**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

**e-Meeting, 20th – 30th April, 2020**

**Agenda item:** 7.2.11

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

**Title:** Summary on email discussion [100b-e-NR-UEFeatures-Remaining] NR\_L1enh\_URLLC

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the following email discussion in AI 7.2.11 regarding Rel-16 NR UE features.

[100b-e-NR-UEFeatures-Remaining] Email discussion/approval of remaining issues (especially the one identified as low priority items in FL’s summaries) starting no earlier than 4/30 till next meeting – Hiroki (DCM)/Ralf (ATT)

Companies are encouraged to check further updates for UE features list based on R1-2003073 shown below and provide feedback if any. Please note that the target of this email discussion is to reflect agreeable updates rather than solving any controversial discussion point. If there is any controversial discussion point, it should be discussed in the next RAN1 meeting.

1. NR\_L1enh\_URLLC

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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 (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **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 | Note | Mandatory/Optional |
| 11. NR\_L1enh\_URLLC | 11-1 | Monitoring DCI format 1\_2 and DCI format 0\_2 | 1. Supports monitoring DCI format 1\_2 for DL scheduling
2. Supports monitoring DCI format 0\_2 for UL scheduling
 |  | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A]  |  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-1a | Monitoring both DCI format 0\_1/1\_1 and DCI format 0\_2/1\_2 in the same search space  | 1. Supports monitoring both DCI format 0\_1/1\_1 and DCI format 0\_2/1\_2 in the same search space
 | 11-1 | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A] |  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-2 | Rel-16 PDCCH monitoring capability  | 1. Supported combination(s) of (X, Y, μ). For each reported combination, the UE supports the limit C on the maximum number of non-overlapped CCEs for channel estimation per PDCCH monitoring span and the limit M on the maximum number of monitored PDCCH candidates per PDCCH monitoring span
2. If UE reports the support of more than one combination of (X, Y) for a given SCS, and if multiple combinations of (X, Y) are valid for the span pattern, the combination (X, Y) with the maximum value of C and M from the valid combinations is applied
3. Capability on the number of CCs with Rel-16 PDCCH monitoring capability on all the serving cells.
 | 3-5b (TBD) | Yes | N/A |  | [FSPC]FFS: Compoent 5) reported per UE | [N/A] | [N/A] | [N/A] | This capability is necessary for SCS 15 kHz and 30 kHz. For μ=0 and 1, candidate value set for (X, Y, μ): {(7, 3, μ), (4, 3, μ), (2, 2, μ)}For component 1, a list of separate UE capabilities (X, Y, μ)for processing capability #1;For component 1, a list of separate UE capabilities (X, Y, μ)for processing capability #2;For component 3, if UE supports carrier aggregation with more than 2 DL carriers with Rel-16 PDCCH monitoring capability on all the carriers, UE should report this capability.Candidate value for component 3: {2, 3, …, 16} | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-3 | More than one PUCCH for HARQ-ACK transmission within a slot | 1. Supports sub-slot based HARQ-ACK feedback procedure.

• A UL slot consists of a number of sub-slots. No more than one transmitted PUCCH carrying HARQ-ACKs starts in a sub-slot.• At least one sub-slot configuration for PUCCH can be UE specifically configured to a UE. • Supports a single configuration for PUCCH resource for all sub-slots in a slot. The starting symbol of a PUCCH resource is defined with respect to the first symbol of sub-slot. Any sub-slot PUCCH resource is not across sub-slot boundaries. 1. Supported sub-slot configuration
2. [Supported combinations of (A, B), where A is the minimum gap between sub-slots containing actual PUCCH transmissions measured from beginning to beginning of the sub-slots, including across slots, and B is the sub-slot duration, with both A and B in units of symbols]
 |  | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A]  | Candidate value set for component 2:{ 7-symbol\*2, 2-symbol\*7 and 7-symbol\*2} for NCP or { 6-symbol\*2, 2-symbol\*6 and 6-symbol\*2} for ECP[Candidate value set for component 3):(A, B) = {(7, 7),(4, 2) and (7, 7),(2, 2) and (7, 7)}]FFS: Whether to keep component 3) and accordingly the above note for component 3) | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4 | Two HARQ-ACK codebooks with up to one sub-slot based HARQ-ACK codebook (i.e. slot-based + slot-based, or slot-based + sub-slot based) simultaneously constructed for supporting PDSCH reception with different priorities at a UE  | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed with the restriction up to one sub-slot based HARQ-ACK codebook.
2. Supports separate PUCCH configuration for different HARQ-ACK codebooks
3. Supports 2-level priority of HARQ-ACK for dynamically scheduled PDSCH and SPS PDSCH.
4. [Supports a DCI format (from the formats 1\_1/1\_2) scheduling PDSCH with different HARQ-ACK priorities when only DCI format 0\_1/1\_1 is configured or only DCI format 0\_2/1\_2 is configured per BWP]
5. Supports separate configuration of parameters PDSCH-HARQ-ACK-Codebook, UCI-OnPUSCH and ‘codeBlockGroupTransmission” for different HARQ-ACK codebooks.
6. [Supported maximum number of actual PUCCH transmissions for HARQ-ACK within a slot]
 | [11-3] (TBD) | Yes | N/A |  | FFS [Per UE or Per FS] | [No] | [No] | [N/A]  | [If a UE reports both 11-3 and 11-4, it can support two slot-based HARQ-ACK codebooks, and one slot-based and one-sub-slot-based HARQ-ACK codebooks. If a UE reports 11-4 but not 11-3, it can only support two slot-based HARQ-ACK codebooks.] | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4a | Two sub-slot based HARQ-ACK codebooks simultaneously constructed for supporting PDSCH reception with different priorities at a UE  | 1. Supports two sub-slot based HARQ-ACK codebooks with different priorities to be simultaneously constructed.
2. Supports separate PUCCH configuration for different HARQ-ACK codebooks
3. Supports 2-level priority of HARQ-ACK for dynamically scheduled PDSCH and SPS PDSCH.
4. [Supports a DCI format (from the formats /1\_1/1\_2) scheduling PDSCH with different HARQ-ACK priorities when only DCI format 0\_1/1\_1 is configured or only DCI format 0\_2/1\_2 is configured in USS per BWP]
5. Supports separate configuration of parameters PDSCH-HARQ-ACK-Codebook, UCI-OnPUSCH and ‘codeBlockGroupTransmission” for different HARQ-ACK codebooks.
6. [Supported maximum number of actual PUCCH transmissions for HARQ-ACK within a slot]
 | 11-3 (TBD) | Yes | N/A |  | FFS [Per UE or Per FS] | [No] | [No] | [N/A] |  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | [11-4b] | [DL priority indication in DCI with mixed DCI formats] | [DL priority indication in DCI with mixed DCI formats] | 11-1a, 11-4 (TBD) | Yes | N/A |  | Per UE | [No] | [No] | [N/A]  |  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-6 | PUSCH repetition Type A | 1. PUSCH transmission with Rel-15 behavior with or without slot aggregation.

• With slot aggregation, the number of repetitions can be dynamically indicated (as agreed for Rel-16).• When dynamically indicated, the number of repetitions is jointly coded with SLIV in TDRA table, by adding an additional column for the number of repetitions in the TDRA table. | 2-12, 2-13, 2-14, 2-15 (TBD) | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A]  | FFS: Whether to add a component for the supported maximum number of PUSCH repetitions | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-7 | UL cancelation scheme for self-carrier | 1. Supports group common DCI (i.e. DCI format 2\_4) for cancelation indication [on the same CC as PUSCH or SRS]
2. UL cancelation for PUSCH
* Cancellation is applied to each PUSCH repetition individually in case of PUSCH repetitions
1. UL cancelation for SRS symbols that overlap with the cancelled symbols

[For the serving cell, the UE determines the first symbol of the $T\_{CI}$ symbols to be the first symbol that is after $T\_{proc,2}+d$ from the end of a PDCCH reception where the UE detects the DCI format 2\_4, where $d$ is provided by higher layer.]  | TBD | Yes | N/A |  | [Per UE]FFS: FS | [No] | [No] | [N/A]  | [More than one monitoring occasion for DCI format 2\_4 per slot is applied only if the UE reports to support FG 3-5 or FG 3-5a or FG 3-5b]  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-7a | UL cancelation scheme for cross-carrier | 1. Supports group common DCI (i.e. DCI format 2\_4) for cancelation indication [on a different CC than PUSCH or SRS]
2. UL cancelation for PUSCH
* Cancellation is applied to each PUSCH repetition individually in case of PUSCH repetitions
1. UL cancelation for SRS symbols that overlap with the cancelled symbols

[For the serving cell, the UE determines the first symbol of the $T\_{CI}$ symbols to be the first symbol that is after $T\_{proc,2}+d$ from the end of a PDCCH reception where the UE detects the DCI format 2\_4, where $d$ is provided by higher layer.]  | TBD | Yes | N/A |  | [Per UE]FFS: FS | [No] | [No] | [N/A]  | [More than one monitoring occasion for DCI format 2\_4 per slot is applied only if the UE reports to support FG 3-5 or FG 3-5a or FG 3-5b]  | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | [11-7b] | [Independent cancellation of the overlapping PUSCHs in an intra-band UL CA] | [For a UE indicating the capability of pa-PhaseDiscontinuityImpacts, and if the PUSCH on at least one serving cell is cancelled, the UE may cancel the (repetition of the) PUSCHs transmission on all other intra-band serving cell(s). The cancellation of the (repetition of the) PUSCH transmission on a the set of intra-band serving cell(s) includes all symbols from the earliest symbol that is overlapping with the first cancelled symbol of the PUSCH on the serving cell for which the DCI format 2\_4 is applicable to.] | 6-23, 11-7 (TBD) | Yes | N/A |  | [Per band] | [N/A] | [N/A] | TBD | FFS: Whether to add this FG and the content for each column if added | Optional with capability signaling |
| 11. NR\_L1enh\_URLLC | 11-9 | Multiple active configured grant configurations for a BWP of a serving cell | 1. Supports up to 12 configured/active configured grant configurations in a BWP of a serving cell.

• Separate RRC parameters for different configured grant configurations• Separate activation for different configured grant Type 2 configurations• Separate release for different configured grant Type 2 configurations1. [Supported maximum number of configured/active configured grant configurations in a BWP of a serving cell]
2. [Supported maximum number of configured/active configured grant configurations across all serving cells]
 | TBDFFS: 5-19 or 5-20 | Yes | N/A |  | [Per UE]FFS: FSPC | [No] | [No] | [N/A]  |  | Optional with capability signallingFFS: Candidate value for component 2: {1, 2, …, 12}FFS: Candidate value for component 3: {2, …, [32]} |
| 11. NR\_L1enh\_URLLC | 11-9a | Joint release in a DCI for two or more configured grant Type 2 configurations for a given BWP of a serving cell | 1. M<=4 bits indication in the Release DCI is used for indicating which CG configuration(s) is/are released, where the association between each state indicated by the indication and the CG configuration(s) is

• Up to 2^M states are higher layer configurable, where each of the state can be mapped to a single or multiple CG configurations to be released• In case of no higher layer configured state(s), separate release is used where the release corresponds to the CG configuration index indicated by the indication | 11-9 (TBD) | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A]  | FFS: A UE supporting this feature shall also support 11-10 (Type 2 configured grant release by DCI format 0\_1). A UE supporting this feature and 11-1 (DCI format 0\_2/1\_2) shall also support 11-11 (Type 2 configured grant release by DCI format 0\_2). | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-10  | Type 2 configured grant release by DCI format 0\_1  | 1. Support of type 2 configured grant release by DCI format 0\_1
 | TBDFFS: 5-20 | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A] FFS: The capability interpretation is from the perspective of a carrier on which the release DCI is received | [A UE supporting this feature and 11-1 (DCI format 0\_2/1\_2) shall also support 11-11 (Type 2 configured grant release by DCI format 0\_2).] | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-11  | Type 2 configured grant release by DCI format 0\_2 | 1. Support of type 2 configured grant release by DCI format 0\_2
 | TBDFFS: 5-20, 11-1 | Yes | N/A |  | [Per UE] | [No] | [No] | [N/A] FFS: The capability interpretation is from the perspective of a carrier on which the release DCI is received | [A UE supporting this feature shall also support 11-10 (Type 2 configured grant release by DCI format 0\_1).] | Optional with capability signalling |

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| Company | Comment |
| Apple | 1. 11-2
	1. It seems more logical to switch the order of component 1 and 2. Alternatively, these two can be combined into a single component, to something like “Supported combination(s) of (X, Y, μ). For each reported combination, the UE supports the limit C on the maximum number of non-overlapped CCEs for channel estimation per PDCCH monitoring span and the limit M on the maximum number of monitored PDCCH candidates per PDCCH monitoring span.”
	2. To clarify, component 4 is removed here because this is part of specs?
	3. It doesn’t seem necessary to have “The value of C for combination (7, 3), (4, 3) and (2, 2) for 15 kHz and 30 kHz is 56, 36 and 18, respectively; The value of M for combination (7, 3), (4, 3) and (2, 2) for 15 kHz is 44, 28 and 14, respectively; The value of M for combination (7, 3), (4, 3) and (2, 2) for 30 kHz is 36, 24 and 12, respectively.” These are clearly defined in the specs, and there is no need to duplicate. If it is really considered necessary, it would be better to have a reference.
2. 11-4
	1. The prerequisite of 11-3 should not be there. Even if a UE does not support 11-3, it can still report 11-4 for slot-based and slot-based HARQ-ACK codebooks. Instead, it is recommended to add a sentence in the note that “If a UE reports both 11-3 and 11-4, it can support two slot-based HARQ-ACK codebooks, and one slot-based and one-sub-slot-based HARQ-ACK codebooks. If a UE reports 11-4 but not 11-3, it can only support two slot-based HARQ-ACK codebooks.”
3. 11-4a
	1. The prerequisite should be 11-3.
	2. Component 4 should be in bracket. This was copied from 11-4, but somehow the bracket was missing.
	3. Component 6 from 11-4 in bracket should be copied here also.
4. 11-7 / 11-7a
	1. Wonder if it is possible already to remove the brackets for “[on the same CC as PUSCH or SRS]” and “[on a different CC than PUSCH or SRS]”.
	2. The notes should include Rel-16 PDCCH monitoring capability also (11-2, 11-2x) in addition to “FG 3-5 or FG 3-5a or FG 3-5b”.
5. 11-9
	1. For component 2 and 3, would prefer changing “active” to “configured/active” to be consistent with component 1.
	2. Can consider combining component 1 and 2.
6. 11-10/11-11
	1. The prerequisite should not include 5-19 because this is for Type 2 CG.
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| Ericsson | * 11-2:
	+ Move this to “Note” column: “Candidate value set for (X, Y): {(7, 3), (4, 3), (2, 2)}”. Also, suggest adding “For μ=0 and 1” to match better with “combination (X, Y, μ)” description. That is, have this in the Note column: “For μ=0 and 1, candidate value set for (X, Y, μ): {(7, 3, μ), (4, 3, μ), (2, 2, μ)}”
	+ In general, it’s strange to have candidate value set in “Optional/Mandatory” column. Thus, it’s recommended that this being moved to “Note” column as well: “Candidate value for component 4: …”
	+ Agree with Apple that this duplicates the information of C and M in 38.213 and should be removed: “The value of C …”
* Add back FG 11-2b for “Rel-15 monitoring capability and Rel-16 monitoring capability on different serving cells”. Detailed agreements are made in RAN1#100bis for this:

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| Agreements:For the case with Rel-15 monitoring capability and Rel-16 monitoring capability on different serving cells (i.e. case 3), UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16) as UE capability.         If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16),* + gNB configure which combination for UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability

Agreements**:**For one reported combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16) for CA:         The minimum value of pdcch-BlindDetectionCA-R15 is 1 and the minimum value of pdcch-BlindDetectionCA-R16 is 1         [3]<=pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 <=16         Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15         Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15  |

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| ZTE | * 11-2: Delete component 1) and the corresponding text for limit C/M in “Optional/Mandatory” column.
* Agree with Ericssion to add back FG 11-2b to capture the agreements. Whether FG11-2b is split for FG3-1, 3-2, 3-5b or not can be further discussed.
* 11-3: Update this FG to capture the ECP case.
	+ Candidate value set for component 2:{ 7-symbol\*2, 2-symbol\*7 and 7-symbol\*2} for NCP or { 6-symbol\*2, 2-symbol\*6 and 6-symbol\*2} for ECP.

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| Agreements:* A value of subslotLength-ForPUCCH for ECP is either 2 or 6 symbols.
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| Moderator (NTT DOCOMO) | According to above comments, following further update can be made.* 11-2
	+ Component 1 and 2 are merged
	+ Description regarding C/M in “mandatory/optional” column is deleted
	+ Descriptions regarding candidate values are moved from “mandatory/optional” column to “note” column
* 11-3
	+ Candidate value set for component 2 is updated to capture ECP case
* 11-4
	+ 11-3 in “prerequisite FG” column and suggested note from Apple are in brackets
* 11-4a
	+ Component 4 and component 6 copied from 11-4 are in brackets
* 11-9
	+ “active” in component 2/3 is replaced by “configured/active”
* 11-10/11
	+ 5-19 is removed from “prerequisite FG” column
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| Huawei/HiSilicon  | We are fine with the update from moderator in principle, though some changes seems not really necessary. Some view on the update for FG 11-4a as below. * 11-4a: We are fine to add the new component 6 with bracket for further disucsson, however whether the new added component 6 should be there or not would depend on component 3 under FG 11-3, since the prerequisite of FG 11-4a is FG 11-3, if component 3 for FG 11-3 will be kept there, then component 6 for FG 11-4a may be not needed, depending on how to interpretate component 3 under FG 11-3 though. In our understanding, component 3 under FG 11-3 would implicitly give the maximum number of actual PUCCH transmissions within a slot, and it should be applied to all HARQ-ACK codebooks. Note that the sub-slot configuration under component 2 in FG 11-3 is only to provide the potential location of a PUCCH transmission, it should not be considered as actual PUCCH transmissions.
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| Nokia, NSB  | * 11-1, 11-1a: per UE, no xDD/FRy differentiation
* 11-2: Type FS, component 4 is per UE
* 11-3: component 3 is not needed. Per UE, no xDD/FRy differentiation
* 11-4: Some more discussion /clarification on component 6 may be needed. Is this max. number of actual repetitions for a TB or across all PUSCHs/TBs per slot?
* 11-4a: 11-4 should be a pre-requisite FG
* 11-4b: OK to keep the FG. Per UE, no xDD/FRy differentiation
* 11-6: per UE, no xDD/FRy differentiation
* 11-7: component 3: text in square brackets can be removed, no need to specify the feature behavior here. Per UE, no xDD/FRy differentiation
* 11-7a: component 3: text in square brackets can be removed, no need to specify the feature behavior here.
* 11-7b: Given that there is a strong willingness from chipset vendors to keep this FG we can accept it to move forward.
* 11-9: OK to confirm components 2 and 3. We would prefer to clarify that the components in this FG refer to active configurations, as otherwise it is unclear what is the meaning of the components. Per UE, no xDD/FRy differentiation
* 11-9a: Per UE, no xDD/FRy differentiation. Notes: We are fine to require the UE to also support 11-10 and 11-11.
* 11-10: Per UE, no xDD/FRy differentiation. Ok to remove brackets from the notes.
* 11-11: Per UE, no xDD/FRy differentiation. Ok to remove brackets from the notes.
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