no strong motivation to support sub-slot repetition for CSI reporting for URLLC
* **FG 25-3s is not split per UCI type**
  + **Add a note that dynamic PUCCH repetition factor indication is only supported for HARQ-ACK in the component column**
    - Support: Huawei, HiSilicon, vivo, Nokia, NSB, Ericsson, Intel, Samsung, DOCOMO
      * it is agreed that “Dynamic PUCCH repetition factor indication for SR or P/SP-CSI on PUCCH is not supported in Rel-17.”,

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| Company | Comment |
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**High priority question 3-2:**

* **Companies are encouraged to provide views on whether to add following new FGs**
  + **FG for support of inter-sub-slot frequency hopping for PUCCH repetitions over 7-OS sub-slots**
  + **FG for support of inter-sub-slot frequency hopping for PUCCH repetitions over 2-OS sub-slots**

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**Medium priority question 3-3:**

* **Companies are encouraged to provide views on whether the type of FGs 25-2 to 25-3a should be per UE or per FS or per FSPC**
  + FG 25-2
    - Per UE: Huawei, HiSilicon, DOCOMO
    - Per FS:
    - Per FSPC: Qualcomm
    - Same as FG 25-3: Apple
  + FG 25-3
    - Per UE: Ericsson, DOCOMO
    - Per FS: Huawei, HiSilicon, vivo, Apple
    - Per FSPC: Qualcomm
  + FG 25-3a
    - Per UE: Ericsson, DOCOMO
    - Per FS: Huawei, HiSilicon, vivo, Apple
    - Per FSPC:

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**Low priority question 3-4:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 25-2 to 25-3a**

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**Low priority question 3-5:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 25-2 to 25-3a which do not have capability signaling impacts**

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# **25-4 to 25-7: Retransmission of cancelled HARQ-ACK**

In [1], FGs 25-4 to 25-7 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-4 | One-shot HARQ ACK feedback triggered by DCI format 1\_2 | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 scheduling a PDSCH  2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value | 10-16  11-1 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-5 | PHY priority handling for one-shot HARQ ACK feedback | Support transmission of type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI | 10-16  11-4 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support configuration of up to X enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | 10-16 | Yes | N/A |  | Per UE | No | No | N/A | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-7 | Triggered HARQ-ACK codebook re-transmission | 1. Support HARQ-ACK re-transmission from an earlier PUCCH slot based on the triggering information in DCI format 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | 1. FG 25-4/5: Change “Per UE” to “Per band” to align with the granularity of the prerequisite. 2. FG 25-6:    1. Change “Per UE” to “Per band” to align with the granularity of the prerequisite.    2. Add a component for the maximum number of simultaneously configurable enhanced Type 3 CB.    3. Add a component for the maximum number of configured CCs for CB generation and a component for the maximum number of configured HARQ processes for CB generation. According to the agreement below, smaller CB size is achieved by either limited to a subset of configured CC or a subset of configured HARQ processes, UE capability should be set on the maximum number of configured CC or the maximum number of configured HARQ processes.   ==========  **Agreement**  The following enhanced Type 3 CB types of smaller size are supported, the CB to contain either:   * the HARQ processes of a subset of configured CCs, or * a subset of configured HARQ processes (specific to CCs)   FFS: additional enh. Type 3 CB types  **==========**   * 1. Delete 10-16 from the prerequisite feature group for FG 25-6. Enhanced type 3 HARQ-ACK codebook feedback is to achieve smaller size compared to Rel-16 type 3 HARQ-ACK codebook, thus the support of enhanced type 3 doesn't necessarily mean the support of Rel-16 type 3 HARQ-ACK codebook.   2. For enhanced type 3 HARQ-ACK codebook, different UE capabilities should be set for combination of enhanced type 3 HARQ-ACK codebook with slot-based PUCCH and sub-slot based PUCCH, similar as FG 25-8 for type 1 HARQ-ACK codebook. Therefore, FG 25-6 should be limited to slot-based PUCCH while add a new FG 25-6a for sub-slot PUCCH.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback for slot PUCCH | 1. Support feedback of enhanced type 3 HARQ-ACK codebook for slot PUCCH, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to X enhanced type 3 HARQ-ACK codebooks for slot PUCCH.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook for slot PUCCH based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  ~~4~~. Support transmission of enhanced type 3 HARQ-ACK codebook for slot PUCCH using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4)  5. Supported maximum number of configured CCs Y for an enhanced type 3 codebook.  6. Supported maximum number of configured HARQ processes Z for an enhanced type 3 codebook. | ~~10-16~~ | Yes | N/A |  | Per band | N/A | N/A | N/A | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured  For component 5, the UE indicates its capability in the number of configured CCs: {1,...,Y}  For component 5, the UE indicates its capability in the number of configured HARQ processes: {1,...,Z} | Optional with capability signaling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-6a | Enhanced type 3 HARQ-ACK codebook feedback for sub-slot PUCCH | 1. Support feedback of enhanced type 3 HARQ-ACK codebook for sub-slot PUCCH, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to X enhanced type 3 HARQ-ACK codebooks for sub-slot PUCCH.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook for sub-slot PUCCH based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook for sub-slot PUCCH using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4)  5. Supported maximum number of configured CCs Y for an enhanced type 3 codebook.  6. Supported maximum number of configured HARQ processes Z for an enhanced type 3 codebook.  7. Supported maximum number of actual PUCCH transmissions for enhanced type 3 HARQ-ACK codebook within a slot  Candidate values for the component 6 of FG25-6a is: For NCP, {1,2,4,7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {1,2,4,6} for 2-symbol\*6 sub-slot configuration | 25-6  11-3 | Yes | N/A |  | Per band | N/A | N/A | N/A | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured  For component 4, the UE indicates its capability in the number of CCs: {1,...,Y}  Component 6 is reported for 2-symbol\*7 sub-slot configuration. For 7-symbol\*2 sub-slot configuration, the value of component 6 is {2} for both NCP and ECP cases. | Optional with capability signaling |  1. FG 25-7: Fine with the current FG 25-7, including the cells in yellow. |
| [3] | ZTE | **Index 25-4:**  Index 25-4 is for One-shot HARQ ACK feedback triggered by DCI format 1\_2. The components consists of two parts:  1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 scheduling a PDSCH  2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value.  RAN1 has the agreement in RAN1#106bis-e meeting that:   |  | | --- | | **Agreement**  Reuse the legacy 1-bit ‘*one-shot HARQ-ACK request*’ for triggering indication of the enhanced Type 3 HARQ-ACK CB of smaller size.   * At least if only a single enhanced Type 3 HARQ-ACK CB is configured, the triggering DCI with the triggering bit set to ‘1’ is also able to schedule PDSCH. |   But there is no clear agreement on supporting feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH. Although it is well known that feedback of Rel-16 type 3 HARQ-ACK codebook has been supported, triggered by a DCI 1\_1 without scheduling a PDSCH, it is natural to copy the behaviour to new DCI format 1\_2. But should we explicitly indicate this in the table of UE feature after we have achieved the consensus or agreement. By now we suggest putting the brackets in the second bullet.  ***Proposal 1:*** *The following adjustment is proposed for 25-4.*   |  | | --- | | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 scheduling a PDSCH  [2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value] |   **Index 25-6 and 25-7:**  The two indices are separately for the Enhanced type 3 HARQ-ACK codebook feedback and Triggered HARQ-ACK codebook re-transmission. The common things are both supporting DCI format 1\_2 and two HARQ-ACK codebooks / PUCCH config. The feature of supporting DCI format 1\_2 is 11-1 and the feature of supporting two HARQ-ACK codebooks / PUCCH config is 11-4. So we are wondering why we not include 11-1 and 11-4 both in the prerequisite feature column of index 25-6 and 25-7.  ***Proposal 2:*** *Include 11-1 and 11-4 both in the prerequisite feature group column of index 25-6 and 25-7.*  Also in 25-7, the component of description for Triggered HARQ-ACK codebook re-transmission is not clear. The “earlier PUCCH slot” is not clear to aim the cancelled HARQ-ACK codebook, below adjustment can clarity the retransmission is for the cancelled HARQ-ACK codebook, the cancellation of the HARQ-ACK codebook is due to various reasons, such as conflicts with the HP channel or Dl symbols, or cancellation based on CI. So we propose:  ***Proposal 2:*** *The following adjustment is proposed for component of 25-7*.   |  | | --- | | * 1. Support HARQ-ACK re-transmission ~~from an earlier PUCCH slot~~ of the cancelled HARQ-ACK based on the triggering information in DCI format 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1) * 2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | |
| [4] | vivo | **FG 25-4 & FG 25-5 & FG25-6**   * **whether/how to separate FGs 25-4 to 25-6**   From UE complexity perspective, it is unnecessity to further split UE capability into FG 25-4a, FG25-5a and 25-6a for reduced size Type 3 codebook. The reason for introducing FG25-4 and 25-5 for Type 3 codebook with full size is mainly because Type3 codebook with full size and DCI format 1\_2 and PHY priority handling are specified in different WIs, due to time limitation, the two FGs are not supported in Rel-16.  According to the latest agreements, the maximum number of simultaneously configurable enhanced Type 3 CB supported by a UE is 8, which should be updated in FG 25-6.  FG 10-16 is the prerequisite feature groups of FG 25-4/5/6, which type is Per band. Thus, the type of FGs 25-4 to 25-6 should be Per band.  ***Proposal 3: It is unnecessary to further split UE capability FGs 25-4 to 25-6. The maximum number of configurable enhanced Type 3 CB is updated as follow.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-4 | One-shot HARQ ACK feedbacktriggered by DCI format 1\_2 | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 scheduling a PDSCH  2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value | 10-16  11-1 | Yes | N/A |  | Per ~~UEBand~~ | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-5 | PHY priority handling for one-shot HARQ ACK feedback | Support transmission of type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI | 10-16  11-4 | Yes | N/A |  | Per ~~UEBand~~ | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to ~~X~~ 8 enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | 10-16 | Yes | N/A |  | Per ~~UEBand~~ | No | No | N/A | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured | Optional with capability signaling |   **FG 25-7**  For first bullet in components column of FG 25-7, we think ‘sub-slot’ should be added.  ***Proposal 4: For FG 25-7 ‘sub-slot’ should be added in components column.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-7 | Triggered HARQ-ACK codebook re-transmission | 1. Support HARQ-ACK re-transmission from an earlier PUCCH slot or sub-slot based on the triggering information in DCI format 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-5**   + RAN1 agreed to support UE capability signaling of {1,2,4,8} CBs, and therefore the description of component 2 in ’Components’ and ’Note’ would need to be changed accordingly (in green):  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to 8~~X~~ enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | 10-16 | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,2,4,8~~...,X~~}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured | Optional with capability signaling | |
| [6] | Ericsson | * **Companies are encouraged to provide views on whether the type of FGs 25-4 to 25-7 should be per UE or per band or per FSPC**  |  |  | | --- | --- | | Ericsson | Per UE.  Same comment as before: It is not clear how band differentiation would impact the feature and the corresponding testing. Also, considering RAN2 recommendation, FSPC should be avoided as much as possible (R2-2002378) |  1. Adopt “Per UE” type for FG 25-4 to 25-7. |
| [7] | OPPO | For FG 25-6, it uses FG 10-16 (the FG of Rel-16 One-shot HARQ ACK feedback) as prerequisite feature group. This seems not reasonable to us since UE may choose to implement the Rel-17 enhanced Type 3 HARQ-ACK codebook feedback for partial HARQ-ACK retransmission to increase the system spectrum efficiency, but choose not to support the FG of Rel-16 One-shot HARQ ACK feedback since the feedback is so redundant. The logic is, a Rel-17 feature may be implemented by UE supporting only Rel-15 functionalities, instead of Rel-16. In such a case, it is preferred not to use FG 10-16 as the prerequisite feature group for FG 25-6.  In addition, the components of FG 25-6 include support of enhanced Type 3 CB triggered by DCI format 1\_1 AND DCI format 1\_2. However, similar logic as the above, UE may only choose to implement the triggering mechanism in DCI format 1\_1 OR DCI format 1\_2, so it is preferred to change the wording “DCI format 1\_1 and DCI format 1\_2” in the components of FG 25-6 to “DCI format 1\_1 and/or DCI format 1\_2”.  Moreover, it has been agreed in last RAN1 meeting that the maximum number of simultaneously configurable enhanced Type 3 CB is indicated by the UE through UE capability signaling from the set of {1,2,4,8}, so it is suggested to separate the capability of different maximum number of enhanced Type 3 CB since it surely requires different UE implementation complexity.  **Agreement**  The maximum number of simultaneously configurable enhanced Type 3 CB is indicated by the UE through UE capability signaling from the set of {1, 2, 4, 8}.  ***Proposal 4: Modify FG 25-6 as:***   1. ***It is preferred not to use FG 10-16 as the prerequisite feature group for FG 25-6*** 2. ***Change the wording “DCI format 1\_1 and DCI format 1\_2” in the components to “DCI format 1\_1 and/or DCI format 1\_2”*** 3. ***Add FG 25-6a, 25-6b, 25-6c for handling of different maximum number of simultaneously configurable enhanced Type 3 CB(s)***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback **with maximum 1 configured Type 3 CB** | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and**/or** DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to **1** enhanced type 3 HARQ-ACK codebooks.  3. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | ~~10-16~~ | Yes | N/A |  | Per UE | No | No | N/A | ~~For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X},~~  ~~For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured~~ | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-6a | Enhanced type 3 HARQ-ACK codebook feedback **with maximum 2 configured Type 3 CB** | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and**/or** DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to **2** enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and**/or** DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | ~~10-16~~ | Yes | N/A |  | Per UE | No | No | N/A | ~~For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X},~~  ~~For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured~~ | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-6b | Enhanced type 3 HARQ-ACK codebook feedback  **with maximum 4 configured Type 3 CB** | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and**/or** DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to **4** enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and**/or** DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | ~~10-16~~ | Yes | N/A |  | Per UE | No | No | N/A | ~~For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X},~~  ~~For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured~~ | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-6c | Enhanced type 3 HARQ-ACK codebook feedback  **with maximum 8 configured Type 3 CB** | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and**/or** DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)  2. Support configuration of up to **8** enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and**/or** DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4) | ~~10-16~~ | Yes | N/A |  | Per UE | No | No | N/A | ~~For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,...,X},~~  ~~For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured~~ | Optional with capability signaling |   It was agreed in RAN1 #10bis-e that for one-shot triggering of HARQ-ACK re-transmission on PUCCH, the HARQ-ACK codebook per PHY priority per HARQ-ACK CB type is constructed by appending the retransmission HARQ-ACK CB to the HARQ-ACK CB indicated to be transmitted. To our understanding, this agreement brings additional complexity for UE implementation since UE needs to check if there are indicated HARQ-ACK CB transmission as well as triggered retransmission HARQ-ACK CB, if it is, UE needs to perform HARQ-ACK CB construction as agreed. So we suggest to add description of the HARQ-ACK CB construction in components of FG 25-7.  **Agreement**  For one-shot triggering of HARQ-ACK re-transmission on PUCCH,   * in case the dynamic Type 2 HARQ-ACK codebook is configured, the HARQ-ACK codebook per PHY priority on the indicated PUCCH is constructed by appending the Type 2 HARQ-ACK codebook to be re-transmitted to the Type 2 HARQ-ACK codebook of the indicated PUCCH (carrying new, initial HARQ-ACK information) per PHY priority. * in case the semi-static Type 1 HARQ-ACK codebook is configured, the HARQ-ACK codebook per PHY priority on the indicated PUCCH is constructed by appending the Type 1 HARQ-ACK codebook to be re-transmitted to the Type 1 HARQ-ACK codebook of the indicated PUCCH (carrying new, initial HARQ-ACK information) per PHY priority.   In addition, similar with FG 25-6, the wording “DCI format 1\_1 and DCI format 1\_2” in the components of FG 25-7 is changed to “DCI format 1\_1 and/or DCI format 1\_2”. Moreover, the wording of “PUCCH slot” should be changed to “PUCCH slot/sub-slot” to align with the following RAN1 agreement:  **Agreement**  For one-shot HARQ re-transmission on PUCCH, the triggering DCI dynamically indicates a ‘HARQ re-tx offset’ which is used to define the offset in number of PUCCH slots/sub-slots between the triggering DCI and the PUCCH slot/sub-slot of the HARQ-ACK codebook to be re-transmitted. For the triggering DCI received in slot/sub-slot m, indicating the HARQ-ACK re-tx in slot/sub-slot m+k and indicating HARQ\_retx\_offset, the PUCCH slot/sub-slot n of the HARQ-ACK codebook to be re-transmitted is determined as either:   * Alt. 1: n = m - HARQ\_retx\_offset * Alt. 2: n = m + k - HARQ\_retx\_offset * FFS: value range of the HARQ-retx\_offset   ***Proposal 5: Modify FG 25-7 as:***   1. ***Add description of HARQ-ACK CB construction in Components of FG 25-7*** 2. ***Change the wording “DCI format 1\_1 and DCI format 1\_2” in the components to “DCI format 1\_1 and/or DCI format 1\_2”*** 3. ***Change the wording “PUCCH slot” in the components to “PUCCH slot/sub-slot”***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-7 | Triggered HARQ-ACK codebook re-transmission | 1. Support HARQ-ACK re-transmission from an earlier PUCCH slot**/sub-slot** based on the triggering information in DCI format 1\_1 and**/or** DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4)  **3. Support HARQ-ACK codebook construction by appending the HARQ-ACK codebook to be re-transmitted to the HARQ-ACK codebook of the indicated PUCCH per PHY priority and per HARQ-ACK CB Type.** |  | Yes | N/A |  | Per UE | No | No |  | N/A |  | Optional with capability signaling | |
| [9] | Samsung | 25-4  In TR 38.822 v16.0.0, there are three 11-1s; 11-1 (Basic BAP procedures) for NR\_IAB-Core, 11-1 (Additional measurement gap patterns for PRS measurements) for NR positioning and 11-1(Monitoring DCI format 1\_2 and DCI format 0\_2) for NR\_L1enh\_URLLC. So, this ambiguity should be clarified.  25-7  Like 25-4, it is likely that some of UEs doesn’t support 11-1. So, this capability should be separated depending on DCI format like 10-16 (DCI format 1\_1) and 25-4(DCI format 1\_2)  Similar to 25-5, it is likely that some of UEs doesn’t support 11-4. So, second component should independent UE capability which is conditioned with 11-4. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-4:   + Type:     - The Rel-16 UE feature of support of DCI 1\_2 is per UE, yet the support of one-shot CB (Type 3) is per band, so this should be per band * 25-6:   + Type:     - Per band is prefeerred, following the logic for Rel-16 Type 3 CB |
| [11] | NTT DOCOMO, INC. | * FG 25-4: One-shot HARQ ACK feedback triggered by DCI format 1\_2   + Component 1 can be revised as: Support feedback of type 3 HARQ-ACK codebook with full size or reduced size with either one of low or high priority, triggered by a DCI 1\_2 scheduling a PDSCH   + Component 2 can be revised as: Support feedback of type 3 HARQ-ACK codebook with full size or reduced size with either one of low or high priority, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value   + Type should be per UE   + FGs 10-16 and 11-1 can be kept as prerequisite feature groups * FG 25-5: PHY priority handling for one-shot HARQ ACK feedback   + Component can be revised as: Support transmission of type 3 HARQ-ACK codebook with full size or reduced size using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI   + Type should be per UE   + FGs 10-16 and 11-4 can be kept as prerequisite feature groups * FG 25-6: Enhanced type 3 HARQ-ACK codebook feedback   + Component 1 can be revised as: Support feedback of enhanced type 3 HARQ-ACK codebook with or without priority indicator in the triggering DCI, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, and 1-1)   + Component 2 can be revised based on the agreement in RAN1#106bis-e as: Support configuration of up to ~~X~~8 enhanced type 3 HARQ-ACK codebooks   + Type should be per UE   + FGs 10-16 can be kept as prerequisite feature group. Also, FGs 11-1 and 11-4 can be added as prerequisite feature groups.   + Note can be revised based on the agreement in RAN1#106bis-e as: For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1,~~...,X,~~ 2, 4, 8} * FG 25-7: Triggered HARQ-ACK codebook re-transmission   + Component 1 can be revised as: Support HARQ-ACK re-transmission ~~from an earlier PUCCH slot~~ of the cancelled HARQ-ACK based on the triggering information in DCI format 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)   + Type should be per UE   + FGs 11-1 and 11-4 can be added as prerequisite feature groups. |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  With regards to 25-4 -One-shot HARQ feedback triggered by DCI 1\_2-the prerequisites are:   * 10-16 (support for 1-shot HARQ-ACK feedback) and * 11-1 (monitoring DCI 1\_2)   10-16 has RRC Parent IE *SharedSpectrumChAccessParamsPerBand-r16* and 11-1 *Phy-ParametersCommon*. Therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 5:* Feature 25-4 (One-shot HARQ feedback triggered by DCI 1\_2) should be supported per Feature Set Per Component Carrier (FSPC).**  With regards to 25-5 - PHY layer priority for One-shot HARQ feedback - the prerequisites are:   * 10-16 (support for 1-shot HARQ-ACK feedback) and * 11- 4 (2 HARQ-ACK codebooks with up to 1 sub-slot based HARQ-ACK codebook)   10-16 has RRC Parent IE *SharedSpectrumChAccessParamsPerBand-r16* and 11-4 *FeatureSetUplink-v1640*.  Therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 6:* Feature 25- 5 (PHY layer priority for One-shot HARQ feedback) should be supported per Feature Set Per Component Carrier (FSPC).**  With regards to 25-6 - Enhanced Type 3 HARQ-ACKfeedback - the prerequisites are:   * 10-16 (support for 1-shot HARQ-ACK feedback) and   10-16 has RRC Parent IE *SharedSpectrumChAccessParamsPerBand-r16*. Therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 7:* Feature 25- 6 (Enhanced Type 3 HARQ-ACK feedback) should be supported per Feature Set Per Component Carrier (FSPC).**  With regards to 25-7 - Triggered HARQ-ACK codebook retransmission - the feature should be supported per band.  ***Proposal 8:* Feature 25-7 (Triggered HARQ-ACK codebook retransmission) should be supported per Feature Set Per band.** |

## **Discussion**

**[FL1] High priority proposal 4-1:**

* **The value X is confirmed as “8” in component 2 in FG 25-6**
* **Update the text in Note column in FG 25-6 as “For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1, 2, 4, 8}”**
  + RAN1 agreed to support UE capability signaling of {1,2,4,8} CBs

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**High priority question 4-2:**

* **Companies are encouraged to provide views on whether to add following components into FG 25-6**
  + **Component for the maximum number of configured CCs for CB generation**
    - Support: Huawei, HiSilicon
  + **Component for the maximum number of configured HARQ processes for CB generation**
    - Support: Huawei, HiSilicon

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**High priority question 4-3:**

* **Companies are encouraged to provide views on whether to separate FG 25-6 into one for slot based PUCCH and the other for sub-slot based PUCCH**
  + Support: Huawei, HiSilicon

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**High priority question 4-4:**

* **Companies are encouraged to provide views on whether/how to separate FG 25-7**
  + **Separate FG per DCI format**
    - Support: Samsung
  + **Separate component 2 as another FG**
    - Support: Samsung

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**Medium priority question 4-5:**

* **Companies are encouraged to provide views on whether the type of FGs 25-4 to 25-7 should be per UE or per band or per FSPC**
  + FG 25-4
    - Per UE: Ericsson, DOCOMO
    - Per band: Huawei, HiSilicon, vivo, Apple
    - Per FSPC: Qualcomm
  + FG 25-5
    - Per UE: Ericsson, DOCOMO
    - Per band: Huawei, HiSilicon, vivo
    - Per FSPC: Qualcomm
  + FG 25-6
    - Per UE: Ericsson, DOCOMO
    - Per band: Huawei, HiSilicon, vivo, Apple
    - Per FSPC: Qualcomm
  + FG 25-7
    - Per UE: Huawei, HiSilicon, Ericsson, DOCOMO
    - Per FS: Qualcomm

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**Low priority question 4-6:**

* **Companies are encouraged to provide views on** **whether/how to revise the prerequisite feature groups for FGs 25-4 to 25-7**

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**Low priority question 4-7:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 25-4 to 25-7 which do not have capability signaling impacts**

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# **25-8: Semi-static HARQ-ACK codebook for sub-slot PUCCH**

In [1], FG 25-8 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-8 | Semi-static HARQ-ACK codebook for sub-slot PUCCH | Semi-static (Type 1) HARQ-ACK codebook for sub-slot based PUCCH configuration | 4-11  11-3 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. FG 25-8: Change “Per UE” to “Per FS” to align with the prerequisite. |
| [6] | Ericsson | * **Companies are encouraged to provide views on whether the type of FG 25-8 should be per UE or per band or per FSPC**  |  |  | | --- | --- | | Ericsson | Per UE.  Same comment as before: It is not clear how band differentiation would impact the feature and the corresponding testing. Also, considering RAN2 recommendation, FSPC should be avoided as much as possible (R2-2002378) |  1. Adopt “Per UE” type for FG 25-8. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-8:   + Type:     - Per sub-slot URLLC feature in Rel-16 is per FS, this should be per FS |
| [11] | NTT DOCOMO, INC. | * FG 25-8: Semi-static HARQ-ACK codebook for sub-slot PUCCH   + Type should be per UE   + FGs 4-11 and 11-3 can be kept as prerequisite feature groups. |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  With regards to 25-8 - Semi-static HARQ-ACK codebook for sub-slot PUCCH - the prerequisites are:   * 4-11 (support for semi-static HARQ-ACK feedback) and * 11-3 (support for more than 1 PUCCH HARQ within a slot)   4-11 has RRC Parent IE *Phy-ParametersCommon* and 11-3 *FeatureSetUplink-v1610.*  Therefore the feature should be supported per Feature Set per Component Carrier (FSPC).  ***Proposal 9:* Feature 25-8 (Semi-static HARQ-ACK codebook for sub-slot PUCCH) should be supported per Feature Set Per Component Carrier (FSPC).** |

## **Discussion**

**Medium priority question 5-1:**

* **Companies are encouraged to provide views on whether the type of FG 25-8 should be per UE or per FS or per FSPC**
  + Per UE: Ericsson, DOCOMO
  + Per FS: Huawei, HiSilicon, Apple
  + Per FSPC: Qualcomm

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**Low priority proposal 5-2:**

* **Prerequisite feature groups for FG 25-8 are confirmed as FGs 4-11 and 11-3**

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**Low priority question 5-3:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 25-8 which do not have capability signaling impacts**

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# **25-9 to 25-10: PUCCH cell switching**

In [1], FGs 25-9 to 25-10 are captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-9 | Semi-static PUCCH cell switching | Semi-static PUCCH cell switching using configured time-domain domain pattern of applicable PUCCH cell / carrier  FFS whether to separate the capability for different numerologies |  | Yes | N/A |  | Per UE | No  (TDD only) | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-10 | PUCCH cell switching based on dynamic indication | PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH  FFS whether to separate the capability for different numerologies |  | Yes | N/A |  | Per UE | No  (TDD only) | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. FG 25-9/25-10: For FFS whether to separate the capability for different numerologies, we think it should be independent UE capability for same numerology and different numerologies to leave more flexibility at the UE side. |
| [3] | ZTE | **Index 25-9 and 25-10:**  The type definition from moderator on index 25-9 and 25-10 is “Per UE”. But we think “Per BC” is better for the two feature group. For a certain UE, not all the band combination is suitable for PUCCH switching, for example, one UE could switch between carrier 1 and carrier 2, but carrier 3 is not allowed for switching. So the feature of supporting Semi-static PUCCH carrier switching or dynamic PUCCH carrier switching seems more suitable as Per BC definition.  ***Proposal 3:*** *The type of the feature group 25-9 and 25-10 is proposed to change to Per BC.* |
| [4] | vivo | **FG 25-9 & FG 25-10**   * whether to separate the capability for different numerologies   In our opinion, PUCCH cell switch cross cells with same numerology should be the baseline and PUCCH cell switch across cells with different numerology should be deemed as a more advanced UE feature. Supporting separate UE capability provide flexible UE implementation. We suggest split FG 25-9 and FG 5-10 into separate UE capabilities.  For FG 25-9, semi-static PUCCH carrier switching is applicable to all UCI types including HARQ-ACK, SR and CSI. This should be captured in the corresponding components column.  For FG 25-10, according to the agreement, in addition to HARQ-ACK of PDSCH dynamically scheduled by a DCI indicating a PUCCH carrier, the dynamic target carrier indication also applies to:   * HARQ-ACK corresponding to the first SPS PDSCH activated by Activation DCI based on the indication in the activation DCI * HARQ-ACK corresponding to the SPS Release DCI based on the indication in the release DCI * triggered PUCCH for Rel-16 Type 3 CB, Rel-17 enh. Type 3 CB of smaller size and Rel-17 one-shot triggering for HARQ-Ack retransmission based on the indication in the triggering DCI   For FG 25-10, these applicable cases should be explicitly described in the components.  **Proposal 5: *For FG 25-9 and 25-10, support separate UE capability for different numerologies. The applicable cases should be explicitly described in the components.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-9 | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching | 1.Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching with the same numerology using configured time-domain pattern of applicable PUCCH cell / carrier  ~~FFS whether to separate the capability for different numerologies~~  2.semi-static PUCCH carrier switching is applicable to all UCI types including HARQ-ACK, SR and CSI |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-9a | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching | 1.Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching with the same or different numerologies using configured time-domain pattern of applicable PUCCH cell / carrier  ~~FFS whether to separate the capability for different numerologies~~  2.semi-static PUCCH carrier switching is applicable to all UCI types including HARQ-ACK, SR and CSI |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-10 | PUCCH cell ~~(FFS or PUCCH carrier)~~switching based on dynamic indication | PUCCH cell ~~(FFS or PUCCH carrier)~~switching with the same numerology based on dynamic indication in the DCI scheduling the PUCCH, which is applicable to   1. HARQ-ACK of PDSCH dynamically scheduled by a DCI indicating a PUCCH carrier 2. HARQ-ACK corresponding to the first SPS PDSCH activated by Activation DCI based on the indication in the activation DCI 3. HARQ-ACK corresponding to the SPS Release DCI based on the indication in the release DCI 4. triggered PUCCH for Rel-16 Type 3 CB, Rel-17 enh. Type 3 CB of smaller size and Rel-17 one-shot triggering for HARQ-Ack retransmission based on the indication in the triggering DCI   ~~FFS whether to separate the capability for different numerologies~~ |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-10a | PUCCH cell ~~(FFS or PUCCH carrier)~~switching based on dynamic indication | PUCCH cell ~~(FFS or PUCCH carrier)~~switching with the same or different numerologies based on dynamic indication in the DCI scheduling the PUCCH, which is applicable to   1. HARQ-ACK of PDSCH dynamically scheduled by a DCI indicating a PUCCH carrier 2. HARQ-ACK corresponding to the first SPS PDSCH activated by Activation DCI based on the indication in the activation DCI 3. HARQ-ACK corresponding to the SPS Release DCI based on the indication in the release DCI 4. triggered PUCCH for Rel-16 Type 3 CB, Rel-17 enh. Type 3 CB of smaller size and Rel-17 one-shot triggering for HARQ-Ack retransmission based on the indication in the triggering DCI   ~~FFS whether to separate the capability for different numerologies~~ |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-9:**   + No need for separate capabilities for different numerologies   + Minor editorial suggestion to remove the ’carrier’ in the component description (in green)  |  |  |  | | --- | --- | --- | | 25-9 | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching using configured time-domain pattern of applicable PUCCH cell ~~/ carrier~~  FFS whether to separate the capability for different numerologies |  * **25-10:**   + No need for separate capabilities for different numerologies |
| [6] | Ericsson | * **Companies are encouraged to provide views on whether the type of FGs 25-9 and 25-10 should be per UE or per BC or per FS**  |  |  | | --- | --- | | Ericsson | Per UE.  Same comment as before: It is not clear how band differentiation would impact the feature and the corresponding testing. Also, considering RAN2 recommendation, FSPC should be avoided as much as possible (R2-2002378) |  1. Adopt “Per UE” type for FG 25-9. |
| [7] | OPPO | There is an FFS on whether to separate the capability for different numerologies. To our understanding, if PUCCH cell switching for both same numerology and different numerologies are both supported, it should be based on separate UE capability similar with cross-carrier scheduling with same or different numerologies. This is because for PUCCH cell switching with different numerologies, additional UE implementation is needed to handle the timing conversion for different SCS.  In addition, it was agreed in last RAN1 meeting that Rel-17 supports PUCCH cell switching between 2 cells, we suppose this should be added to the components of FG 25-9 and FG 25-10.  **Agreement**  PUCCH cell switching between 2 cells is supported in Rel-17.  ***Proposal 6: For FG 25-9 and FG 25-10:***   1. ***Separate the UE capability for same numerology and different numerology;*** 2. ***Add the description of supported cells for PUCCH cell switching to the components of FG 25-9 and 25-10:***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-9 | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching **with same numerology** | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~ switching **between 2 cells** using configured time-domain pattern of applicable PUCCH cell / carrier |  | Yes | N/A |  | Per UE | **TDD only** | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-9a | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~switching  **with different numerology** | Semi-static PUCCH cell ~~(FFS or PUCCH carrier)~~ switching **between 2 cells** using configured time-domain pattern of applicable PUCCH cell / carrier |  | Yes | N/A |  | Per UE | **TDD only** | No | N/A |  | Optional with capability signaling | | 25.NR\_IIOT\_URLLC\_enh | 25-10 | PUCCH cell ~~(FFS or PUCCH carrier)~~switching based on dynamic indication **with same numerology** | PUCCH cell ~~(FFS or PUCCH carrier)~~ switching **between 2 cells** based on dynamic indication in the DCI scheduling the PUCCH |  | Yes | N/A |  | Per UE | **TDD only** | No | N/A |  | Optional with capability signaling | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | 25.NR\_IIOT\_URLLC\_enh | 25-10a | PUCCH cell ~~(FFS or PUCCH carrier)~~ switching based on dynamic indication **with different numerology** | PUCCH cell ~~(FFS or PUCCH carrier)~~ switching **between 2 cells** based on dynamic indication in the DCI scheduling the PUCCH |  | Yes | N/A |  | Per UE | **TDD only** | No | N/A |  | Optional with capability signaling | |
| [8] | Intel Corporation | * 25-9 Semi-static PUCCH cell switching * 25-10 PUCCH cell switching based on dynamic indication   + Regarding the FFS whether to separate the capability for different numerologies, we are supportive. As it can be seen in current discussions, the different numerologies require additional handling mechanisms for the cases of SCS reference larger or smaller than SCS of switched cell. |
| [9] | Samsung | - It should be separated depending on same or different numerologies since a UE should operate PUCCH transmission in slot basis. So, if different numerologies is considered, additional UE complexity should be required to process PUCCH cell switching over different numerologies.  - In RAN1#106bis-e, it was agreed that PUCCH cell switching is only supported in TDD case. So, this UE capability should be only for TDD. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-9:   + Type:     - Since this is for inter-band TDD, per band per band combination is more reasonable. * 25-10:   + Type:     - Since this is for inter-band TDD, per band per band combination is more reasonable. |
| [11] | NTT DOCOMO, INC. | * FG 25-9: Semi-static PUCCH cell switching   + Regarding the FFS whether to separate the capability for different numerologies, we prefer not to separate the capability for different numerologies. There is no explicit agreement for UE behavior of switching among PUCCH cells with different numerologies so far. No agreement is reached to define possible limitation for numerologies of different PUCCH cells, either.   + Type should be per UE * FG 25-10: PUCCH cell switching based on dynamic indication   + Regarding the FFS whether to separate the capability for different numerologies, we prefer not to separate the capability for different numerologies. There is no explicit agreement for UE behavior of switching among PUCCH cells with different numerologies so far. No agreement is reached to define possible limitation for numerologies of different PUCCH cells, either.   + Type should be per UE |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  With regards to the Feature 25-9, the feature is not necessary at FDD. The feature should be supported, for obvious reasons, per Feature Set per Band combination.  ***Proposal 10:* Feature 25-9 (semi-static PUCCH cell switch) and 25-10 (dynamic PUCCH cell switch) are for TDD only. Furthermore, they should be per band combination rather than per UE.** |
| [13] | MediaTek | PUCCH cell switching (FG25-9 & FG25-10): PUCCH cell switching feature should have UL CA as Prerequisite FG. Also, the type for FG25-9 & FG25-10 should be per band combination.   1. ***Change the Type of FG25-9 & FG25-10 from “Per UE” to “Per BC”, and add FG6-6 as “Prerequisite FG” for these two FGs.*** |

## **Discussion**

**[FL1] High priority proposal 6-1:**

* **FGs 25-9 and 25-10 are split into ones for the capability for same numerology and the others for different numerologies between switchable carriers**
  + Support: Huawei, HiSilicon, vivo, OPPO, Intel, Samsung
    - to leave more flexibility at the UE side
    - additional UE implementation is needed to handle the timing conversion for different SCS
  + Not support: Nokia, NSB, DOCOMO
    - There is no explicit agreement for UE behavior of switching among PUCCH cells with different numerologies so far. No agreement is reached to define possible limitation for numerologies of different PUCCH cells, either.

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**Medium priority question 6-2:**

* **Companies are encouraged to provide views on whether the type of FGs 25-9 and 25-10 should be per UE or per BC or per FS**
  + FG 25-9
    - Per UE: Ericsson, DOCOMO
    - Per BC: ZTE, Qualcomm, MediaTek
    - Per FS: Apple
  + FG 25-10
    - Per UE: DOCOMO
    - Per BC: ZTE, Qualcomm, MediaTek
    - Per FS: Apple

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**Low priority question 6-3:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 25-9 to 25-10**

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**Low priority question 6-4:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 25-9 and 25-10 which do not have capability signaling impacts**

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# **25-11: 4-bits subband CQI**

In [1], FG 25-11 is captured as below.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-11 | 4-bits subband CQI | Subband CQI reporting with 4 bits per subband |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. FG 25-11: Fine with the current including cells in yellow. |
| [6] | Ericsson | For FG 25-11 in the preliminary list [1], no prerequisite FG is stated. However, the 4-bit subband CQI reporting should be an enhancement of basic CSI feedback. Hence FG 2-32 “Basic CSI feedback” should be added as a prerequisite as shown below.  Additionally, the 4-bit subband CQI should be confirmed as a “per UE” capability.  Table 1: Proposed FG for enhanced CSI feedback.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | | 25. NR\_IIOT\_URLLC\_enh | 25-11 | 4-bits subband CQI | Subband CQI reporting with 4 bits per subband | 2-32 |  1. Add FG 2-32 “Basic CSI feedback” as a prerequisite for FG 25-11 “4-bits subband CQI”. 2. Confirm FG 25-11 “4-bits subband CQI” as a “Per UE” capability. |
| [11] | NTT DOCOMO, INC. | * FG 25-11: 4-bits subband CQI   + Type should be per UE   + FG 2-32 can be added as prerequisite feature group. |

## **Discussion**

**Medium priority proposal 7-1:**

* **Type of FG 25-11 is per UE**
  + Support: Huawei, HiSilicon, Ericsson, DOCOMO

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**Low priority proposal 7-2:**

* **FG 2-32 is added as a prerequisite feature group for FG for FG 25-11**
  + Support: Ericsson, DOCOMO

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**Low priority question 7-3:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 25-11 which do not have capability signaling impacts**

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# **25-12 to 25-13: UE initiating a semi-static channel occupancy**

In [1], FGs 25-12 to 25-13 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-12 | UE initiating a semi-static channel occupancy with configurations dependent on gNB semi-static channel access configurations | Support initiating a semi-static channel access occupancy by the UE where the corresponding period is the same as, integer multiple of, or inter-factor of the period configured for a semi-static channel occupancy that can be initiated by gNB. | 10-1a | Yes | N/A |  | Per band | N/A | N/A | N/A | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-13 | UE initiating a semi-static channel occupancy with independent configurations from gNB semi-static channel access configurations | Support initiating a semi-static channel access occupancy by the UE where the corresponding period is independently configured from the period configured for a semi-static channel occupancy that can be initiated by gNB. | 10-1a, 25-12 | Yes | N/A |  | Per band | N/A | N/A | N/A | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | 1. FG 25-12: Add basic feature components agreed for a UE that can operate as an initiating device in the semi-static channel access mode as follows. It can be decided whether the condition on the gap duration in component 2 needs to be captured or not, i.e., “a gap greater than 16us”.  |  |  |  |  |  | | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-12 | UE initiating a semi-static channel occupancy with configurations dependent on gNB semi-static channel access configurations | 1. Support initiating a semi-static channel access occupancy by the UE where the corresponding period is the same as, integer multiple of, or inter-factor of the period configured for a semi-static channel occupancy that can be initiated by gNB.  2. 9us sensing to initiate a semi-static CO or transmit after [a gap greater than 16us from] any transmission burst within a UE-initiated CO.  3. Determination of COT initiator assumption based on rules for configured UL  4. Validating COT initiator assumption indicated in UL scheduling DCI | 10-1a |  1. FG 25-13: Remove FG 10-1a from the prerequisite, since it was agreed in the last meeting to add FG 25-12 as a prerequisite FG which in turn has FG 10-1a as a prerequisite FG. |
| [6] | Ericsson | The remain issue with respect to UE features for operation on shared spectrum was whether to update the component description of FG 25-12 as the following (Details available at **[FL4] Low priority question 8-5** in [3] )  Table 2: FG 25-12 with proposed updates for component description   |  |  |  | | --- | --- | --- | | 25-12 | UE initiating a semi-static channel occupancy with configurations dependent on gNB semi-static channel access configurations | 1. Support initiating a semi-static channel access occupancy by the UE where the corresponding period is the same as, integer multiple of, or inter-factor of the period configured for a semi-static channel occupancy that can be initiated by gNB.  2. 9us sensing to initiate a semi-static CO or transmit after [a gap greater than 16us from] any transmission burst within a UE-initiated CO.  3. Determination of COT initiator assumption based on rules for configured UL  4. Validating COT initiator assumption indicated in UL scheduling DCI |   From our perspective, the proposed additions are important to be included and tested to ensure proper intra-operability.   1. Adopt the proposed changes in red in Table 2 for FG 25-12. |
| [9] | Samsung | 25-13  We think that 25-12 should be Prerequisite feature groups instead of 10-1a since 25-12 is subset of 25-13. |

## **Discussion**

**Low priority proposal 8-1:**

* **Following components are added in FG 25-12**
  + **Component 2: 9us sensing to initiate a semi-static CO or transmit after [a gap greater than 16us from] any transmission burst within a UE-initiated CO.**
  + **Component 3: Determination of COT initiator assumption based on rules for configured UL**
  + **Component 4: Validating COT initiator assumption indicated in UL scheduling DCI**

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# **[25-14] to [25-15]: PHY prioritization of overlapping DG-PUSCH and CG-PUSCH with different priorities**

In [1], FGs 25-14 to 25-15 are captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | [25-14] | PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH | Support PHY prioritization for the case where low-priority DG-PUSCH collides with high-priority CG-PUSCH | 12-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | [25-15] | PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH | Support PHY prioritization of overlapping high-priority dynamic grant PUSCH and low-priority configured grant PUSCH on a BWP of a serving cell | 12-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. FG 12-14: The square bracket for FG 25-14 can be moved based on the agreement in RAN1#106b-e. 2. FG 12-15: Still need to wait for the progress from intra-UE multiplexing. |
| [3] | ZTE | **Index 25-14:**  As we have the agreement on the handling of the collision between HP CG PUSCH and LP DG PUSCH in RAN1#106bis-e meeting.   |  | | --- | | **Agreement**  For collision between HP CG PUSCH and LP DG PUSCH, if MAC delivers two MAC PDUs to PHY, PHY layer can make the prioritization so that the UE is expected to transmit the CG PUSCH and cancel the DG PUSCH at latest from the first symbol that is overlapping with the CG PUSCH.   * Note: For the DG PUSCH, it is up to UE implementation to handle ~~the~~ OFDM symbols of the DG PUSCH before the start of HP CG PUSCH which are nonoverlapping with the HP CG PUSCH. * FFS: How to handle the collision when there is repetition for CG and/or DG PUSCH |   For FG 25-14, the square brackets as “PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH” should be removed. And for FG 25-15, the square brackets should be kept to see the outcome of RAN1#107-e meeting.  ***Proposal 4:*** *The following modifications are proposed for feature group 25-14:*   * *Remove the [] of index 25-14* |
| [4] | vivo | **FG 25-14**  According to the agreements in the latest RAN1 meeting, it has been agreed to support the collision handling between HP CG PUSCH and LP DG PUSCH with condition on two MAC PDUs delivered from MAC to PHY.  Thus, the [square brackets](http://www.baidu.com/link?url=lpP35DJvbFT6dvaZx8SYYKEpeOeruCwD6xgaPyPpn-mCRFZFfZ-1mSYGt8xtfEVbsY1SAr16_Wdi9nWtLkCM5eu8n9vCwcOIJOyTxeU46pY-9F42I8OwgDLCfrj6h3TK) of FG 25-14 can be deleted.  ***Proposal 6: The*** [***square brackets***](http://www.baidu.com/link?url=lpP35DJvbFT6dvaZx8SYYKEpeOeruCwD6xgaPyPpn-mCRFZFfZ-1mSYGt8xtfEVbsY1SAr16_Wdi9nWtLkCM5eu8n9vCwcOIJOyTxeU46pY-9F42I8OwgDLCfrj6h3TK) ***and color of FG 25-14 can be removed.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | ~~[~~25-14~~]~~ | PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH | Support PHY prioritization for the case where low-priority DG-PUSCH collides with high-priority CG-PUSCH | 12-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-15:**   + Square brackets can be removed, i.e. UE feature is needed, as RAN1 finalized the details of this feature during RAN1#106bis-e:  |  | | --- | | **Agreement**  For collision between HP CG PUSCH and LP DG PUSCH, if MAC delivers two MAC PDUs to PHY, PHY layer can make the prioritization so that the UE is expected to transmit the CG PUSCH and cancel the DG PUSCH at latest from the first symbol that is overlapping with the CG PUSCH.   * Note: For the DG PUSCH, it is up to UE implementation to handle OFDM symbols of the DG PUSCH before the start of HP CG PUSCH which are nonoverlapping with the HP CG PUSCH. * FFS: How to handle the collision when there is repetition for CG and/or DG PUSCH | |
| [6] | Ericsson | For FG 25-14 and 25-15 in R1-2108679, the description should be aligned to avoid any confusion that there are any differences other than the LP vs HP of DG-PUSCH vs CG-PUSCH. Thus we recommend the editorial changes in Table 4. Furthermore, [25-14] and [25-15] should be merged into one feature group, with description “PHY prioritization of overlapping DG-PUSCH and CG-PUSCH of different PHY priorities”   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | | 25. NR\_IIOT\_URLLC\_enh | [25-14] | HY prioritization of overlapping DG-PUSCH and CG-PUSCH of different PHY priorities  ~~PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH~~ | Support PHY prioritization of overlapping ~~for the case where~~ low-priority DG-PUSCH and ~~collides with~~ high-priority CG-PUSCH on a BWP of a serving cell | 12-1 | | 25. NR\_IIOT\_URLLC\_enh | [25-15] (merge with [25-14]) | ~~PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH~~ | Support PHY prioritization of overlapping high-priority ~~dynamic grant~~ DG-PUSCH and low-priority ~~configured grant~~ CG-PUSCH on a BWP of a serving cell | 12-1 |  1. Merge [25-14] and [25-15] into a single feature group with description “PHY prioritization of overlapping DG-PUSCH and CG-PUSCH of different PHY priorities” |
| [9] | Samsung | We are fine to remove brackets for 25-14 and 25-15. |
| [10] | Apple | It was discussed in RAN #93-e for possible downscoping on them. We note the relevant Rel-16 maintenace work is essentially at a deadlock, and it is unlikely the Rel-16 maintenance work can be finshed in one meeting (November 2021) and at the same time the design details on DG/CG PUSCH proritization can be finalized. At RAN1 #106bis-e, even though there was one agreement reached concerning DG/CG PUSCH prioritization, that really does not substantially move the design much. Hence we suggest to remove 25-14 and 25-15 or at least keep the brackets for 25-14 and 25-15. |
| [11] | NTT DOCOMO, INC. | * [FG 25-14]: PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH   + Square brackets should be removed based on the agreement in RAN1#106bis-e |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  Regarding to feature 25-15, the current formulation is problematic. As we explained in R1-2110181 [2], a UE needs extra processing time to handle the cancel/dropping of a LP PUSCH before switch to transmit a HP PUSCH. One should notice that cancel/drop a PUSCH is more complicated than cancel/drop a PUCCH, which is why extra processing time is needed on top of Rel-16 cancellation time for cancel/drop a PUCCH.  ***Proposal 11:* For feature 25-15 (PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH), on top of Rel-16 cancellation time (N2+d1) for PUCCH/PUCCH or PUCCH/PUSCH collision, additional time d2 is needed (which results N2+d1+d2 in total cancellation time) for LP CG-PUSCH and HP DG-PUSCH collision resolution. The additional number of OFDM symbols (d2) needed is listed in following table.**  Table 1. d2 for LP CG-PUSCH and HP DG-PUSCH collision resolution   |  |  | | --- | --- | |  | d2 [symbols] | | **0** | **1** | | **1** | **2** | | **2** | **4** | | **3** | **8** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | [25-15] | PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH | Support PHY prioritization of overlapping high-priority dynamic grant PUSCH and low-priority configured grant PUSCH on a BWP of a serving cell with additional cancellation time d2 on top of N2+d1 (which is Rel-16 PUCCH/PUCCH or PUCCH/PUSCH cancellation time), which results total cancellation time N2+d1+d2.  Note: the value of d2 is given in table as below.  Table: d2 for LP CG-PUSCH and HP DG-PUSCH collision resolution   |  |  | | --- | --- | |  | d2 [symbols] | | 0 | 1 | | 1 | 2 | | 2 | 4 | | 3 | 8 | | 12-1 | Yes | N/A |  | ~~Per band~~  Per FS | N/A | N/A | N/A |  | Optional with capability signaling | |

## **Discussion**

**[FL1] High priority proposal 9-1:**

* **FG 25-14 is kept as “PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH” as follows**

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| 25. NR\_IIOT\_URLLC\_enh | ~~[~~25-14~~]~~ | PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH | Support PHY prioritization for the case where low-priority DG-PUSCH collides with high-priority CG-PUSCH | 12-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |

Note that any contents highlighted in yellow mean FFS and to be discussed further.

Agreement at RAN1#106bis-e

|  |
| --- |
| **Agreement**  For collision between HP CG PUSCH and LP DG PUSCH, if MAC delivers two MAC PDUs to PHY, PHY layer can make the prioritization so that the UE is expected to transmit the CG PUSCH and cancel the DG PUSCH at latest from the first symbol that is overlapping with the CG PUSCH.   * Note: For the DG PUSCH, it is up to UE implementation to handle OFDM symbols of the DG PUSCH before the start of HP CG PUSCH which are nonoverlapping with the HP CG PUSCH. * FFS: How to handle the collision when there is repetition for CG and/or DG PUSCH |

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# **25-16 to 25-17: Intra-UE multiplexing with different priorities**

In [1], FGs 25-16 to 25-17 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-16 | HARQ-ACK with different priorities multiplexing using a PUCCH | 1. Support multiplexing a high-priority HARQ-ACK and a low-priority HARQ-ACK into a PUCCH. Support separate coding for the two HARQ-ACKs.  2. [Support multiplexing a low-priority HARQ-ACK and a high-priority SR into a PUCCH for some HARQ-ACK/SR PF combinations (FFS applicable combinations).]  3. [Support multiplexing a low-priority HARQ-ACK, a high-priority HARQ-ACK and a high-priority SR into a PUCCH.]  FFS whether to merge with FG 25-17  FFS whether to separate capability for different UCI type | 11-3 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-17 | HARQ-ACK piggybacked on a PUSCH of a different priority | 1. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  2. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  3. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI.  4. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI.  FFS whether to merge into FG 25-16  FFS whether to separate capability for different UCI type | 11-3  12-1 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | Huawei, HiSilicon | 1. FG 25-16/FG 25-17: Prefer to keep FG 25-17 and FG 25-16 separately. The mechanisms on PUCCH and PUSCH are different, and the impact on UE is different. 2. FG 25**-**16:    1. Change 11-3 to one of {11-4, 11-4a}, as 11-4/11-4a is the UE capability of supporting two HARQ-ACK codebook with different priorities.    2. Change “Per UE” to “Per FS” to align with the granularity of the prerequisite. 3. FG 25-17:    1. Delete 12-1 from the prerequisite feature group for FG 25-17. 12-1 is to define prioritization of overlapping channel/signals with two priority levels in physical layer, while 25-17 here is to define multiplexing of overlapping channel/signals with two priority levels in physical layer. There is no need to couple these two capabilities. Therefore, 12-1 should be removed from the prerequisite. In addition, if 12-1 is removed, then we can **add one component “Configuration of PHY priority level for CG PUSCH, and dynamic indication of priority level for dynamic PUSCH with a single DCI format” to FG 25-17.**    2. Change “Per UE” to “Per FS” to align with the granularity of the prerequisite. |
| [3] | ZTE | **Index 25-17**  For the usage of parentheses in component of 25-17, we should keep the commonality on each part of the components. So we propose to remove the parentheses for item 1 and 2.  ***Proposal 5:*** *The following adjustment is proposed for component of 25-17.*   |  | | --- | | 1. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH ~~(~~conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  2. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH ~~(~~conveying UL-SCH only~~)~~. Support separate beta\_offset values for this priority combination.  3. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI.  4. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI. | |
| [4] | vivo | **FG 25-16 & FG 25-17**  For FG 25-16 and FG 25-17, we suggest to merge these two FGs. It seems no additional complexity for UE supporting HARQ-ACK multiplexing on a PUCCH and multiplexing on a PUSCH. On the other hand, it is unreasonable for UE to support transmitting HARQ-ACK with both High Priority and Low Priority only on PUCCH or PUSCH.  For UCI type for multiplexing with different priorities, the discussion is ongoing. It should be discussed after the further conclusion achieved.  For FG 25-16, the prerequisite feature groups are FG 11-3 which is per *FeatureSetUplink.* Thus, the type of FG 25-16 should be Per FS.  ***Proposal 7: Merge FG 25-17 into FG 25-16.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25.NR\_IIOT\_URLLC\_enh | 25-16 | HARQ-ACK with different priorities multiplexing using a PUCCH | 1. Support multiplexing a high-priority HARQ-ACK and a low-priority HARQ-ACK into a PUCCH. Support separate coding for the two HARQ-ACKs.  2. [Support multiplexing a low-priority HARQ-ACK and a high-priority SR into a PUCCH for some HARQ-ACK/SR PF combinations (FFS applicable combinations).]  3. [Support multiplexing a low-priority HARQ-ACK, a high-priority HARQ-ACK and a high-priority SR into a PUCCH.]  4. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  5. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  6. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI.  7. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI.  ~~FFS whether to merge with FG 25-17~~  FFS whether to separate capability for different UCI type | 11-3 | Yes | N/A |  | Per ~~UE~~FS | No | No | N/A |  | Optional with capability signaling | | ~~25.NR\_IIOT\_URLLC\_enh~~ | ~~25-17~~ | ~~HARQ-ACK piggybacked on a PUSCH of a different priority~~ | ~~1. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.~~  ~~2. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.~~  ~~3. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI.~~  ~~4. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI.~~  ~~FFS whether to merge into FG 25-16~~  ~~FFS whether to separate capability for different UCI type~~ | ~~11-3~~  ~~12-1~~ | ~~Yes~~ | ~~N/A~~ |  | ~~Per UE~~ | ~~No~~ | ~~No~~ | ~~N/A~~ |  | ~~Optional with capability signaling~~ | |
| [5] | Nokia, Nokia Shanghai Bell | * **25-17:**   + Merge with FG 25-16, or at least add FG 25-16 as pre-requisite. It is not reasonable to assume a UE would be able to do multiplex HARQ-ACK of different priorities only when piggybacking on PUSCH but would be unable to do the same with PUCCH.   + No need for separate capabilities per UCI type |
| [7] | OPPO | There are two FFSs with regard to FG 25-16 and 25-17:  For the first FFS, we slightly prefer to merge the two FGs as it is a bit strange that UE can multiplex HARQ-ACK with different priorities in PUCCH channel, while not in PUSCH channel. Moreover, supporting FG 25-17 in addition to FG 25-16 seems not add much complexity for UE implementation.  For the second FFS, as commented by some other companies, some cases are still under discussion and it has not been discussed whether the configuration of all the above cases needs to be done simultaneously by gNB or gNB can choose to separately configure enabling part of the cases based on its implementation. So we prefer to postpone the discussion until more progress is made in AI 8.3.3.  Regarding to the prerequisite feature groups for FGs 25-16 and 25-17, we prefer to remove FG 12-1 since it is unnecessary to couple Rel-16 intra-UE prioritization capability with Rel-17 intra-UE multiplexing capability. UE may choose to implement FG 25-16 and 25-17, while not to implement 12-1. This is because for a UE capable of intra-UE multiplexing almost no longer needs to perform cancelation between UL channels with different priorities.  ***Proposal 7: It is slightly preferred to merge FG 25-16 and FG 25-17.***  ***Proposal 8: It is preferred to postpone the discussion on separate capability for different UCI types until more progress is made in AI 8.3.3.***  ***Proposal 9: Remove 12-1 from the prerequisite feature groups of FG 25-17.*** |
| [8] | Intel Corporation | * 25-16 HARQ-ACK with different priorities multiplexing using a PUCCH * 25-17 HARQ-ACK piggybacked on a PUSCH of a different priority   + Regarding the FFS whether to merge into FG 25-16 and FG 25-17, we have a preference to merge. We think the two features are complementing each other and compose the proper framework of R17 intra-UE multiplexing. If some components are not supported by a UE, the network scheduling flexibility is limited in this case.   + Regarding the FFS whether to separate capability for different UCI type, we have a slight preference of not doing that to allow a greater network scheduling flexibility to support intra-UE multiplexing use cases. |
| [9] | Samsung | 25-16 and 25-17 should be merged together since both design principles are the same to UE and no implementation difference is identified. Furthermore, it may need additional huge specification efforts since RAN1 should consider the case where a UE supports only one of UE capabilities. This case may affect Intra-UE multiplexing procedures that has already a lot of important pending issues to be addressed. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-16:   + Type:     - Note the cancellation behavior is defined at FS level, this should be at FS level also.     - Premature to discuss the components * 25-17:   + Type:     - Note the cancellation behavior is defined at FS level, this should be at FS level also.     - Premature to discuss the components * 25-16 and 25-17:   + For UCI multiplexing, it is reasonable to merge them into a single feature. |
| [11] | NTT DOCOMO, INC. | * FG 25-16: HARQ-ACK with different priorities multiplexing using a PUCCH * FG 25-17: HARQ-ACK piggybacked on a PUSCH of a different priority   + Regarding the FFS whether to merge FG 25-16 and FG 25-17, we prefer merging FG 25-16 and FG 25-17 rather than the separation, similar to UCI multiplexing capability defined in Rel-16.   + Regarding the FFS whether to separate capability for different UCI type, we don’t support further separating capability for different UCI types. We think separate capabilities for different UCI types will increase scheduling complexity and thus it would be hard to implement/operate the PUCCH/PUSCH multiplexing of different priorities at gNB side.   + Type should be per UE   + FGs 11-3 and 12-1 can be kept as prerequisite feature groups for merged FG 25-16/25-17. |
| [12] | Qualcomm Incorporated | First of all, it is observed that the type of many features is “per UE” in R1-2108679. We think this is very problematic. If we make a feature per-UE, then we make it a necessity that the UE implements and tests the feature in unlicensed (unconditionally) and in NTN (conditioned on how NTN features will be handled in general).  As long as unlicensed base stations don't get this feature implemented, testing is not possible, and the feature is going to get effectively disabled across the board.  Due to the above concern, we make the following proposal.  ***Proposal 1:*** **Unless otherwise stated, the type for a UE feature should be at least per band (if not with finer granularity type), given the potential UE testing differentiation among licensed, unlicensed, and NTN band.**  Regarding to feature 25-16 and 25-17, each individual component under these two features should have independent capability signaling, e.g., a UE support the 1st component of 25-16 (LP HARQ-ACK and HP HARQ multiplexing on PUCCH) does not necessily have the capability to support the 3rd component of 25-16 (LP HARQ-ACK, HP HARQ-ACK, and SR multiplexing on a PUCCH). Separate capabilities are needed to allow different UE implementations.  ***Proposal 12:* The components 1, 2, and 3 of feature 25-16 (HARQ-ACK with different priorities multiplexing using a PUCCH), should be in separate rows to have separate capability signaling. Furthermore, support a new component 4 (multiplexing a low-priority HARQ-ACK, a high priority HARQ-ACK, a high-priority/low-priority SR, and CSI into a PUCCH) with separate capability signaling.**  ***Proposal 13:* The components 1, 2, 3, and 4 of feature 25-17 (HARQ-ACK piggybacked on a PUSCH of a different priority), should be in separate rows to have separate capability signaling.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 25. NR\_IIOT\_URLLC\_enh | 25-16a | HARQ-ACK with different priorities multiplexing using a PUCCH | 1. Support multiplexing a high-priority HARQ-ACK and a low-priority HARQ-ACK into a PUCCH. ~~Support separate coding for the two HARQ-ACKs.~~  ~~2. [Support multiplexing a low-priority HARQ-ACK and a high-priority SR into a PUCCH for some HARQ-ACK/SR PF combinations (FFS applicable combinations).]~~  ~~3. [Support multiplexing a low-priority HARQ-ACK, a high-priority HARQ-ACK and a high-priority SR into a PUCCH.]~~  ~~FFS whether to merge with FG 25-17~~  ~~FFS whether to separate capability for different UCI type~~ | 11-3 | Yes | N/A |  | ~~Per UE~~  Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-16b | HARQ-ACK and SR with different priorities multiplexing using a PUCCH | Support multiplexing a low-priority HARQ-ACK and a high-priority SR into a PUCCH for some HARQ-ACK/SR PF (FFS applicable combinations). | 11-3 | Yes | N/A |  | Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-16c | High-priority HARQ-ACK, low priority HARQ-ACK, and SR multiplexing using a PUCCH | Support multiplexing a low-priority HARQ-ACK, a high-priority HARQ-ACK and a high-priority SR into a PUCCH. | 11-3 | Yes | N/A |  | Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-17a | ~~HARQ-ACK piggybacked on a PUSCH of a different priority~~  Low-priority HARQ-ACK multiplexing on High-priority PUSCH | 1. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  ~~2. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.~~  ~~3. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI.~~  ~~4. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI.~~  ~~FFS whether to merge into FG 25-16~~  ~~FFS whether to separate capability for different UCI type~~ | 11-3  12-1 | Yes | N/A |  | ~~Per UE~~  Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-17b | High-priority HARQ-ACK multiplexing on low-priority PUSCH | Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination. | 11-3  12-1 | Yes | N/A |  | Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-17c | multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI | Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH conveying UL-SCH, a high-priority HARQ-ACK and/or CSI | 11-3  12-1 | Yes | N/A |  | Per FS | No | No | N/A |  | Optional with capability signaling | | 25. NR\_IIOT\_URLLC\_enh | 25-17d | multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI | Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH conveying UL-SCH, a low-priority HARQ-ACK and/or CSI | 11-3  12-1 | Yes | N/A |  | Per FS | No | No | N/A |  | Optional with capability signaling | |

## **Discussion**

**[FL1] High priority proposal 10-1:**

* **Merge FG 25-17 into FG 25-16**
  + **FFS whether to separate capability for different UCI type, to be discussed after some progress is made in AI 8.3.3**
    - Support: vivo, Nokia, NSB, OPPO, Intel, Samsung, DOCOMO
      * no additional complexity for UE supporting HARQ-ACK multiplexing on a PUCCH and multiplexing on a PUSCH
      * It is not reasonable to assume a UE would be able to do multiplex HARQ-ACK of different priorities only when piggybacking on PUSCH but would be unable to do the same with PUCCH
      * If some components are not supported by a UE, the network scheduling flexibility is limited in this case.
      * It may need additional huge specification efforts since RAN1 should consider the case where a UE supports only one of UE capabilities.
      * similar to UCI multiplexing capability defined in Rel-16
    - Not support: Huawei, HiSilicon, Qualcomm
      * The mechanisms on PUCCH and PUSCH are different, and the impact on UE is different
      * to allow different UE implementations

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**Medium priority question 10-2:**

* **Companies are encouraged to provide views on whether the type of FGs 25-16 and 25-17 should be per UE or per FS**
  + Per UE: DOCOMO
  + Per FS: Huawei, HiSilicon, vivo, Apple, Qualcomm

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**Low priority question 10-3:**

* **Companies are encouraged to provide views on whether/how to revise the prerequisite feature groups for FGs 25-16 and 25-17**

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**Low priority question 10-4:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FGs 25-16 and 25-17 which do not have capability signaling impacts**

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# **25-18: Parallel PUCCH and PUSCH transmission** **across CCs in inter-band CA**

In [1], FG 25-18 is captured as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-18 | Parallel PUCCH and PUSCH transmission across CCs in inter-band CA | Support simultaneous PUCCH/PUSCH transmissions on different cells [at least] for inter-band CA. |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [2] | Huawei, HiSilicon | 1. FG 25-18: Change “Per UE” to “Per BC”, since the capability for UE would dependent on the CA band combination. |
| [3] | ZTE | **Index 25-18:**  This feature group is supporting parallel PUCCH and PUSCH transmission across CCs in inter-band CA. The type of this feature group is proposed to “Per BC”. The reason is similar with proposal 4 as not all band combination is supporting parallel PUCCH and PUSCH transmission.  ***Proposal 6:*** *The type of the feature group 25-18 is proposed to change to Per BC.* |
| [6] | Ericsson | For the topic of simultaneous PUCCH/PUSCH for CA, currently it has been agreed to support it for inter-band CA. For intra-band CA, it’s still FFS. Based on companies’ input, the main concern of supporting simultaneous PUCCH/PUSCH for intra-band CA is phase discontinuity if the PUCCH and PUSCH do not start and end at the same times. Phase discontinuity has been discussed since Rel-15. FG 6-23 was introduced for UE to indicate the incapability of PA phase discontinuity. As shown below, FG 6-23 can cover overlapping PUSCH-PUSCH as well as overlapping PUCCH-PUSCH. With this understanding, simultaneous PUCCH/PUSCH for intra-band CA should be supported for UEs that do not indicate the incapability FG 6-23. Thus we recommend to introduce the FG 25-18a, as shown in Table 5 below, with the note clarifying that FG 25-18a is applicable to UEs capable of handling PA phase discontinuity.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 6-23 | Incapability motivated by impacts of PA phase discontinuity with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers for intra-band EN-DC, intra-band CA, and FDM based ULSUP | Incapability motivated by impacts of PA phase discontinuity with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers for intra-band EN-DC, intra-band CA, and FDM based ULSUP |  | *pa-PhaseDiscontinuityImpacts* |   Table 3: Proposed FG for simultaneous PUCCH/PUSCH for intra-band CA.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | | 25. NR\_IIOT\_URLLC\_enh | 25-18a | Parallel PUCCH and PUSCH transmission across CCs in intra-band CA | Support simultaneous PUCCH/PUSCH transmissions on different cells for intra-band CA. | 6-5 | Applicable to UEs not indicating FG 6-23 |  1. FG 25-18a is added for simultaneous PUCCH/PUSCH in intra-band CA.   For FG 25-18, FG 6-5 “Basic DL NR-NR CA operation” should be added as a prerequisite FG. Also “[at least]” can be deleted, since FG 25-18 describes inter-band CA only, i.e., intra-band CA is not a concern here.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | | 25. NR\_IIOT\_URLLC\_enh | 25-18 | Parallel PUCCH and PUSCH transmission across CCs in inter-band CA | Support simultaneous PUCCH/PUSCH transmissions on different cells ~~[at least]~~ for inter-band CA. | 6-5 |  1. Adopt the editorial changes to Components for FG [25-14], [25-15], 25-18. |
| [9] | Samsung | From at least RAN1 agreement, inter-band CA is only scope of simultaneous PUCCH/PUSCH transmission. So, [at least] should be removed and then can be revisited if intra-band case is also supported. |
| [10] | Apple | Given many details for Rel-17 design are still to be agreed, in general all the component descriptions should be enclosed in brackets to avoid premature discussion on them.  As for UE capability’s granularity, URLLC features tend to be complicated from the perspective of UE implementation. The “per UE” designation can lead to UE implementation efforts for no apparent use cases, so its use should be adequately justified.   * 25-18:   + Type:     - Should be per FS     - This about putting PUCCH on a particular band |
| [11] | NTT DOCOMO, INC. | * FG 25-18: Parallel PUCCH and PUSCH transmission across CCs in inter-band CA   + Type should be per UE |
| [13] | MediaTek | Regarding FG25-18, the support of parallel PUCCH and PUSCH transmission across CCs in inter-band CA should be reported per band combination.   1. ***Change the Type of FG25-18 from “Per UE” to “Per BC”.*** |

## **Discussion**

**High priority question 11-1:**

* **Companies are encouraged to provide views on whether to add an FG for parallel PUCCH and PUSCH transmission across CCs in intra-band CA**
  + Support: Ericsson

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| Company | Comment |
| FL | To be discussed after some progress is made in AI 8.3.3 |

**Medium priority question 11-2:**

* **Companies are encouraged to provide views on whether the type of FG 25-18 should be pe UE or per BC or per FS**
  + Per UE: DOCOMO
  + Per BC: Huawei, HiSilicon, ZTE, MediaTek
  + Per FS: Apple

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**Low priority question 11-3:**

* **Companies are encouraged to provide views on whether to add FG 6-5 as a prerequisite feature group for FG 25-18**

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**Low priority question 11-4:**

* **Companies are encouraged to provide views on whether/how to revise any other contents in FG 25-18 which do not have capability signaling impacts**

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# **Other FGs**

This section discusses other FGs which are not included in [1].

Following feedbacks are provided in contributions for the RAN1#107-e meeting.

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| [6] | Ericsson | For the topic of propagation delay compensation, progress has been made in RAN1 discussion that enhancements are needed for UEs to provide time synchronization for IIoT use cases. In RAN2#115e, the following agreement was made:  **Agreements (RAN2#115e)**  1. RAN2 assumes that gNB can perform pre-compensation. RAN2 agrees to introduce signalling to enable/disable UE-side PDC.  2. The gNB can enable/disable UE-side PDC via unicast-RRC signalling for Rel-17  Thus an FG needs to be introduced for such UEs. An example is shown in Table 7 below. The details of the FG can be updated once more design details are developed in RAN1 discussion, for example, to support TA-based method or RTT-based method.   1. A feature group is introduced for supporting propagation delay compensation in Rel-17.   Table 5: Exemplary FG for propagation delay compensation.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Type**  **( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Mandatory/Optional** | | Propagation delay compensation | Support propagation delay compensation for time synchronization of the Uu interface | N/A | Yes | Per UE | No | No | N/A | Optional with capability signalling | |

## **Discussion**

**High priority question 12-1:**

* **Companies are encouraged to provide views on whether to add an FG for propagation delay compensation for time synchronization of the Uu interface**
  + Support: Ericsson

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# **Conclusions**

TBD

# **References**

[1] R1-2110587 Updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e Moderators (AT&T, NTT DOCOMO, INC.)

[2] R1-2110821 Rel-17 UE features for URLLC Huawei, HiSilicon

[3] R1-2110926 Discussion on UE features for enhanced IIoT and URLLC ZTE

[4] R1-2111052 Discussion on UE features for IIoT and URLLC vivo

[5] R1-2111154 On UE features for enhanced IIoT and and URLLC Nokia, Nokia Shanghai Bell

[6] R1-2111192 Rel-17 UE Features for IIoT/URLLC Ericsson

[7] R1-2111345 Discussion on UE features for IIoT and URLLC OPPO

[8] R1-2111527 Discussion on UE capability for URLLC/IIOT Intel Corporation

[9] R1-2111771 UE features for IIoT/URLLC Samsung

[10] R1-2111908 View on Rel-17 UE features for enhanced IIoT and and URLLC Apple

[11] R1-2112134 Discussion on Rel.17 UE features for enhanced IIoT/URLLC NTT DOCOMO, INC.

[12] R1-2112248 UE features for enhanced IIOT and URLLC Qualcomm Incorporated

[13] R1-2112288 Views on UE features for enhanced IIoT and URLLC MediaTek Inc.