**3GPP TSG RAN WG1 #105-e R1-2106160**

**e-Meeting, May 10th – 27th, 2021**

**Agenda item:** 7.2.11

**Source:** Moderators (AT&T, NTT DOCOMO, INC.)

**Title:** Updated RAN1 UE features list for Rel-16 NR after RAN1#105-e

**Document for:** Information

1. Introduction

This contribution includes updates on Rel-16 NR RAN1 UE features based on the agreements made in RAN1#105-e meeting.

1. NR\_2step\_RACH

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 9. NR\_2step\_RACH | 9-1 | Basic channel structure and procedure of 2-step RACH | 1. Fallback procedures from 2-step RACH to 4-step RACH 2. msgA PRACH resource and format determination 3. msgA PUSCH configuration 4. Validation and transmission of MsgA PRACH and PUSCH 5. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH 6. msgB monitoring and decoding 7. PUCCH transmission for HARQ-ACK feedback to a msgB 8. Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB |  | Yes (but gNB does not need to know whether FG9-1 is supported or not for UEs before RRC connection) | N/A | UE cannot initiate a 2-step RACH process, and thus would not be expected understand the 2-step RACH configurations | per UE | No | No | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | 9-3 | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA with msgA in PCell/PScell | 4-26, 9-1 | Yes | N/A | UE cannot transmit an MsgA and other UL transmissions in parallel across CCs in inter-band CA | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 9. NR\_2step\_RACH | 9-4 | MsgA operation in a band combination including SUL | MsgA operations in a band combination including SUL | 9-1, 6-16 | Yes | N/A | UE does not support msgA operations in a band combination including SUL | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |

1. NR-unlicensed

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 10. NR-unlicensed | 10-1 | UL channel access for dynamic channel access mode | 1. Type 1 channel access and contention window size adjustment  2. Type 2A channel access  3. Type 2B channel access  4. Type 2C channel access  5. 20MHz LBT bandwidth  6. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | 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  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario A2, B, C, D and E with dynamic channel access mode |
| 10. NR-unlicensed | 10-1a | UL channel access for semi-static channel access mode | 1. Type 2C channel access  2. Single sensing slot of 9us channel access  3. 20MHz LBT bandwidth  4. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | 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  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario A2, B, C, D and E with semi-static channel access mode |
| 10. NR-unlicensed | 10-2 | SSB-based RRM for dynamic channel access mode | 1. SSB-based RRM with Q for dynamic channel access mode |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario A1, A2, B, C, D and E with dynamic channel access mode |
| 10. NR-unlicensed | 10-2a | SSB-based RRM for semi-static channel access mode | 1. SSB-based RRM with Q for semi-static channel access mode, when SMTC window is no longer than the fixed frame period |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario A1, A2, B, C, D and E with semi-static channel access mode |
| 10. NR-unlicensed | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell for PCell and PSCell |  | 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  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario B, C, D and E |
| 10. NR-unlicensed | 10-2c | SSB-based RLM for dynamic channel access mode | 1. SSB-based RLM with Q for dynamic channel access mode |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-3 applies to licensed band operation only, and functionalities of FG1-3 is covered by FG10-2c/2d in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario B, C, D and E with dynamic channel access mode |
| 10. NR-unlicensed | 10-2d | SSB-based RLM for semi-static channel access mode | 1. SSB-based RLM with Q for semi-static channel access mode, when DRS window is no longer than the fixed frame period |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-3 applies to licensed band operation only, and functionalities of FG1-3 is covered by FG10-2c/2d in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario B, C, D and E with semi-static channel access mode |
| 10. NR-unlicensed | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell for PCell |  | 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  This FG is a part of basic operation for following scenarios defined in TS38.300   * Scenario C and D |
| 10. NR-unlicensed | 10-2f | Support monitoring of extended RAR window | 1. Support of RAR extension from 10ms to 40ms by decoding of the 2-bit SFN indication in DCI 1\_0 |  | 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 |
| 10. NR-unlicensed | 10-2g | SSB-based BFD/CBD for dynamic channel access mode | SSB-based BFD/CBD with Q for dynamic channel access mode |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 10. NR-unlicensed | 10-2h | SSB-based BFD/CBD for semi-static channel access mode | SSB-based BFD/CBD with Q for semi-static channel access mode |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 10. NR-unlicensed | 10-2i | CSI-RS-based BFD/CBD for operation with shared spectrum channel access | CSI-RS-based BFD/CBD for operation with shared spectrum channel access |  | 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 |
| 10. NR-unlicensed | 10-7 | UL channel access for 10 MHz SCell | 1. 10 MHz LBT bandwidth | one of {10-1, 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 |
| 10. NR-unlicensed | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. Channel occupancy reporting |  | 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 |
| 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. Support transmitting SRS starting in all symbols (0,…,13) of a slot |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |
| 10. NR-unlicensed | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 1. Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16 |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Candidate values of component 1: {1, 2, ,3, 4, 5}  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 10. NR-unlicensed | 10-20a | Support coreset configuration with rb-Offset | 1. Support coreset configuration with rb-Offset |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |
| 10. NR-unlicensed | 10-23 | CGI reading on unlicensed cell for ANR functionality | 1. Support acquisition of relevant information from a neighbouring NR unlicensed cell in an unlicensed carrier by reading the RMSI of the neighbouring unlicensed cell and reporting the acquired information to the network |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Support reading RMSI from an unlicensed cell for ANR  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 10. NR-unlicensed | 10-25 | Enable configured UL transmissions when SFI field in DCI 2\_0 is configured but DCI 2\_0 is not detected | 1. Support configuration of enableConfiguredUL-r16 and enable transmission of higher-layer configured UL \*SRS, PUCCH, CG-PUSCH etc) when SFI field in DCI 2\_0 is configured but DCI 2\_0 is not detected |  | 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 |
| 10. NR-unlicensed | 10-27 | Wideband PRACH | 1. Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 1151 for 15kHz and ZC sequence = 571 for 30kHz |  | 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 |
| 10. NR-unlicensed | 10-29 | Support available RB set indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read availableRB-Sets-r16 |  | 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 |
| 10. NR-unlicensed | 10-30 | Support channel occupancy duration indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read COT duration |  | 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 |
| 10. NR-unlicensed | 10-8 | Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift due to CRS collision | 1. Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift due to CRS collision | 5-6a | Yes | N/A |  | Per band | N/A | N/A | N/A | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-2 | Optional with capability signalling |
| 10. NR-unlicensed | 10-9 | Search space set group switching with DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Monitor DCI 2\_0 with a search space set switching field  3. Support switching the search space set group with PDCCH decoding in group 1  4. Support a timer to switch back to original search space set group  5. Monitor DCI 2\_0 for channel occupancy time and use the end of channel occupancy time to switch back to the original search space set group |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-9b | Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Support switching the search space set group with PDCCH decoding in group 1  3. Support a timer to switch back to original search space set group |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-9c | Joint search space group switching across multiple cells | 1. Configured with a group of cells and switch search space set group jointly over these cells | one of {10-9, 10-9b} | Yes | N/A |  | Per BC | N/A | N/A | N/A | Without this capability, the UE will switch search space set groups for different cells independently  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-9d | Support Search space set group switching capability 2 | 1. Search space set group switching Capability-2: P=10/12/22 symbols for µ = 0/1/2 SCS | one of {10-9, 10-9b} | Yes | N/A |  | Per band | N/A | N/A | N/A | Without this capability, the UE supports search space set group switching capability-1: P=25/25/25 symbols for µ=0/1/2  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-14 | Non-numerical PDSCH to HARQ-ACK timing | 1. Support configuration of a value for dl-DataToUL-ACK indicating an inapplicable time to report HARQ ACK |  | Yes | N/A |  | Per band | N/A | N/A | N/A | If non-numerical K1 value is supported  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-15 | Enhanced dynamic HARQ codebook | 1. Support of bit fields signalling PDSCH HARQ group index and NFI in DCI 1\_1 (configuration of nfi-TotalDAI-Included)  2. Support of bit field in DCI 0\_1 for other group total DAI if configured. (configuration of ul-TotalDAI-Included)  3. Support the retransmission of HARQ ACK (pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16) |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each group | Optional with capability signalling |
| 10. NR-unlicensed | 10-16 | One-shot HARQ ACK feedback | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 scheduling a PDSCH 2. Support feedback of type 3 HARQ-ACK codebook , triggered by a DCI 1\_1 without scheduling a PDSCH using a reserved FDRA value |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Upon triggering, UE reports A/N for all HARQ processes and all CCs in a PUCCH group. | Optional with capability signalling |
| 10. NR-unlicensed | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | [10-19a] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | [10-19b] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | [10-19c] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | [10-19d] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | [10-19e] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | [10-19f] |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. NR-unlicensed | 10-26 | CSI-RS based RLM for operation with shared spectrum channel access | CSI-RS based RLM for operation with shared spectrum channel access |  | 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  Note: Rel-15 FG1-7 applies to licensed band operation only, and functionalities of FG1-7 is covered by FG10-26 in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-26a |  |  |  |  |  |  |  |  |  |  | RAN1 respectfully ask RAN2 to make the capability bit for this FG as dummy. |  |
| 10. NR-unlicensed | 10-26b | CSI-RS based RRM measurement with associated SS-block for operation with shared spectrum channel access | 1) CSI-RSRP measurement for operation with shared spectrum channel access  2) CSI-RSRQ measurement for operation with shared spectrum channel access |  | 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  Note: Rel-15 FG1-4 applies to licensed band operation only, and functionalities of FG1-4 is covered by FG10-26b in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-26c | CSI-RS based RRM measurement without associated SS-block for operation with shared spectrum channel access | 1) CSI-RSRP measurement for operation with shared spectrum channel access  2) CSI-RSRQ measurement for operation with shared spectrum channel access  3) There is SS-block in the target frequency on which the RRM measurement is performed for operation with shared spectrum channel access |  | 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  Note: Rel-15 FG1-5 applies to licensed band operation only, and functionalities of FG1-5 is covered by FG10-26c in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-26d | CSI-RS based RS-SINR measurement for operation with shared spectrum channel access | CSI-SINR measurements for operation with shared spectrum channel access | 10-26b | 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  Note: Rel-15 FG1-6 applies to licensed band operation only, and functionalities of FG1-6 is covered by FG10-26d in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-26e | RLM based on a mix of SS block and CSI-RS signals within active BWP for operation with shared spectrum channel access | RLM based on a mix of SS block and CSI-RS signals within active BWP for operation with shared spectrum channel access | 10-26, one of {10-2c, 10-2d} | 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  Note: Rel-15 FG1-8 applies to licensed band operation only, and functionalities of FG1-8 is covered by FG10-26e in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-26f | CSI-RS based contention free RA for HO for operation with shared spectrum channel access | CSI-RS based contention free RA for HO for operation with shared spectrum channel access | One of {10-26b, 10-26c} | 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  Note: Rel-15 FG1-9 applies to licensed band operation only, and functionalities of FG1-9 is covered by FG10-26f in unlicensed band operation. | Optional with capability signalling |
| 10. NR-unlicensed | 10-31 | Support of P/SP-CSI-RS reception with CSI-RS-ValidationWith-DCI-r16 configured | 1. Validate P/SP-CSI-RS reception when receiving a DCI granting a PDSCH over the same set of symbols  2. Validate P/SP-CSI-RS reception when receiving a DCI triggering a A-CSI-RS over the same set of symbols |  | Yes | N/A |  | Per band | N/A | N/A |  | If UE does not signal capability for FG 10-31, the UE cannot be configured with CSI-RS-ValidationWith-DCI-r16.  If none of the RRC parameters CO-DurationPerCell-r16, SlotFormatIndicator, and CSI-RS-ValidationWith-DCI-r16 is configured on a cell with shared spectrum access, and P/SP CSI-RS is configured, for reception/cancellation of SP/P CSI-RS the behavior in 11.1 of TS38.213 applies as per agreement.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 10. NR-unlicensed | 10-3 | PRB interlace mapping for PUSCH | 1. PRB interlace frequency domain resource allocation for PUSCH |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUSCH  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-3a | PRB interlace mapping for PUCCH | 1. PRB interlace frequency domain resource allocation for PUCCH format 0 and format 1 2. PRB interlace frequency domain resource allocation for PUCCH format 2 3. PRB interlace frequency domain resource allocation for PUCCH format 3 |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUCCH format 0/1  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-12 | OCC for PRB interlace mapping for PF2 and PF3 | 1. OCC2  2. OCC4 | 10-3a | Yes | N/A |  | Per band | N/A | N/A | N/A | UE OCC capability for EPF2/EFP3  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-13a | Extended CP range of more than one symbol for CG-PUSCH | 1. UE supports generating a CP extension of length longer than 1 symbol for Configured Grant PUSCH transmission | One or both of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | How long a UE can generate the CP extension beyond 1 symbol for CG-PUSCH  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-18 | Configured grant with retransmission in CG resources | 1. Support retransmission in CG resources  2. Support configured grant retransmission timer  3. Support DFI monitoring  4. Support CG-UCI in CG-PUSCH | One or both of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support configured grant with retransmission in configured grant resource  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
| 10. NR-unlicensed | 10-21a | Support using ED threshold given by gNB for UL to DL COT sharing | 1. Use ULtoDL-CO-SharingED-Threshold-r16 for Type 1 channel access for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for Type 1 channel access for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information | 10-1 | 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 signalling |
| 10. NR-unlicensed | 10-21b | Support UL to DL COT sharing | 1. Support Type 1 LBT for scheduled UL to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  2. Support Type 1 LBT for CG-PUSCH to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  3. Indicate in CG-UCI the COT sharing information | 10-1 | 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 |
| 10. NR-unlicensed | 10-24 | CG-UCI multiplexing with HARQ ACK | 1. Support multiplexing CG-UCI with HARQ ACK | 10-18 | 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 signalling |
| 10. NR-unlicensed | 10-28 | Configured grant with Rel-16 enhanced resource configuration | 1. Support configuration of resources with cg-nrofSlots-r16 and cg-nrofPUSCH-InSlot-r16, | One or both of {5-19, 5-20} | 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 signalling |
| 10. NR-unlicensed | 10-32 | SS block based SINR measurement (SS-SINR) for unlicensed spectrum | SS-SINR measurement for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG1-2 applies to licensed band operation only, and functionalities of FG1-2 is covered by FG10-32 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-33 | Semi-persistent CSI report on PUCCH for unlicensed spectrum | 1) Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH) for unlicensed spectrum  2) Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG2-32a applies to licensed band operation only, and functionalities of FG2-32a is covered by FG10-33 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-33a | Semi-persistent CSI report on PUSCH for unlicensed spectrum | Support semi-persistent CSI report on PUSCH for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG2-32b applies to licensed band operation only, and functionalities of FG2-32b is covered by FG10-33a in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-34 | Dynamic SFI monitoring for unlicensed spectrum | Adjust periodic and semi-persistent signal reception and transmission in response to detected dynamic UL/DL configuration for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG3-6 applies to licensed band operation only, and functionalities of FG3-6 is covered by FG10-34 in unlicensed band operation.  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of the FG10-34 is based on both the support of this capability for the band of the scheduled/triggered/indicated cell and the support of this capability for the band of the scheduling/triggering/indicating cell. | Optional with capability signaling |
| 10. NR-unlicensed | 10-35 | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same starting symbol on the PUCCH resources in a slot for unlicensed spectrum | SR/HARQ-ACK/CSI multiplexing once per slot, where overlapping PUCCH resources have the same starting symbols on the PUCCH resources in a slot while precluding the case of SR/HARQ-ACK by overlapping PUCCH resources with the same starting symbols on the PUCCH resources in a slot for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-19 applies to licensed band operation only, and functionalities of FG4-19 is covered by FG10-35 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
| 10. NR-unlicensed | 10-35a | SR/HARQ-ACK multiplexing once per slot using a PUCCH (or HARQ-ACK piggybacked on a PUSCH) when SR/HARQ-ACK are supposed to be sent with different starting symbols in a slot for unlicensed spectrum | Overlapping PUCCH resources have different starting symbols in a slot for unlicensed spectrum | 10-35 | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-19a applies to licensed band operation only, and functionalities of FG4-19a is covered by FG10-35a in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-35b | SR/HARQ-ACK/CSI multiplexing more than once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same or different starting symbol in a slot for unlicensed spectrum | Overlapping PUCCH resources have same or different starting symbols in a slot for unlicensed spectrum | 10-35c | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-19b applies to licensed band operation only, and functionalities of FG4-19b is covered by FG10-35b in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-35c | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with different starting symbols in a slot for unlicensed spectrum | Overlapping PUCCH resources have different starting symbols in a slot for unlicensed spectrum | 10-35a | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-19c applies to licensed band operation only, and functionalities of FG4-19c is covered by FG10-35c in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-36 | HARQ-ACK multiplexing on PUSCH with different PUCCH/PUSCH starting OFDM symbols for unlicensed spectrum | HARQ-ACK piggyback on a PUSCH with/without aperiodic CSI once per slot when the starting OFDM symbol of the PUSCH is different from the starting OFDM symbols of the PUCCH resource that HARQ-ACK would have been transmitted on for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-28 applies to licensed band operation only, and functionalities of FG4-28 is covered by FG10-36 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
| 10. NR-unlicensed | 10-37 | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 for unlicensed spectrum | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG4-23 applies to licensed band operation only, and functionalities of FG4-23 is covered by FG10-37 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2 (whenever PUCCH is supported on NR-U cell), B, C, D and E |
| 10. NR-unlicensed | 10-38 | Type 1 configured PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions with RV sequences for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-14 applies to licensed band operation only, and functionalities of FG5-14 is covered by FG10-38 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-39 | Type 2 configured PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions with RV sequences for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-16 applies to licensed band operation only, and functionalities of FG5-16 is covered by FG10-39 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-40 | PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-17 applies to licensed band operation only, and functionalities of FG5-17 is covered by FG10-40 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
| 10. NR-unlicensed | 10-40a | PDSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-17a applies to licensed band operation only, and functionalities of FG5-17a is covered by FG10-40a in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-41 | DL SPS for unlicensed spectrum | DL SPS for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-18 applies to licensed band operation only, and functionalities of FG5-18 is covered by FG10-41 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-42 | Type 1 Configured UL grant for unlicensed spectrum | K = 1 for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-19 applies to licensed band operation only, and functionalities of FG5-19 is covered by FG10-42 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-43 | Type 2 Configured UL grant for unlicensed spectrum | K = 1 for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-20 applies to licensed band operation only, and functionalities of FG5-20 is covered by FG10-43 in unlicensed band operation. | Optional with capability signaling |
| 10. NR-unlicensed | 10-44 | Pre-emption indication for DL for unlicensed spectrum | Pre-emption indication for DL for unlicensed spectrum |  | Yes | N/A |  | Per UE | No | No | N/A | Note: Rel-15 FG5-21 applies to licensed band operation only, and functionalities of FG5-21 is covered by FG10-44 in unlicensed band operation. | Optional with capability signaling |

1. NR\_L1enh\_URLLC

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 11-1b | Type 1 HARQ-ACK codebook support for relative TDRA for DL | 1. Support Type 1 HARQ-ACK codebook for TDRA using the starting symbol of the PDCCH monitoring occasion in which the DL assignment is detected as the reference of the SLIV | 11-1 | Yes | N/A |  | Per UE | No | Yes  Note: Differentiation is from the perspective of the scheduled carrier | 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. Maximum number of DL and UL unicast DCI formats in a span   For the set of monitoring occasions which are within the same span:   * Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for FDD * Processing one unicast DCI scheduling DL and two unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD * Processing two unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD |  | Yes | N/A |  | Per FS for component 1  Note: Indicating support of this capability in a band in a BC implies that only rel-16 monitoring can be configured in a CA configuration for the BC if the CA configuration includes the band and if rel-16 monitoring is configured for the band | N/A | N/A | N/A | This capability is signaled 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; | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells | 1. Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells    * Candidate value for the component: {2, 3, …, 16} 2. Supported span arrangement for CA    * Candidate value for the component: {aligned spans only, aligned spans and non-aligned spans} | 11-2 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2b | Mix of Rel. 16 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability on different carriers | 1. Support Rel-15 monitoring capability and Rel-16 monitoring capability on different serving cells | 11-2 | Yes | N/A |  | Per FS  Note: Per FS is selected because same type with 3-5b is preferred | N/A | N/A | N/A |  | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16)    * Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15    * Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15 2. Supported span arrangement for CA    * Candidate value for the component: {aligned spans only, aligned spans and non-aligned spans} | 11-2b | Yes | N/A |  | Per BC | N/A | N/A | N/A | The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability is 3 | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2d | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-16 PDCCH monitoring capability on all the serving cells | 1. Supported combination of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16*) | 11-2 | Yes | N/A |  | Per BC | N/A | N/A | N/A | If the UE reports pdcch-BlindDetectionCA-r16,   * Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 1 to pdcch-BlindDetectionCA-r16-1 * Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 1 to pdcch-BlindDetectionCA-r16-1 * pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16   Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability and the UE is configured on both the MCG and the SCG for NR-DC as indicated in UE-NR-Capability   * the value of pdcch-BlindDetectionMCG-UE-r16 or of pdcch-BlindDetectionSCG-UE-r16 is 1, * pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells).   Note: If a UE supports FG 11-2a or FG 11-2f, then the capability defined by FG 11-2a or FG 11-2f is applied to FG 11-2d. | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2e | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16*) | 11-2b | Yes | N/A |  | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16*) corresponds to one combination of (*pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r16*)  If the UE reports pdcch-BlindDetectionCA-r15,   * Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15 * Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15 * pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15   Otherwise, if N\_(NR-DC,max,r15)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r15monitoringcapability   * Candidate values for pdcch-BlindDetectionMCG-UE-r15 is [0, 1, 2] * Candidate values for pdcch-BlindDetectionSCG-UE-r15 is [0, 1, 2] * pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15 >= N\_(NR-DC,max,r15)^(DL,cells)   If the UE reports pdcch-BlindDetectionCA-r16,   * Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16 * Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16 * pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16   Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability   * Candidate values for pdcch-BlindDetectionMCG-UE-r16 is [0, 1] * Candidate values for pdcch-BlindDetectionSCG-UE-r16 is [0, 1] * pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells)   Note: If a UE supports FG 11-2c or FG 11-2g, then the capability defined by FG 11-2c or FG 11-2g is applied to FG 11-2e. | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells with restriction for non-aligned span case | 1. Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells    * Candidate value for the component: {2, 3, …, 16} 2. UE supports aligned span and non-aligned span   In case of non-aligned span when the configured number of cells with Rel-16 PDCCH monitoring is larger than the UE reported value, PDCCH monitoring occasion(s) should be configured only on same symbol(s) every slot | 11-2 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-2g | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers with restriction for non-aligned span case | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16)    * Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15    * Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15 2. UE supports aligned span and non-aligned span   In case of non-aligned span when the configured number of cells with Rel-16 PDCCH monitoring is larger than the UE reported value, PDCCH monitoring occasion(s) should be configured only on same symbol(s) every slot | 11-2b | Yes | N/A |  | Per BC | N/A | N/A | N/A | The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability is 3 | 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 |  | Yes | N/A |  | Per FS  Per FS is selected because in bands or BCs with large number of carriers or large BW, the UE’s processing power is spent on PDCCH/PDSCH decoding, and hence in some cases the support of the new codebook or some codebook configurations may not be possible | N/A | N/A | 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  The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  A UE supporting 11-3 is also expected to support FGs 4-1, 4-3, 4-4, 4-5, and 4-19 with a “slot” being replaced by a sub-slot of length 2 or 7 symbols for NCP and (2 and 6 symbols for ECP) for the PUCCH formats that can be accommodated in the corresponding sub-slot durations | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-3c | 2 PUCCH of format 0 or 2 in the same subslot for a single 7\*2-symbol subslot based HARQ-ACK codebook | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-3 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7” is replaced by “6” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-3d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for a single 2\*7-symbol subslot based HARQ-ACK codebook | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-3 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-3e | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for a single 2\*7-symbol HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot | 11-3 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-3f | 2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebook which are not covered by 11-3d and 11-3e | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks which are not covered by 11-3d and 11-3e | 11-3 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-3g | SR/HARQ-ACK multiplexing once per subslot using a PUCCH (or HARQ-ACK piggybacked on a PUSCH) when SR/HARQ-ACK are supposed to be sent with different starting symbols in a subslot | If a UE supports a subslot based HARQ-ACK codebook, the UE also supports:  Overlapping PUCCH resources with different starting symbols in a subslot | 11-3 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A |  | 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 HARQ-ACK codebooks 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   Candidate values for the component 6 of FG11-4 is: For NCP, {4, 5, 6, 7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {4,5,6} for 2-symbol\*6 sub-slot configuration. |  | Yes | N/A |  | Per FS  Per FS is selected because in bands or BCs with large number of carriers or large BW, the UE’s procesing power is spent on PDCCH/PDSCH decoding, and hence in some cases the support of the new codebook or some codebook configurations may not be possible | N/A | N/A | 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.  The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  Component 6 is applied to the sub-slot HARQ-ACK codebook. It is assumed that only 1 actual PUCCH transmission for HARQ-ACK within a slot for slot-based HARQ-ACK codebook.   * 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. * For component 6, maximum of 1 actual PUCCH transmission for HARQ-ACK within a slot for slot-based HARQ-ACK codebook. Thus value reported for component 6 has no meaning for “slot-based + slot based”. | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4a | Two subslot based HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities at a UE | 1. Supports two subslot 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   Candidate values for the component 6 of FG11-4a is: For NCP, {4, 5, 6, 7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {4,5,6} for 2-symbol\*6 sub-slot configuration. | 11-3 and 11-4 | Yes | N/A |  | Per FS  Per FS is selected because in bands or BCs with large number of carriers or large BW, the UE’s procesing power is spent on PDCCH/PDSCH decoding, and hence in some cases the support of the new codebook or some codebook configurations may not be possible | N/A | N/A | N/A | The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  Component 6 is applied to the two sub-slot HARQ-ACK codebooks, respectively.   * 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 signalling |
| 11.  NR\_L1enh\_URLLC | 11-4b | DL priority indication in DCI with mixed DCI formats | 1. Support of priority indicator field configured in DCI formats 1\_1 and 1\_2 in a BWP when configured to monitor both DCI formats 1\_1 and 1\_2 in the BWP | 11-1, 11-4 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4c | 2 PUCCH of format 0 or 2 for two HARQ-ACK codebooks with one 7\*2-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 7\*2-symbol subslot HARQ codebook, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-4 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2  For ECP, “7” is replaced by “6” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-4 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4e | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two subslot based HARQ-ACK codebooks | If the UE supports two subslot HARQ codebooks, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR | 11-4a | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting. | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4g | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two subslot based HARQ-ACK codebooks | If the UE supports two subslot HARQ-ACK codebooks both configured with 2\*7-symbols, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of a codebook | 11-4a | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot and one slot based HARQ-ACK codebook which are not covered by 11-4d and 11-4f | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:  1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4d and 11-4f | 11-4 | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22a  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-4i | 2 PUCCH transmissions in the same subslot for two subslot based HARQ-ACK codebooks which are not covered by 11-4e and 11-4g | If the UE supports two HARQ-ACK codebooks both with 2\*7-symbol configuration, the UE also supports:  1) 2PUCCH transmissions in the same subslot of a codebook which are not covered by 11-4e and 11-4g | 11-4a | Yes | N/A |  | Per FS  Per FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-5 | PUSCH repetition Type B | 1. For a transport block, one dynamic UL grant or one configured grant schedules two or more PUSCH repetitions that can be in one slot, or across slot boundary in consecutive available slots. 2. Dynamic indication of the nominal number of repetitions in the DCI scheduling dynamic PUSCH. 3. The time window within which valid symbols are used for transmission is L\*K, starting from the first symbol indicated by the SLIV in TDRA field. 4. PUSCH repetition type B is supported for DCI format 0\_1 and DCI format 0\_2 (for DG and type 2 CG). 5. S and L are separately indicated (4-bit for S and 4-bit for L). L <= 14. 6. Handling of interaction with DL/UL directions depending on whether dynamic SFI is configured or not, including both cases with and without higher layer parameter InvalidSymbolPattern configured 7. Supported maximum number of PUSCH transmissions within a slot for all TB(s), where each actual repetition for PUSCH repetition type B is counted as 1 PUSCH transmission, separately reported for UE processing capability 1 and for UE processing capability 2 if UE supports both processing capabilities   Note: Number of TBs are based on reported Rel-15 capability on number of TBs, and reported value for component 7 cannot be smaller than the reported value of the number of TBs   1. Supported PUSCH hopping scheme |  | Yes | N/A |  | Per FS  Note: Per FS is selected to follow Rel-15 reporting type for number of TBs to be supported | N/A | N/A | N/A | Candidate value for component 7: {2, 3, 4, 7, 8, 12}  Candidate value for component 8: {Inter-slot hopping, Inter-repetition hopping, both Inter-slot hopping and Inter-repetition hopping}  PUSCH repetition type B with configured grant is applied only if UE reports the support of FG 5-19 or FG 5-20, and subjected to the capability of FG 5-19 and FG 5-20  The case that both dynamic SFI and InvalidSymbolPattern are configured is applied only if UE reports the support of FG3-6 | 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. | One of {5-16, 5-17] | Yes | N/A |  | Per UE | No | No | N/A | Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as “per UE” | 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 DL CC as that scheduling 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 |  | Yes | N/A |  | Per FS  Per FS is selected because the FG is very demanding in UE processing, considering that this can be a UE with processing capability 1 but required to be able to cancel according to processing capability 2, and hence it is important to take into account the BC information for dimensioning purpose | N/A | N/A | 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 or 11-2 or 11-2a | 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 DL CC than that scheduling 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 |  | Yes | N/A |  | Per FS  Per FS is selected because the FG is very demanding in UE processing, considering that this can be a UE with processing capability 1 but required to be able to cancel according to processing capability 2, and hence it is important to take into account the BC information for dimensioning purpose | N/A | N/A | 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 or 11-2 or 11-2a  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 11-7a is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-7b | Independent cancellation of the overlapping PUSCHs in an intra-band UL CA | 1. 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 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 | Yes | N/A |  | Per band | N/A | N/A | N/A | If UE indicates 6-23 but does not support this FG, UE is not expected to be scheduled simultaneous PUSCHs on multiple carriers but receiving UL CI only for subset of carriers in intra-band carriers | Optional with capability signaling |
| 11.  NR\_L1enh\_URLLC | 11-8 | Enhanced UL power control scheme | 1. For DG-PUSCH, one bit (separately from SRI) in UL grant is used to indicate the P0 value if SRI is present in the UL grant, and 1 or 2 bits is used to indicate the P0 value if SRI is not present in the UL grant |  | Yes | N/A |  | Per UE | No | Yes  Note: Differentiation is from the perspective of the scheduled carrier | N/A |  | 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 configurations   1. Supported maximum number of configured/active configured grant configurations in a BWP of a serving cell   Candidate values for component 2: {1, 2, 4, 8, 12}   1. Supported maximum number of configured/active configured grant configurations across all serving cells, and across MCG and SCG in case of NR-DC   Candidate values for component 3: {2, …, 32} | One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | -For all the reported bands in FR1, a same X1 value is reported for component 3. For all the reported bands in FR2, a same X2 value is reported for component 3.  -The total number of configured/active configured grant configurations across all serving cells in FR1 is no greater than X1.  -The total number of configured/active configured grant configurations across all serving cells in FR2 is no greater than X2.  -If there are some serving cell(s) in FR1 and some serving cell(s) in FR2, the total number of configured/active configured grant configurations across all serving cells is no greater than max(X1, X2).  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG11-9 is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signalling |
| 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 | Yes | N/A |  | Per band | N/A | N/A | N/A | Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG11-9a is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | 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 | 5-20 | Yes | N/A |  | Per UE | No | No | N/A | 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 | 5-20, 11-1 | Yes | N/A |  | Per UE | No | No | N/A | A UE supporting this feature shall also support 11-10 (Type 2 configured grant release by DCI format 0\_1). | Optional with capability signalling |
| 11.  NR\_L1enh\_URLLC | 11-12 | CBG-based re-transmission for UL using CBGTI with only in-order CBG-based re-transmission(s) for cancelled initial PUSCH transmission | 1. Support of CBG-based PUSCH re-transmission(s) of a TB using CGBTI in case the initial PUSCH transmission was not cancelled due to gNB scheduling/indication/configuration.  2. Support of CBG-based PUSCH re-transmission(s) of a TB using CGBTI in case the initial PUSCH transmission was cancelled due to gNB scheduling/indication/configuration and the following condition is satisfied: the UE is scheduled for a re-transmission of a CBG #N in a given TB when CBG #N-1 has been transmitted before or is scheduled in the same UL grant that includes CBG#N. |  | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |

1. NR\_IIOT

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 12. NR\_IIOT | 12-1 | UL intra-UE multiplexing/prioritization of overlapping channel/signals with two priority levels in physical layer | Support intra-UE multiplexing/prioritization of overlapping PUCCH/PUCCH and PUCCH/PUSCH with two priority levels in physical layer (PHY)   1. Configuration of PHY priority level for CG PUSCH and SR, and dynamic indication of priority level for dynamic PUSCH with a single DCI format 2. Multiplexing/prioritization between UL channels/signals with the same PHY priority level 3. Prioritization between UL channels/signals with different PHY priority levels 4. Additional number of symbols (d1) needed beyond the PUSCH preparation time for cancelling a low priority UL transmission. 5. Additional number of symbols (d2) of the preparation time needed for the high priority UL transmission that cancels a low priority UL transmission |  | Yes | N/A |  | Per FS  Per FS is selected because this FG involves various kinds of prioritization/cancellation/multiplexing, it is very processing intensive, and hence it is important to have finer granularity so that the UE does not have to under-report based on the worst band/band combination | N/A | N/A | N/A | Candidate value set for component 4: {0, 1, 2}  Candidate value set for component 5: {0, 1, 2} | Optional with capability signaling |
| 12. NR\_IIOT | 12-1a | UL priority indication in DCI with mixed DCI formats | Support of priority indicator field configured in DCI formats 0\_1 and 0\_2 in a BWP when configured to monitor both DCI formats 0\_1 and 0\_2 in the BWP | 12-1 and 11-1 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signalling |
| 12. NR\_IIOT | 12-2 | Multiple SPS configurations | 1. 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, including separate RRC parameters and separate activation/release for different SPS configurations 2. The max number of active SPS configurations in a BWP of a serving cell 3. The max number of active SPS configurations across all serving cells, and across MCG and SCG in case of NR-DC 4. The related HARQ-ACK enhancements to support multiple active SPS configurations | 5-18 DL SPS | Yes | N/A |  | Per band | N/A | N/A | N/A | Component-2, candidate value set is {1, 2, …, 8}  Component-3, candidate value set is {2, …, 32}  -For all the reported bands in FR1, a same X1 value is reported for component 3. For all the reported bands in FR2, a same X2 value is reported for component 3.  -The total number of active SPS configurations across all serving cells in FR1 is no greater than X1.  -The total number of active SPS configurations across all serving cells in FR2 is no greater than X2.  -If there are some serving cell(s) in FR1 and some serving cell(s) in FR2, the total number of active SPS configurations across all serving cells is no greater than max(X1, X2).  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG12-2 is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signaling |
| 12. NR\_IIOT | 12-2a | Joint release in a DCI for two or more SPS configurations for a given BWP of a serving cell | 1. M<=4 bits indication in the Release DCI is used for indicating which SPS configuration(s) is/are released, where the association between each state indicated by the indication and the SPS 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 SPS configurations to be released  • In case of no higher layer configured state(s), separate release is used where the release corresponds to the SPS configuration index indicated by the indication   1. The related HARQ-ACK enhancements to support joint release | 12-2 | Yes | N/A |  | Per band | N/A | N/A | N/A | Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG12-2a is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signaling |
| 12. NR\_IIOT | 12-3 | SPS release by DCI format 1\_1 | Support of SPS release by DCI format 1\_1 | 5-18 DL SPS | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-3a | SPS release by DCI format 1\_2 | Support of SPS release by DCI format 1\_2 | 5-18 DL SPS and 11-1 | Yes | N/A |  | Per UE | No | No | N/A |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-5 | Configuration of aggregation factor per SPS configuration | Support of configurable PDSCH aggregation factor ({1, 2, 4, 8}) per DL SPS configuration | 5-18 DL SPS | Yes | N/A |  | Per UE | No | Yes | N/A |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-6 | Support of SPS periodicity shorter than 10 ms | Support of SPS periodicity shorter than 10 ms | 5-18 DL SPS | Yes | N/A |  | Per UE | No | Yes | N/A |  | Optional with capability signalling |

1. NR positioning

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.   a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}   1. DL PRS buffering capability: Type 1 or Type 2 2. Type 1 – sub-slot/symbol level buffering 3. Type 2 – slot level buffering 4. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE. 5. T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms 6. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms 7. Max number of DL PRS resources that UE can process in a slot under it    1. FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz    2. FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz   Note: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than 30%. |  | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  Notes for component 3:  a.UE reports one combination of (N, T) values per band, where N is a duration of DL PRS symbols in ms processed every T ms for a given maximum bandwidth (B) in MHz supported by UE  b.UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value  c.UE DL PRS processing capability is defined for a single positioning frequency layer. UE capability for simultaneous DL PRS processing across positioning frequency layers is not supported in Rel.16 (i.e. for a UE supporting multiple positioning frequency layers, a UE is expected to process one frequency layer at a time)  d.UE DL PRS processing capability is agnostic to DL PRS comb factor configuration  e.The reporting of (N, T) values for maximum BW in MHz is not dependent on SCS  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-1a | Max number of positioning frequency layers UE supports across all positioning methods across all bands | Max number of positioning frequency layers UE supports across all positioning methods across all bands  Values: {1, 2, 3, 4} |  | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-2 | DL PRS Resources for DL AoD | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   1. Max number of TRPs across all positioning frequency layers per UE.   Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-2a | DL PRS Resources for DL AoD on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-2b | DL PRS Resources for DL AoD on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC | N/A | N/A | N/A | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   1. Max number of TRPs across all positioning frequency layers per UE.   Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-3a | DL PRS Resources for DL-TDOA on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-3b | DL PRS Resources for DL-TDOA on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC | N/A | N/A | N/A | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.   Values = {1, 2}   1. Max number of TRPs across all positioning frequency layers per UE.   Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}   1. Max number of positioning frequency layers UE supports   Values = {1, 2, 3, 4} | 13-1 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-4a | DL PRS Resources for Multi-RTT on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set   Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands   1. Max number of DL PRS Resources per positioning frequency layer.   Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-4b | DL PRS Resources for Multi-RTT on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.   Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands   1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.   Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | No | N/A |  | Per BC | N/A | N/A | N/A | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-5 | DL PRS Measurement Report for DL-AoD | 1. Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE   Values = {1, 2, 3, 4, 5, 6, 7, 8} | 13-2, | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported.  the number of RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band | Optional with capability signaling |
| 13. NR Positioning | 13-6 | DL PRS Measurement Report for DL-TDOA | 1. DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4} 2. Support DL PRS-RSRP measurements. Values = {0, 1} | 13-3 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-7 | Support of SSB from neighbor cell as QCL source of a DL PRS | 1. Support of SSB from neighbor cell as QCL source of a DL PRS    * Support of reuse SSB measurement from RRM for receiving PRS   Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2 | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-7a | Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbor cell as QCL source of a DL PRS   Note: Refers to Type-D support for FR2 | 13-1 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling |
| 13. NR Positioning | 13-8 | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.   Values = {1, 2, 4, 8, 12, 16}.   1. Max number of P/SP/AP SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64}   1. Max number of P/SP/AP SRS Resources including the SRS resources for positioning per BWP per slot.   Values = {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Note: Max number of P/SP/AP SRS Resources in Component 3 include both SRS resources configured by SRS-Resource and SRS resources configured by SRS-PosResource-r16 supported by UE   1. Max number of periodic SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64}   1. Max number of periodic SRS Resources for positioning per BWP per slot.   Values = {1,2,3,4,5,6,8,10,12,14}  OLPC for SRS for positioning based on SSB from serving cell is part of FG13-8  Note: no dedicated capability signaling is intended for this component |  | Yes | N/A |  | Per FS  Note: Per FS is selected because similar capability was reported per FS (in FeatureSetUplink) in Rel-15 | N/A | N/A | N/A | Note: if the UE does not indicate this capability for a band in a band combination, the UE does not support SRS for Positioning in this band in the band combination.   * UE not supporting FG13-8 does not support FG13-8a or FG13-8b in the band in the band combination. * The same approach is applicable to FG13-8c, FG13-8d, and FG13-8e. | Optional with capability signaling |
| 13. NR Positioning | 13-8a | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64}   1. Max number of aperiodic SRS Resources for positioning per BWP per slot.   Values = {1,2,3,4,5,6,8,10,12,14} | 13-8 | Yes | N/A |  | Per FS  Note: Per FS is selected because similar capability was reported per FS (in FeatureSetUplink) in Rel-15 | N/A | N/A | N/A |  | Optional with capability signaling |
| 13. NR Positioning | 13-8b | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.   Values = {1,2,4,8,16,32,64}   1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP per slot.   Values = {1,2,3,4,5,6,8,10,12,14} | 13-8 | Yes | N/A |  | Per FS  Note: Per FS is selected because similar capability was reported per FS (in FeatureSetUplink) in Rel-15 | N/A | N/A | N/A |  | Optional with capability signaling |
| 13. NR Positioning | 13-8c | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.   Values = {1, 2, 4, 8, 12, 16}.   1. Max number of P/SP/AP SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64}   1. Max number of periodic SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64} | 13-8 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-8d | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning per BWP.   Values = {1,2,4,8,16,32,64} | 13-8a, 13-8c | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-8e | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.   Values = {1,2,4,8,16,32,64} | 13-8b,13-8c | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
| 13. NR Positioning | 13-9 | OLPC for SRS for positioning based on PRS from the serving cell | 1. OLPC for SRS for positioning based on PRS from the serving cell in the same band | 13-1 and 13-8 | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-9a | OLPC for SRS for positioning based on SSB from neighbouring cells | 1. OLPC for SRS for positioning based on SSB from neighbouring cells in the same band | 13-8 | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band | 13-9 | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-9e | PathLoss estimate maintenance per serving cell | 1. Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning per serving cell in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions”    * Candidate values are {1, 4, 8, 16}    * Note: SRS in “PUSCH/PUCCH/SRS” refers to SRS configured by SRS-Resource | One of {13-9, 13-9a, 13-9b, 13-9c} | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported  SRS and SSB and/or PRS are in the same band  Note: if the UE does not indicate this capability for a band, the UE does not support any pathloss estimates in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions in that band. | Optional with capability signaling |
| 13. NR Positioning | 13-9f | PathLoss estimate maintenance across all cells | 1. Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning across all cells in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions”    * Candidate values are {1, 4, 8, 16}    * Note: SRS in “PUSCH/PUCCH/SRS” refers to SRS configured by SRS-Resource | One of {13-9, 13-9a, 13-9b, 13-9c} | Yes | N/A |  | Per UE | No | No | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported  SRS and SSB and/or PRS are in the same band | Optional with capability signaling |
| 13. NR Positioning | 13-10 | Spatial relation for SRS for positioning based on SSB from the serving cell | 1. Spatial relation for SRS for positioning based on SSB from the serving cell in the same band | 13-8 | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10a | Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 1. Spatial relation for SRS for positioning based on CSI-RS from the serving cell in the same band | 13-10 | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10b | Spatial relation for SRS for positioning based on PRS from the serving cell | 1. Spatial relation for SRS for positioning based on PRS from the serving cell in the same band | One of  {13-2, 13-3, 13-4} and13-8 | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10c | Spatial relation for SRS for positioning based on SRS | 1. Spatial relation for SRS for positioning based on SRS in the same band | 13-8, | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10d | Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 1. Spatial relation for SRS for positioning based on SSB from the neighbouring cell in the same band | 13-10 | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band | 13-10b | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-10f | Spatial relation maintenance | 1. Max Number of maintained spatial relations for all the SRS resource sets for positioning across all serving cells in addition to the spatial relations maintained spatial relations per serving cell for the PUSCH/PUCCH/SRS transmissions.   Values = {0,1,2,4,8,16}  Note: component 1 is for all cells across all bands  Note: SRS in “PUSCH/PUCCH/SRS” refers to SRS configured by SRS-Resource | One of {13-10, 13-10a, 13-10b, 13-10d, 13-10e} | Yes | N/A |  | Per UE | No | No (FR2 only) | N/A | Need for location server to know if the feature is supported.  SRS and SSB and/or PRS are in the same band | Optional with capability signaling |
| 13. NR Positioning | 13-11a | Association between SRS for positioning and DL PRS for Multi-RTT | 1. Support of measurements derived on one or more DL PRS resource/resource sets which may be in different positioning frequency layers for SRS transmitted in a single CC.   Note: PRS and SRS may be in a different band | 13-4 and 13-8 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-11 | UE Rx-Tx Measurement Report for Multi-RTT | 1. Max number of UE Rx–Tx time difference measurements corresponding to a single SRS resource/resource set for positioning with each measurement corresponding to a single DL PRS resource/resource set.   Value for component 1: {1,2,3,4}  Note: DL PRS resource/sets are on the same frequency layer  Note: the number of UE Rx – Tx time difference measurements refers to the measurements for a single TRP   1. Support RSRP measurements. Values = {0, 1}   Note: If the UE reports value 1 for component 2, same number of RSRP measurements supported as UE Rx-Tx measurements for component 1 | 13-4 and 13-8 | No | N/A |  | Per UE | No | Yes | N/A | Need for location server to know if the feature is supported.  FG13-11 covers the case that SRS and DL PRS are on the same band | Optional with capability signaling |
| 13. NR Positioning | 13-12 | SS-RSRP RRM measurements for NR E-CID Positioning | 1. Support of cell-specific SS-RSRP RRM measurements with LPP report for NR E-CID Positioning 2. Support of beam-specific SS-RSRP RRM measurements with LPP report for NR E-CID Positioning | 1-1 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-12a | SS-RSRQ RRM measurements for NR E-CID Positioning | 1. Support of cell-specific SS-RSRQ RRM measurements with LPP report for NR E-CID Positioning 2. Support of beam-specific SS-RSRQ RRM measurements with LPP report for NR E-CID Positioning | 1-1 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-12b | CSI-RSRP RRM measurements for NR E-CID Positioning | 1. Support of cell-specific CSI-RSRP RRM measurements with LPP report for NR E-CID Positioning 2. Support of beam-specific CSI-RSRP RRM measurements with LPP report for NR E-CID Positioning | 1-4 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-12c | CSI-RSRQ RRM measurements for NR E-CID Positioning | 1. Support of cell-specific CSI-RSRQ RRM measurements with LPP report for NR E-CID Positioning 2. Support of beam-specific CSI-RSRQ RRM measurements with LPP report for NR E-CID Positioning | 1-4 | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-13 | Simultaneous DL-AoD and DL-TDoA processing | 1. Support of simultaneous processing for DL AoD and DL TDoA measurements   If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and DL TDoA measurements | 13-2 and 13-3 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-14 | Simultaneous DL-AoD and Multi-RTT processing | 1. Support of simultaneous processing for DL AoD and Multi-RTT measurements   If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and M-RTT measurements | 13-2, 13-4 and 13-8 | No | N/A |  | Per band | N/A | N/A | N/A | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 13. NR Positioning | 13-15 | Simultaneous SRS transmission within a band across multiple CCs | 1. The number of SRS resources for positioning on a symbol within a band   Candidate values {2}  Note: if the UE does not indicate this capability for a band, the UE does not support the feature in this band | 13-8 | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-15a | Simultaneous SRS transmission for a given BC | 1. The number of SRS resources for positioning on a symbol for a given BC   Candidate values {2}  Note: For single-band BCs, it defines the capability for intra-band CA, and for BCs with at least two bands, it defines the capability for inter-band CA.  Note: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination | 13-8 | Yes | N/A |  | Per BC | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-18 | Support of parallel processing of LTE PRS and NR PRS | 1. Support of parallel processing of LTE PRS and NR PRS |  | No | N/A |  | Per UE | No | No | N/A | Need for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-19 | Simultaneous positioning SRS and MIMO SRS transmission within a band across multiple CCs | 1. The number of SRS resources for positioning and SRS resource for MIMO on a symbol within a band   Candidate values {2}  Note: SRS resource for MIMO refers to SRS resource configured by SRS-Resource.  Note: If UE reports 2 for the candidate value, it means both the number of SRS resource for positioning and SRS resource for MIMO equals to 1.  Note: if the UE does not indicate this capability for a band, the UE does not support the feature in this band | 13-8 | Yes | N/A |  | Per band | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
| 13. NR Positioning | 13-19a | Simultaneous positioning SRS and MIMO SRS transmission for a given BC | 1. The number of SRS resources for positioning and SRS resource for MIMO on a symbol for a given BC   Candidate values {2}  Note: SRS resource for MIMO refers to SRS resource configured by SRS-Resource.  Note: If UE reports 2 for the candidate value, it means both the number of SRS resource for positioning and SRS resource for MIMO equals to 1.  Note: For single-band BCs, it defines the capability for intra-band CA, and for BCs with at least two bands, it defines the capability for inter-band CA.  Note: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination | 13-8 | Yes | N/A |  | Per BC | N/A | N/A | N/A | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |

1. NR TEI

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 14. NR TEI | 14-1 | Multiple LTE-CRS rate matching patterns | 1. Maximum number of LTE-CRS rate matching patterns in total within a NR carrier using 15 kHz SCS 2. Maximum number of LTE-CRS non-overlapping rate matching patterns within a NR carrier using 15 kHz SCS | 5-28 (Rate-matching around LTE CRS) | Yes | N/A |  | Per band | N/A | N/A (FR1 only) | N/A | For DSS  The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot  UE reporting component 1 for 14-1 also reports component 2.  Reporting of values of Component 1 larger than two is only applicable when reporting values of Component 2 larger than one. | Optional with capability signalling  Component 1:{2, 3, 4, 5, 6}  Component 2: {1, 2, 3} |
| 14. NR TEI | 14-1a | Two LTE-CRS overlapping rate matching patterns within a part of NR carrier using 15 kHz overlapping with a LTE carrier | 1. Support of two LTE-CRS overlapping rate matching patterns within a part of NR carrier using 15 kHz SCS overlapping with a LTE carrier | 14-1 | Yes | N/A |  | Per band | N/A | N/A (FR1 only) | N/A | For DSS  The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot | Optional with capability signaling |
| 14. NR TEI | 14-2 | PDSCH Type B mapping of length 9 and 10 OFDM symbols | 1. support of PDSCH Type B scheduling of length 9 and 10 OFDM symbols 2. support of DMRS shift for length-10 symbols | 5-6a (PDSCH mapping type B) | Yes | N/A |  | Per band | N/A | N/A (FR1 only) | N/A | For DSS  FG10-8 covers PDSCH type B mapping without DMRS shift due to CRS collision. | Optional with capability signaling |
| 14. NR TEI | 14-3 | One slot periodic TRS configuration for FR1 | 1. UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated | 2-51 (CSI-RS for tracking) | Yes | N/A |  | Per band | N/A (TDD only) | N/A (FR1 only) | N/A | UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated.  This FG is not also applicable for the case that all slots are indicated as flexible | Optional with capability signalling |
| 14. NR TEI | 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch | 2-55 | Yes | N/A |  | Per BC (same reporting type as srs-TxSwitch in Rel-15) | N/A | N/A | N/A | Agreement:  •Rel-16 UE capability design for SRS antenna switching in conjunction with the existing Rel-15 UE capability should allow UE to indicate support of one of the following combinations  o{t1r1, t1r2}  o{t1r1, t1r2, t1r4}  o{t1r1, t1r2, t2r2, t2r4}  o{t1r1, t2r2}  o{t1r1, t2r2, t4r4}  o{t1r1, t1r2, t2r2, t1r4, t2r4}  oNote: Detailed signaling design is up to RAN2 | Optional with capability signalling  Component 1: Candidate value set:  {  o{t1r1, t1r2}  o{t1r1, t1r2, t1r4}  o{t1r1, t1r2, t2r2, t2r4}  o{t1r1, t2r2}  o{t1r1, t2r2, t4r4}  o{t1r1, t1r2, t2r2, t1r4, t2r4}  }  Component2: Candidate value set: {yes, no}  Component 3: Candidate value set: {yes, no} |
| 14. NR TEI | 14-5 | Half-duplex UE behaviour in TDD CA for same SCS | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with same SCS | 6-5 and simultaneousRxTxInterBandCA not supported | Yes | N/A |  | Per BC | N/A (TDD only) | N/A | N/A | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | Optional with capability signaling |
| 14. NR TEI | 14-6 | New RACH configuration for FR1 TDD | 1. new RACH configuration entries with subframe number 2 and/or 7 for RACH periodicity longer than 10 ms |  | No | N/A |  | N/A | N/A (TDD only) | N/A (FR1 only) | N/A | Agreement:  •A new UE capability is not introduced for this TEI, i.e., it is a mandatory UE feature for Rel-16. | Mandatory without capability signalling |
| 14. NR TEI | 14-7 | New capability for beamSwitchTiming values of 224 and 336 | 1. Indicates the minimum number of required OFDM symbols {224, 336} between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition ‘ON’  * Candidate values: {224, 336} | 2-28 | Yes | N/A |  | Per band | N/A | N/A (FR2 only) | N/A | Agreements:  ・48 is used as the beam switching threshold for Ues reporting 224 or 336  ØWhen using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition ‘ON’ to apply TCI indication in CSI-RS triggering DCI.  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 14-7 is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signaling |
| 14. NR TEI | 14-8 | CSI trigger states containing non-active BWP | 1. CSI trigger states containing non-active BWP |  | Yes | N/A |  | Per UE | No | No | N/A | Agreements:  TEI – “CSI trigger states containing non-active BWP”  ・When a UE is triggered with a CSI report for a DL BWP that is non-active, the UE is not expected to report the CSI for the non-active BWP and the CSI report associated with the BWP is omitted.  ・When a UE is triggered with aperiodic CSI-RS in a DL BWP that is non-active, the UE is not expected to measure the aperiodic CSI-RS.  ・The above non-active BWP is the non-active BWP when receiving the associated CSI-RS with the following relaxation for UE processing.  In the CC of the associated CSI-RS, if the active BWP when receiving the CSI-RS is different from the active BWP when receiving the triggering DCI  The last symbol of the PDCCH span of the DCI carrying the BWP switching shall be no later than the last symbol of the PDCCH span of the CSI trigger DCI, irrespective of whether they are in the same CC or not and irrespective of whether they are in the same SCS or not.  The UE is not expected to have any other BWP switching in that CC after the last symbol of the PDCCH span covering CSI trigger DCI and before the first symbol of the triggered CSI-RS resource.  ・Note: the UE is not required to measure P/SP-CSI-RS in the non-active BWP per current specification | Optional with capability signaling |

1. 5G\_V2X\_NRSL

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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**  **(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** |
| 15-1 | Receiving NR sidelink | 1) UE can receive NR PSCCH/PSSCH. Up to a total of A sidelink HARQ processes across all links are supported.  2) UE can receive X PSCCH in a slot.  3) UE can attempt to decode Y= NRB non-overlapping RBs per slot  4) UE supports reception of PSSCH according to the 64QAM MCS table  5) UE supports PT-RS reception in FR2.  8) UE can receive using the subcarrier spacing and CP length defined for a given band in RAN4  10) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  12) UE can receive using 30 kHz subcarrier spacing with normal CP in FR1, 120 kHz subcarrier spacing with normal CP FR2 | None | Yes | Yes |  | Per band | N.A. | N.A. | N.A. | This is the basic FG for sidelink  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note:  NRB is the number of RBs defined per channel bandwidth by RAN4 in 38.101-1 Table 5.3.2-1 for FR1 and 38.101-2 Table 5.3.2.-1 for FR2  Note: Component 8 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 12 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-1 candidate value set: {16, 24, 32, 48, 64}  Component-2 candidate value set: {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}  Component-8 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-8 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-8 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz) | Optional with capability signaling. For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-2 | Transmitting NR sidelink mode 1 scheduled by NR Uu | 1) UE can transmit PSCCH/PSSCH using dynamic scheduling or configured grant type 1 and 2 in NR sidelink mode 1 scheduled by NR Uu. Up to 8 configured grants can be configured for a UE. Up to C sidelink HARQ processes are supported including those for configured grants  2) UE can transmit PSSCH according to the normal 64QAM MCS OFDM table.  3) UE supports PT-RS transmission in FR2.  4) UE can monitor DCI format 3\_0 for NR sidelink dynamic scheduling and configured grant type 2 on the same carrier as sidelink.  6) UE can transmit using the subcarrier spacing and CP length it reports.  8) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to ~~{~~#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  9) Support downlink pathloss based open loop power control  11) UE can report sidelink HARQ-ACK to gNB via PUCCH and PUSCH when it is operating in NR sidelink mode 1 |  | Yes | No |  | Per band | N.A. | N.A. | N.A. | Note: Random selection in the exceptional pool is supported.  This is the basic FG for sidelink in licensed spectrum where gNB is operating on or managing that spectrum and optional FG otherwise  Candidate values for C are {8,16}  Component-6 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-6 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-6 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz)  Note: For Component 6, if a band is not indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1, the reported numerology shall be the same for sidelink and uplink.  Component (9) is only required to be supported in a band not indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with the PC5 interface in 38.101-1 Table 5.2E.1-1  In a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1, the UE supports at least 30 kHz with normal CP in FR1, and at least 120 kHz with normal CP in FR2 | Optional with capability signalling  For UE supports NR sidelink in licensed spectrum where gNB is defined, UE must indicate this FG is supported. |
| 15-3 | Transmitting NR sidelink mode 2 | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.  2) UE can transmit PSSCH according to the normal 64QAM MCS table.  3) UE supports PT-RS transmission in FR2.  4) UE can perform mode 2 sensing and resource allocation operations  6) UE can transmit using the subcarrier spacing and CP length it reports for FG 15-1  8) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to ~~{~~#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  10) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR2  11) DL pathloss based open loop power control when mode 2 is configured by NR Uu | 15-1 | Yes | No |  | Per band | N.A. | N.A. | N.A. | Note: Random selection in the exceptional pool is supported.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  This is the basic FG for NR sidelink  Candidate values for B are {8,16}  Note: Component 6 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 10 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-4 | Synchronization sources for NR sidelink | 1) UE can receive S-SSB in NR sidelink if it supports 15-1.  2) UE can transmit S-SSB in NR sidelink if it supports 15-2 or 15-3.  3) UE supports GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.  4) UE can transmit or receive NR sidelink based on the synchronization to an gNB  5) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.  6) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | At least one of 15-1, 15-2, 15-3 | Yes | No |  | Per band | N.A. | N.A. | N.A. | This is the basic FG for sidelink.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 4 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 5 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 6 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-5 | Sidelink congestion control | 1) UE can report CBR measurement to gNB when operating in Mode 1 and mode 2  2) UE can adjust its radio parameters based on CBR measurement and CRlimit.  3) UE can process CBR and CR within the time it indicates | 15-1 and at least one of 15-2 and 15-3 | Yes | No |  | Per band | N.A. | N.A. | N.A. | This is the basic FG for NR sidelink  Note: component 1 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-3 candidate value set  {Congestion process time 1, Congestion process time 2} where  Congestion process time 1: 2, 2, 4, 8 slots for 15, 30, 60, 120 kHz subcarrier spacing.  Congestion process time 2: 2, 4, 8, 16 slots for 15, 30, 60, 120 kHz subcarrier spacing | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-6 | Short-term time-scale TDM for in-device coexistence | 1. Support prioritization between LTE sidelink transmission/reception and NR sidelink transmission/reception | At least one of 15-1, 15-2, 15-3  UE supports LTE V2X sidelink in the band combination | No | No | When LTE V2X sidelink operates in the same band, UE supports TDM for in-device coexistence only when resource pool of NR sidelink does not overlap with resource pool of LTE sidelink in time domain. UE does not support subframe boundary alignment for in-device coexistence when the bands in the band combination are different | per band combination | N.A. | N.A. | N.A. |  | Optional without capability signalling |
| 15-7 | Transmitting LTE sidelink mode 3 scheduled by NR Uu | 1) UE can be scheduled over NR Uu by DCI format 3\_1 for LTE sidelink mode 3 transmission..  2) UE reports a value ‘X’ for the minimum value it supports for the additional time indicated in the NR DCI scheduling LTE sidelink mode 3 | UE supports LTE V2X sidelink | Yes | No |  | Per band | N.A. | N.A. | N.A. | Component-2 candidate value set:  {0ms, 0.25ms, 0.5ms, 0.625ms, 0.75ms, 1ms, 1.25ms, 1.5ms,1.75ms, 2ms, 2.5ms, 3ms, 4ms, 5ms, 6ms, 8ms, 10ms, 20 ms } | Optional with capability signalling |
| 15-9 | Transmitting LTE sidelink mode 4 configured by NR Uu | 1) UE can be configured over NR Uu for LTE sidelink mode 4 operation | UE supports LTE V2X sidelink | Yes | No |  | Per band | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 15-10 | 256QAM sidelink transmission | 1) UE can transmit PSSCH according to the 256QAM MCS table | At least one of 15-2, 15-3 | Yes | Yes | UE does not support transmission according to the 256QAM MCS table | Per band | N.A. | N.A. | N.A. | Note: RAN4 to decide support for 256QAM transmission in an FR | Optional with capability signalling |
| 15-11 | PSFCH format 0 | 1) UE can transmit and receive NR PSFCH format 0  2) UE can receive up to N PSFCH(s) resources in a slot.  3) UE can transmit up to M PSFCH(s) resources in a slot | At least one of 15-1, 15-3 | Yes | No |  | Per band | N.A. | N.A. | N.A. | This is the basic FG for sidelink.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}  Candidate values for M are {4, 8, 16} | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-12 | Low-spectral efficiency 64QAM MCS table | 1) UE can transmit and receive PSSCH according to the low-spectral efficiency 64QAM MCS table. | At least one of 15-1, 15-2, 15-3 | Yes | Yes | UE does not support transmission/reception according to the low spectral-efficiency 64QAM MCS table | Per band | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 15-14 | Sidelink CSI report | 1) UE can transmit and receive sidelink CSI-RS with up to P antenna port(s).  2) UE supports RI and CQI feedback on sidelink. | 15-1 and at least one of 15-2 and 15-3 | No | Yes |  | Per band | N.A. | N.A. | N.A. | Note: Component 1 candidate values are P = {1,2}  Note: When P=1, UE reports RI=1  Note: P=2 is optional | Mandatory with capability signalling for UEs supporting NR sidelink |
| 15-15 | eNB type synchronization source for NR sidelink | 1) UE can transmit or receive NR sidelink based on the synchronization to an eNB.  2) If UE supports 15-4, UE additionally supports eNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.  3) If UE supports 15-4, UE additionally supports eNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | At least one of 15-1, 15-2, 15-3 | Yes | No |  | Per band | N.A. | N.A. | N.A. |  | Optional with capability signalling. |
| 15-16 | Simultaneous transmission of uplink and sidelink | 1) UE supports simultaneous transmission of NR uplink and NR sidelink (in different bands) in a band combination for which the UE indicated simultaneous sidelink and uplink support in a band combination. | At least one of 15-2 and 15-3 | Yes | No |  | Per FS | N.A. | N.A. | N.A. |  | Optional with capability signalling. |
| 15-18 | Support of rank 2 transmission | 1) UE additionally supports rank 2 PSSCH transmission | 15-14 with P=2 | No | No | UE supports rank 1 PSSCH transmission only. | Per band | N.A. | N.A. | N.A. | RAN1 does not see a need for the gNB to know if the feature is supported but would like to leave final decision to RAN2 | Optional without capability signalling |
| 15-19 | Support of rank 2 reception | 1) UE additionally supports rank 2 PSSCH reception | 15-1 | No | Yes | UE supports rank 1 PSSCH reception only. | Per band | N.A. | N.A. | N.A. | RAN1 does not see a need for the gNB to know if the feature is supported but would like to leave final decision to RAN2 | Optional with capability signalling |
| 15-22 | Support of fewer than 14 consecutive sidelink symbols in a slot | 1. UE additionally supports transmission/reception of SL slot configured with 7, 8, 9, 10, 11, 12, 13 consecutive symbols and all the corresponding DMRS patterns | At least one of 15-1, 15-2, 15-3 | Yes | No | UE supports SL only in a SL slot configured with 14 consecutive symbols. | Per band | N.A. | N/A | N.A. |  | Optional with capability signalling |
| 15-23 | Support of open loop SL power control and RSRP report | 1. Support sidelink pathloss based open loop power control and RSRP report in case of unicast | 15-1 and at least one of 15-2 and 15-3 | Yes | Yes |  | Per band | N.A. | N/A | N.A. | This is the basic FG for NR sidelink | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
| 15-24 | Simultaneous reception of downlink and sidelink | UE supports simultaneous reception of NR downlink and NR sidelink in a band combination for which the UE indicated simultaneous sidelink and downlink support in a band combination. | 15-1 | Yes | No |  | Per feature set | N.A. | N.A. | N.A. |  | Optional with capability signalling |
| 15-25 | Transmitting NR sidelink mode 1 scheduled by NR Uu on a different carrier | 1) UE can monitor DCI format 3\_0 on a different carrier from sidelink for NR sidelink dynamic scheduling and configured grant type 2 | FG 15-2 | Yes | No |  | Per FS | N.A. | N.A. | N.A. | If the UE indicates support for FG 15-2 in a band indicated with only the PC5 interface in Table 5.2E.1-1 of 38.101-1, the UE must indicate that FG 15-25 is supported for a band combination with that band. | Optional with capability signalling |

1. NR\_eMIMO

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
|  | 16-1a-1 | SSB/CSI-RS for L1-SINR measurement | Per slot limitations:   1. The max number of SSB/CSI-RS (1Tx) for CMR 2. The max number of CSI-IM/NZP-IMR resources 3. The max number of CSI-RS (2Tx) resources for CMR   Memory limitations:   1. The max number of SSB/CSI-RS resources as CMR 2. The max number of CSI-IM/NZP IMR resources   Other limitations:   1. Supported density of CSI-RS (CMR) 2. The max number of aperiodic CSI-RS resources across all CCs configured to measure L1-SINR (including CMR and IMR) shall not exceed MD\_1 3. Supported SINR measurements | 2-21, 2-22 or 2-23, 2-23a | Yes | N/A |  | Per band | No | No |  | Component 1: Candidate values {8, 16, 32, 64}  Component 2: Candidate values {8, 16, 32, 64}  Component 3: Candidate values {0, 4, 8, 16, 32, 64}  Component 4: Candidate values {8, 16, 32, 64 , 128}  Component 5: Candidate values {8, 16, 32, 64 , 128}  Component 6: Candidate values {‘1 only’, ‘3 only’, ‘1 and 3’}  Component 7: Candidate values {2, 4, 8, 16, 32, 64}  Component 8: Candidate values: bitmap with entries {SSB as CMR with dedicated CSI-IM, SSB as CMR with dedicated NZP IMR, CSI-RS as CMR with dedicated NZP IMR configured, CSI-RS as CMR without dedicated IMR configured}  If a UE supports FG 16-1a-1 it must support CMR(CSI-RS) + dedicated CSI-IM  Note1: The reference slot duration is the shortest slot duration defined for the FR where the reported band belongs  Note2: For component 4 and 5 the configured CSI-RS resources for both active and inactive BWPs are counted  Note3: For components 1, 2 and 3, CSI-RS resources configured as CMR without dedicated IMR are counted both as CMR and IMR  Note4: For components 1, 2, 3, 7, a SSB/CSI-RS resource is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note5: For components 1, 2, 3, 7, if one resource used for L1-SINR measurement is referred N times by one or more CSI reporting settings with reportQuantity -r16= ssb-Index-SINR -r16 or cri-SINR -r16, it is counted N times. | Optional with capability signalling |
| 16-1a-2 | Non-group based L1-SINR reporting | 1. Support of non-group based L1-SINR reporting with N\_max L1-SINR values reported | 16-1a-1 | Yes | N/A |  | Per band | No | No |  | Note: Default value is N\_max = 1 in case 16-1a-2 is not provided by the UE.  Candidate value set is {1, 2, 4} | Optional with capability signalling |
| 16-1a-3 | Group based L1-SINR reporting | 1. Support of group based L1-SINR reporting | 16-1a-1 | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signalling |
| 16-1a-4 | Semi-persistent L1-SINR report on PUCCH | 1. Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH) 2. Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) | 16-1a-1 | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signalling |
| 16-1a-5 | Semi-persistent L1-SINR report on PUSCH | 1. Support semi-persistent report on PUSCH | 16-1a-1 | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signalling |
| 16-1b-1 | TCI state activation across multiple CCs | 1. Support of Simultaneous TCI state activation across multiple CCs: PDCCH, PDSCH | Component 1: 2-1, 2-4 | Yes | N/A |  | per UE | No | Yes |  | Note: Whether a FG to indicate group(s) of bands that share the same DL spatial filters will be introduced is in RAN4 domain | Optional with capability signaling |
| 16-1b-2 | Spatial relation update across multiple CCs | 1. Support of Simultaneous spatial relation update across multiple CCs: AP-SRS, SP-SRS | Component 1: 2-59, 2-60 | Yes | N/A |  | per UE | No | Yes |  | Note: Whether a FG to indicate group(s) of bands that share the same UL spatial filters will be introduced is in RAN4 domain | Optional with capability signaling |
| 16-1b-3 | Spatial relation update for PUCCH group | 1. Support of PUCCH resource groups per BWP for simultaneous spatial relation update | 2-53, 2-59, 4-24 | Yes | N/A |  | per band | No | Yes |  |  | Optional with capability signalling |
| 16-1c | Default spatial relation | Support of default spatial relation and pathloss reference RS for dedicated-PUCCH/SRS and PUSCH | 2-53, 2-59 | Yes | N/A |  | per UE | No | FR2 only |  |  | Optional with capability signaling |
| 16-1d | MAC CE spatial relation update for AP-SRS | Support of spatial relation update for AP-SRS via MAC CE | 2-53, 2-59 | Yes | N/A |  | Per UE | No | FR2 only |  |  | Optional with capability signalling |
| 16-1e | Pathloss reference RS activation via MAC CE | 1. The maximum number of configured pathloss reference RSs for PUSCH/PUCCH/SRS by RRC for MAC-CE based pathloss reference RS update | 8-3 | Yes | N/A |  | Per UE | No | No |  | Candidate values for component (1): {4, 8, 16, 32, 64} | Optional with capability signaling |
| 16-1f | SCell beam failure recovery | 1. The maximum number of SCells configured for SCell beam failure recovery simultaneously | 2-31 | Yes | N/A |  | Per band | No | No |  | Component-1: candidate value set is {1,2,4,8} | Optional with capability signaling |
| 16-1g | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification 2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification | 2-24, 2-31 | Yes | N/A |  | Per UE | No | Yes |  | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}  Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}  Note: For RS configured for new beam identification, they are always counted regardless of beam failure event  Note: The “configure to measure” RS (component1) only counts those in active BWP but the configured RS (component2) counts all configured including both active and inactive BWP  Note: the reference slot duration is the shortest slot duration defined for the reported FR supported by the UE  Note: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note: Regarding the "configured to measure” RS counting   * If one resource is used for one or multiple of BFD /RLM , it is counted as one (basic usage1) * If one resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add 1 (basic usage 2)   + L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘ssb-Index-RSRP’, ‘cri-RSRP’ or with reportQuantity set to 'none' and CSI -RS-ResourceSet with higher layer parameter trs-Info is not configured * If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity -r16= ‘ssb-Index-SINR -r16’ or ‘cri-SINR -r16’ | Optional with capability signaling |
| 16-1g-1 | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification 2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification | 2-24, 2-31, 16-1g | Yes | N/A |  | Per UE | No | No |  | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}  Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}  Note: This FG indicates the maximum number of resources across all FR(s) that are supported by the UE  Note: The signalled values apply to the shortest slot duration defined in any FR(s) that are supported by the UE  Note: The “configured to measure” RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note: Regarding the "configured to measure” RS counting   * If one resource is used for one or multiple of BFD /RLM , it is counted as one (basic usage1) * If one resource is used for one or multiple of NBI (New Beam Identification)/PL-RS/L1-RSRP, add 1 (basic usage 2)   + L1-RSRP measurement includes cases associated with reports with reportQuantity set to ‘ssb-Index-RSRP’, ‘cri-RSRP’ and with reportQuantity set to 'none' and CSI -RS-ResourceSet with higher layer parameter trs-Info is not configured * If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity -r16= ‘ssb-Index-SINR -r16’ or ‘cri-SINR -r16’ | Optional with capability signaling |
| 16-1h | Support of 64 configured PUCCH spatial relations | 1. Support of configuring maximum 64 PUCCH spatial relations per BWP per CC 2. Maximum number of configured spatial relations per CC for PUCCH and SRS | 2-59 | Yes | N/A |  | Per band | No | FR2 only |  | Component 2: Candidate value set {96, 128, 160, 192, 224, 256, 288, 320}    Note: if component 2 is reported, UE shall report 96 in FG 2-59 and the UE may assume that the value reported in FG 2-59 is used by Rel-15 gNB and ignored by Rel-16 gNB. | Optional with capability signaling |
| 16-1j-1 | 2 port CSI -RS for new beam identifications | Support of 2 port CSI -RS for new beam identification with the same resource counting as in FG 16-1g, FG 16-1g-1 |  | Yes | N/A |  | Per UE | No | No |  |  | Optional with capability signaling |
| 16-1j-2 | 2 port CSI -RS for pathloss estimation | Support of 2 port CSI -RS for  pathloss estimation  with the same resource counting as in FG 16-1g, FG 16-1g-1 |  | Yes | N/A |  | Per UE | No | No |  |  | Optional with capability signaling |
| 16-1I | Support of 64 configured candidate beam RSs for PCell/PSCell BFR | 1. Support of configuring maximum 64 candidate beam RSs per BWP per CC | 2-31 | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signaling |
| 16-2a | Multi-DCI based multi-TRP | 1. The maximum number of CORESETs configured per BWP per cell in addition to CORESET 0 2. The maximum number of CORESETs configured per CORESETPoolIndex ( if CORESETPoolIndex is not configured, it is assumed CORESETPoolIndex = 0) per BWP per cell in addition to CORESET 0 3. Support fully/partially overlapping PDSCHs in time and non-overlapping in frequency 4. Maximum number of unicast PDSCHs per CORESETPoolIndex per slot |  | Yes | N/A |  | Per FSPC | No | No |  | Note: A UE may assume that its maximum receive timing difference between the DL transmissions from two TRPs is within a CP  Note: Processing capability 2 is not supported in any CC if at least one CC is configured with two values of CORESETPoolIndex  Component 1: Candidate values {2,3,4,5}  Note: 1. If UE reports value N1 for component 1, that means UE supports up to min (N1+1, 5) CORESETs in total (including CORESET#0) if there is CORESET#0, and supports maximal N1 CORESETs if there is no CORESET#0.  Component 2: Candidate values {1,2,3}  Note: If UE reports value N2 for component 2, that means UE supports up to min (N2+1, 3) CORESETs in total (including CORESET#0) for a TRP if there is CORESET#0, and supports maximal N2 CORESETs for another TRP if there is no CORESET#0.  Component 4: Candidate values {1,2,3,4,7}  Note: per SCS, similar with Rel-15 | Optional with capability signaling |
| 16-2a-0 | Overlapping PDSCHs in time and fully overlapping in frequency and time | 1. Support PDSCHs with fully overlapping REs, i.e. the allocated REs for PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 0 and PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 1 are exactly the same REs 2. The maximal number of PDSCH scrambling sequences per serving cell | 16-2a | Yes | N/A |  | Per band | No | No |  | Note: A UE may assume that its maximum receive timing difference between the DL transmissions from two TRPs is within a CP  Component 2: Candidate values {1, 2} | Optional with capability signalling |
| 16-2a-1 | Overlapping PDSCHs in time and partially overlapping in frequency | 1. Support PDSCHs with partially overlapping REs, i.e. the allocated REs for PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 0 and PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 1 are partially overlapped, with at least one RE | 16-2a-0 | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signalling |
| 16-2a-2 | Out-of-order operation for DL | 1. Support out-of-order operation for PDCCH to PDSCH  2. Support out-of-order operation for PDSCH to HARQ-ACK | 16-2a | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signalling |
| 16-2a-3 | Out-of-order operation for UL | 1. Support out-of-order operation for PDCCH to PUSCH | 16-2a | Yes | N/A |  | Per band | No | No |  | Note: “Same closed loop index for power control across PUSCHs associated with different CORESETPoolIndex values is not supported by a UE indicating the support of this feature when TPC accumulation is enabled.” | Optional with capability signalling |
| 16-2a-4 | HARQ-ACK for multi-DCI based multi-TRP - separate | 1. Support of separate HARQ-ACK 2. The maximum number of long PUCCHs within a slot for separate HARQ-Ack | 16-2a | Yes | N/A |  | Per UE | No | No |  | Candidate values for Component 2:  {LongAndLong, LongAndShort, ShortAndShort} | Optional with capability signalling |
| 16-2a-4a | HARQ-ACK for multi-DCI based multi-TRP - joint | 1. Support of joint HARQ-ACK | 16-2a | Yes | N/A |  | Per UE | No | No |  |  | Optional with capability signalling |
| 16-2a-5 | Separate CRS rate matching | Whether the UE can rate match around configured CRS patterns which is associated with CORESETPoolIndex  (if configured) and are applied to the PDSCH scheduled with a DCI detected on a CORESET with the same value of CORESETPoolIndex | 16-2a and 14-1a | Yes | N/A |  | Per band | No | FR1 only |  | Note: only applicable for 15kHz SCS | Optional with capability signalling |
| 16-2a-6 | Default QCL enhancement for multi-DCI based multi-TRP | Support of default QCL assumption per CORESETPoolIndex | 16-2a and 16-2c | Yes | N/A |  | Per band | N/A | FR2 only |  |  | Optional with capability signalling |
| 16-2a-7 | Maximum number of activated TCI states | 1. The maximal number of activated TCI states per CORESETPoolIndex per BWP per CC including data and control 2. The maximal total number of activated TCI states across CORESETPoolIndex per BWP per CC including data and control | 16-2a | Yes | N/A |  | Per band | No | No |  | Candidate values for Component 1: {1,2,4,8}  Candidate values for Component 2: {2,4,8,16} | Optional with capability signalling |
| 16-2a-8 | Indicates that retransmission scheduled by a different CORESETPoolIndex for multi-DCI multi-TRP is not supported. | For multi-DCI multi-TRP operation, if this FG is indicated, UE does not support retransmission scheduled by PDCCH received in a different CORESETPoolIndex compared to the CORESETPoolIndex of the initial transmission, i.e., the UE is not expected to receive, for the same HARQ process ID, DCI from a different CORESETPoolIndex that schedules the retransmission, i.e., NDI not flipped. This applies to both PDSCH and PUSCH retransmissions. | 16-2a | Yes | N/A |  | Per UE | N/A | N/A | N/A |  | Optional with capability signalling |
| 16-2c | Simultaneous reception with different Type-D | Supports simultaneous reception with different QCL Type-D RSs. |  | Yes | N/A |  | Per band | N/A | FR2 only |  |  | Optional with capability signalling |
| 16-2a-9 | Interpretation of maxNumberMIMO-LayersPDSCH for multi-DCI based mTRP | For multi-DCI multi-TRP operation, if this FG is indicated, “maxNumberMIMO-LayersPDSCH” is interpreted as the maximum number of layers per PDSCH. | 16-2a-0 | Yes | N/A |  | Per band | No | No |  | Note1: For multi-DCI multi-TRP operation, if this FG is not indicated, maxNumberMIMO-LayersPDSCH is interpreted as the maximum number of layers across two PDSCHs if having at least one RE overlapped.  Note2: For data rate calculation in Section 4.1.2 of 38.306, if this FG is indicated, each multi-DCI based multi-TRP CC is counted two times toward J. | Optional with capability signalling |
| 16-2a-10 | Value of BD factor | Value of R for BD/CCE | 16-2a | Yes | N/A |  | Per BC | No | No |  | Component: {1,2} | Optional with capability signalling |
| 16-2b-0 | Two default beams for single-DCI based multi-TRP | Support of default QCL assumption with two TCI states | 16-2c | Yes | N/A |  | Per band | N/A | FR2 only |  |  | Optional with capability signaling |
| 16-2b-1 | Single-DCI based SDM scheme | 1. Support of single-DCI based SDM scheme |  | Yes | N/A |  | Per FS | N/A | N/A |  |  | Optional with capability signaling |
| 16-2b-1b | Single-DCI based SDM scheme – Support of new DMRS port entry | 1. Support of new DMRS port entry {0, 2, 3} | 16-2b-1 | Yes | N/A |  | Per band | N/A | N/A |  |  | Optional with capability signaling |
| 16-2b-1a | Downlink PTRS | 1. Support of 2-port DL PTRS | 16-2b-1 | Yes | N/A |  | Per band | N/A | N/A |  |  | Optional with capability signaling |
| 16-2b-2 | Single-DCI based FDMSchemeA | Support of single-DCI based FDMSchemeA |  | Yes | N/A |  | Per band | No | No |  |  | Optional with capability signaling |
| 16-2b-3 | Single-DCI based FDMSchemeB | Support of single-DCI based FDMSchemeB |  | Yes | N/A |  | per FSPC | No | No |  |  | Optional with capability signaling |
| 16-2b-3a | Single-DCI based FDMSchemeB CW soft combining | 1. For FDMSchemeB, Support CW soft combining that UE can support | 16-2b-3 | Yes | N/A |  | per band | No | No |  |  | Optional with capability signaling |
| 16-2b-4 | Single-DCI based TDMSchemeA | 1. Support of single-DCI based TDMSchemeA 2. Supported maximum TBS size for TDMSchemeA |  | Yes | N/A |  | Per band | No | No |  | Component 2 candidate values {3, 5, 10, 20, no restriction} KByte | Optional with capability signaling |
| 16-2b-5 | Single-DCI based inter-slot TDM | 1. Support of single-DCI based inter-slot TDM 2. Support of RepNumR16 in PDSCH-TimeDomainResourceAllocation and the maximum value of RepNumR16 3. Supported maximum TBS size 4. Maximum number of TCI states |  | Yes | N/A |  | Per band | No | No |  | Component 2 candidate values: {{2,3,4,5,6,7,8,16}}  Component 3 candidate values {{3, 5, 10, 20, no restriction} KByte }  Component 4 candidate values: {1,2} | Optional with capability signaling |
| 16-3a | Regular eType-II | Basic components:   1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=1 2. Support of parameter combinations 1-6 3. Support of rank 1,2 | 2-35 | Yes | N/A |  | Per band and per BC | N/A | N/A |  | Candidate values for component 1:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3a-1 | Support of PMI sub-bands with R=2 | {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=2 | 16-3a | Yes | N/A | If this FG is not reported, UE does not support R=2 | Per band and per BC | N/A | N/A |  | Candidate values for component 1:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3a-2 | Support of parameter combinations 7-8 | Support of parameter combinations 7-8 | 16-3a | Yes | N/A | UE does not support parameter combination 7-8 | Per Band | N/A | N/A |  |  | Optional with capability signaling |
| 16-3a-3 | Support of rank 3,4 | Support of rank 3,4 | 16-3a | Yes | N/A | UE does not support rank 3-4 | Per Band | N/A | N/A |  |  | Optional with capability signaling |
| 16-3a-4 | CBSR | 1) CBSR with amplitude subset restriction | 16-3a | Yes | N/A | CBSR with amplitude subset restriction is not supported | Per Band | N/A | N/A |  |  | Optional with capability signaling |
| 16-3b | Port selection eType-II | Basic components:   1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support port selection eType-II for R=1 2. 6 parameter combinations (combos with L=6 don’t apply) 3. Support of rank 1,2 | 2-35 | Yes | N/A |  | Per band and per BC | N/A | N/A |  | Candidate values for component 1:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3b-1 | Support of PMI sub-bands with R=2 | {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support port selection eType-II for R=2 | 16-3b | Yes | N/A | UE does not support R=2 | Per band and per BC | N/A | N/A |  | Candidate values for component 1:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3b-2 | Support of rank 3,4 | Support of rank 3,4 | 16-3b | Yes | N/A | UE does not support rank 3-4 | Per Band | N/A | N/A |  |  | Optional with capability signaling |
| 16-4 | Low PAPR DMRS for DL | Low PAPR DMRS for PDSCH |  | Yes | N/A |  | Per Band | N/A | N/A |  |  | Optional with capability signaling |
| 16-5a | UL full power transmission mode of *fullpower* | 1. Supported UL full power transmission mode of *fullpower* | 2-13, 2-14 | Yes | N/A |  | Per FS | N/A | N/A |  |  | Optional with capability signaling |
| 16-5b | UL full power transmission *fullpowerMode1* | 1. Supported UL full power transmission *fullpowerMode1* | 2-13, 2-14 | Yes | N/A |  | Per FS | No | No |  |  | Optional with capability signaling |
| 16-5c | UL full power transmission *fullpowerMode2* | 1. The maximum number of SRS resources in one SRS resource set with usage set to ‘codebook’ for Mode 2: {1, 2, 4} | 2-13, 2-14 | Yes | N/A |  | Per FS | No | No |  | A UE that supports FG 16-5c supports at least full power operation with single port | Optional with capability signaling |
| 16-5c-2 | UL full power transmission fullpowerMode2 – SRS resources | 1. The SRS configuration with different number of antenna ports per SRS resource for Mode 2 | 16-5c | Yes | N/A |  | Per FS | No | No |  | Component (1) candidate values: {1\_2, 1\_4, 1\_2\_4}  1st state (1\_2): each SRS resource can be configured with 1 port or 2 ports    2nd state (1\_4): each SRS resource can be configured with 1 port or 4 ports    3rd state (1\_2\_4): each SRS resource can be configured with 1 port or 2 ports or 4 ports  Note: The first, second, or third state can be used if 16-5c is reported as 2 or 4.t | Optional with capability signaling |
| 16-5c-3 | UL full power transmission fullpowerMode2 – full power TPMI groups | 1. TPMI group(s) which delivers full power | 16-5c | Yes | N/A |  | Per FS | No | No |  | Candidate component values: any of {2-port {2-bit bitmap}, one of 4-port non-coherent {G0~G3}, one of 4-port partial-coherent {G0~G6}}  Note: When a full coherent UE operates in mode 2, the way it reports TPMIs should be the same as a partial-coherent UE  Note: For 4 port partial-coherent or full-coherent UE, UE can report: 2-port {2-bit bitmap} and one of 4-port non-coherent {G0~G3} and one of 4-port partial-coherent {G0~G6}  For 4 port non-coherent UE, UE can report: 2-port {2-bit bitmap} and one of 4-port non-coherent {G0~G3}  For 2 port UE, UE can report: 2-port {2-bit bitmap}  Note: A UE that supports FG 16-5c-3 must report at least one | Optional with capability signaling |
| 16-6a | Low PAPR DMRS for PUSCH without transform precoding | 1. For PUSCH without transform precoding |  | Yes | N/A |  | Per band | N/A | N/A |  |  | Optional with capability signalling |
| 16-6b | Low PAPR DMRS for PUCCH | For PUCCH format 3 and PUCCH format 4 with transform precoding and with pi/2 BPSK modulation | FG 1-7 (RAN4) and any combination of {4-4, 4-5 , 4-7} | Yes | N/A |  | Per band | N/A | N/A |  |  | Optional with capability signalling |
|  | 16-6c | Low PAPR DMRS for PUSCH with transform precoding and with pi/2 BPSK | For PUSCH with transform precoding and with pi/2 BPSK modulation | 1-6 (RAN4) and 2-12 | Yes | N/A |  | Per band | N/A | N/A |  |  | Optional with capability signalling |
| 16-7 | Extension of the maximum number of configured aperiodic CSI report settings | Extension of the maximum number of configured aperiodic CSI report settings for all codebook types | 2-32 | Yes | N/A |  | Per band | N/A | N/A |  | Candidate values: {1 to 8} | Optional with capability signaling |
| 16-8 | Active CSI-RS resources and ports for mixed codebook types in any slot | 1. Report a list of codebook combinations as {codebook 1, codebook 2, codebook 3} 2. For each codebook combination, report a list of {max number of ports per resource, max number of resources, max number of total ports} | 2-36/2-40/2-41/2-43 in Rel-15, and 16-3a, 16-3a-1, 16-3b, 16-3b-1 in Rel-16 | Yes | N/A |  | per band and per BC | N/A | N/A |  | Component-1 candidate values:  Codebook 1 = {Type I SP, Type I MP}  (Codebook 2, Codebook 3) = {(Type II, NULL), (Type II PS, NULL), (eType II R=1, NULL), (eType II R=2, NULL), (eType II PS R=1, NULL), (eType II PS R=2, NULL), (Type II, Type II PS)}  Note 3：if a UE reports one or more codebook combinations in 16-8, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note 4: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8 and per-codebook capability 2-36/40/41/43, 16-3a/b and 16-3a-1/16-3b-1  Note 5: Up to 4 combinations for component 1  Component-2 candidate values:   * Maximum 16 triplets for each codebook combination * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signaling |

1. NR\_CLI\_RIM

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** |
| 17. NR\_CLI\_RIM | 17-1 | CLI-RSSI measurement | 1. Support CLI-RSSI measurement. The max number of resources across all CCs configured to measure RSSI shall not exceed 64.  2. Maximum number of measurement resources configured for CLI-RSSI measurement |  | Yes | N/A |  | Per UE | No (TDD only) | Yes | N/A | Candidate values for component 2 are {8, 16, 32, 64}.  CLI measurement is not supported in unlicensed bands in Rel-16 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-2 | SRS-RSRP measurement | 1. Support SRS-RSRP measurement. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 32.  2. Maximum number of measurement resources across all CCs configured for SRS-RSRP measurement  3. Maximum number of measurement resources across all CCs configured for SRS-RSRP measurement within a slot   * A slot is based on minimum SCS among active BWPs across all CCs configured for SRS-RSRP measurement * A SRS resource occasion that overlaps with the slot is counted as one measurement resource in the slot |  | Yes | N/A |  | Per UE | No (TDD only) | Yes | N/A | Candidate values for component 2 are {4, 8, 16, 32}.  Candidate values for component 3 are {2, 4, 8}.  CLI measurement is not supported in unlicensed bands in Rel-16 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-3 | Simultaneous reception of DL signals/channels and CLI-RSSI measurement resource | Support simultaneous reception of DL signals/channels and CLI-RSSI measurement resource | 17-1 | Yes | N/A |  | Per UE | No (TDD only) | Yes | N/A | UE shall prioritize CLI-RSSI measurement when simultaneous reception of DL signals/channels and CLI-RSSI measurement resource is not supported.  How to capture this sentence is up to RAN2 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-4 | Simultaneous reception of DL signals/channels and SRS-RSRP measurement resource | Support simultaneous reception of DL signals/channels and SRS-RSRP measurement resource | 17-2 | Yes | N/A |  | Per UE | No (TDD only) | Yes | N/A | UE shall prioritize SRS-RSRP measurement when simultaneous reception of DL signals/channels and SRS-RSRP measurement resource is not supported.  How to capture this sentence is up to RAN2 | Optional with capability signalling |

1. MR-DC/CA enhancement

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 18. MR-DC/CA enhancement | 18-1 | Basic UL power sharing for DC | Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity. |  | Yes | N/A |  | Per BC | N/A | N/A | N/A | Absence means intra-FR DC is not supported. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1a | Semi-static UL power sharing mode 2 for DC | Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity. | 18-1 | Yes | N/A |  | Per BC | N/A | N/A | N/A | Semi-static power sharing mode 2 between MCG and SCG cells of same FR is applicable only for synchronous NR dual connectivity | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1b | Dynamic UL power sharing for DC | Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity.   1. T\_offset | 18-1 | Yes | N/A |  | Per BC | N/A | N/A | N/A | 1) {short, long} | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-4 | SCell dormancy indication within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 | 6-5 | Yes | N/A |  | Per BC | N/A | N/A | N/A | One dormant BWP and one non-dormant BWP is supported per carrier  More than one non-dormant BWP per carrier is supported only if UE feature 6-3/6-4 is also supported  One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting 6-2 or 6-3 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-4a | SCell dormancy indication outside active time | Support for SCell dormancy indication sent outside the active time on PCell with DCI format 2\_6 | 19-1 | Yes | N/A |  | Per BC | N/A | N/A | N/A | One dormant BWP and one non-dormant BWP is supported per carrier  More than one non-dormant BWP per carrier is supported only if UE feature 6-3/6-4 is also supported  One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting 6-2 or 6-3 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5 | DL cross-carrier scheduling with different SCS | 1. The UE supports DL cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in DL carrier aggregation where numerologies for the scheduling CC and scheduled CC are different  Candidate value set for component 1: {Scheduling CC of lower SCS and scheduled CC of higher SCS, Scheduling CC of higher SCS and scheduled CC of lower SCS, both}   * Note: Following components are applicable to CCS from lower SCS to higher SCS when the UE reports FG 18-5   + Processing one unicast DCI scheduling DL per scheduling CC slot per scheduled CC for FDD scheduling CC   + Processing one unicast DCI scheduling DL per scheduling CC slot per scheduled CC for TDD scheduling CC * Note: Following components are applicable to CCS from higher SCS to lower SCS when the UE reports FG 18-5   + Processing one unicast DCI scheduling DL per N consecutive scheduling CC slot per scheduled CC for FDD scheduling CC   + Processing one unicast DCI scheduling DL per N consecutive scheduling CC slot per scheduled CC for TDD scheduling CC   + N is based on pair of (scheduling CC SCS, scheduled CC SCS): N=2 for (30,15), (60,30), (120,60) and N=4 for (60,5), (120,30), N = 8 for (120,15) | 6-5 | Yes | N/A |  | Per BC | N/A | N/A | N/A | crossCarrierScheduling-OtherSCS | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5a | Default QCL assumption for cross-carrier scheduling | Indicates whether the UE can be configured with enabledDefaultBeamForCCS for default QCL assumption for cross-carrier scheduling for same/different numerologies   * Candidate values are {different only, both}   + When “both” is reported, the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for 18-5 | one of {6-10, 18-5} | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5b | UL cross-carrier scheduling with different SCS | 1. The UE supports UL cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in UL carrier aggregation where numerologies for the scheduling CC and scheduled CC are different  Candidate value set for component 1: {Scheduling CC of lower SCS and scheduled CC of higher SCS, Scheduling CC of higher SCS and scheduled CC of lower SCS, both}   * Note: Following components are applicable to CCS from lower SCS to higher SCS when the UE reports FG 18-5b   + Processing one unicast DCI scheduling UL per scheduling CC slot per scheduled CC for FDD scheduling CC   + Processing 2 unicast DCI scheduling UL per scheduling CC slot per scheduled CC for TDD scheduling CC * Note: Following components are applicable to CCS from higher SCS to lower SCS when the UE reports FG 18-5b   + Processing one unicast DCI scheduling UL per N consecutive scheduling CC slot per scheduled CC for FDD scheduling CC   + Processing 2 unicast DCI scheduling UL per N consecutive scheduling CC slot per scheduled CC for TDD scheduling CC   + N is based on pair of (scheduling CC SCS, scheduled CC SCS): N=2 for (30,15), (60,30), (120,60) and N=4 for (60,5), (120,30), N = 8 for (120,15) | 6-6 | Yes | N/A |  | Per BC | N/A | N/A | N/A | crossCarrierScheduling-OtherSCS | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5c | Processing up to X unicast DCI scheduling for DL per scheduled CC | Processing up to X unicast DCI scheduling for DL per scheduled CC   * + X is based on pair of (scheduling CC SCS, scheduled CC SCS):     - Candidate value(s) of X       * X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)     - X applies per slot of scheduling CC | 18-5 | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5c is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell   * If reported value of X in FG18-5c is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5d | Processing up to X unicast DCI scheduling for UL per scheduled CC | Processing up to X unicast DCI scheduling for UL per scheduled CC   * + X is based on pair of (scheduling CC SCS, scheduled CC SCS):     - Candidate value(s) of X       * X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)     - X applies slot of scheduling CC | 18-5b | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5d is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell   * If reported value of X in FG18-5d is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-6 | Cross-carrier A-CSI RS triggering with different SCS | Cross-carrier A-CSI RS triggering with different SCS  Candidate value set: {PDCCH cell of lower SCS and A-CSI RS cell of higher SCS, PDCCH cell of higher SCS and A-CSI-RS of lower SCS, both} | 2-33 and 6-5 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-6a | Default QCL assumption for cross-carrier A-CSI-RS triggering | Indicates whether the UE can be configured with enabledDefaultBeamForCCS for default QCL assumption for cross-carrier A-CSI-RS triggering for same/different numerologies   * Candidate values are {different only, both}   + When “both” is reported, the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for 18-6 | 6-5 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-7 | CA with non-aligned frame boundaries | CA with non-aligned frame boundaries for inter-band CA | 6-5 for DL CA with non-aligned frame boundaries for inter-band CA  6-6 for UL CA with non-aligned frame boundaries for inter-band CA | Yes | N/A |  | Per BC | N/A | N/A | N/A | Defines whether the UE supports carrier aggregation operation where the frame boundaries of the Pcell and the Scell are not aligned, while the slot boundaries are. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-8 | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | 6-7 | Yes | N/A |  | Per UE | No | No | N/A | Support HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group.  Rel-15 had this per cell group | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-9 | Type2 HARQ-ACK codebook for >1 unicast DL DCIs in same Monitoring Occasion | For HARQ-ACK type 2 codebook: Usage of the PDSCH starting time in addition to the existing MO and Cell index to order the HARQ-ACK feedback | 3-1 | Yes | N/A |  | Per UE | No | No | N/A | Note: The UE capability is introduced with following assumption:  ·Specification reflects that UE behavior is modified only for UEs supporting this capability.  ·UE behavior of a UE supporting this capability is different from UE behavior of a UE not supporting this capability only for following case:  ·Type-2 HARQ-ACK codebook when HARQ-ACK feedback in a codebook corresponds to more than one unicast DL DCI for same scheduled cell in a MO of a scheduling cell. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2 | Single UL TX operation for TDD PCell in EN-DC | TDM restriction to LTE TDD PCell in EN-DC for single UL-Transmission associated functionality when tdm-patternConfig-r16 is configured  1) TDD UL/DL configuration#2, #4, #5 configured as DL-reference UL/DL configuration  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE)  4) the UE does not transmit on SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG if the conditions in TS38.213 Section 7.6.1 are satisfied | EN-DC | Yes | N/A |  | Per band combination | Applicable to TDD-TDD EN-DC only | Applicable to FR1 only |  | Extension of the R15 capability tdm-Pattern to TDD PCell  This FG is for synchronous EN-DC | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2a | Enhanced single UL TX operation for FDD Pcell EN-DC | TDM restriction to LTE FDD Pcell in EN-DC for single UL-Transmission associated functionality when tdm-patternConfig-r16 is configured  1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE)  4) the UE does not transmit on SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG if the conditions in TS38.213 Section 7.6.1 are satisfied | 6-13 | Yes | N/A |  | Per band combination | Applicable to in FDD-LTE -NR EN-DC | Applicable to FR1 only |  | Enhancement to the R15 capability tdm-Pattern | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2b | Support of HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell for type 1 UE | Support of HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell for type 1 UE | 18-2 | Yes | N/A |  | Per band combination | N/A | N/A | N/A | This FG is for synchronous EN-DC | Optional with capability signaling |
| 18. MR-DC/CA enhancement | 18-3 | Dual Tx transmission for EN-DC with FDD PCell(TDM pattern for dual Tx UE) | TDM restriction to LTE FDD PCell in EN-DC for dual UL Tx operation when tdm-patternConfig-r16 is configured  1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE) | 6-13, EN-DC | Yes | N/A |  | Per band combination | Applicable to EN-DC with LTE FDD PCell only | Applicable to FR1 only |  | Extension of the R15 capability tdm-Pattern to a dual Tx UE | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-3a | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern in case of FDD PCell | UE configured with tdm-patternConfig-r16 can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern (only for type 1 UE) in case of FDD PCell | One of {18-2a, 18-3} | Yes | N/A |  | Per UE | Applicable to EN-DC only | Applicable to FR1 only |  |  | Optional with capability signaling |
| 18. MR-DC/CA enhancement | 18-3b | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern in case of TDD PCell | UE configured with tdm-patternConfig-r16 can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern (only for type 1 UE) in case of TDD PCell | 18-2 | Yes | N/A |  | Per UE | Applicable to EN-DC only | Applicable to FR1 only |  | This FG is for synchronous EN-DC | Optional with capability signaling |

1. UE Power Saving

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 19.UE Power Saving | 19-1 | DRX Adaptation | 1. Configured PS\_offset for the detection of  DCI format 2\_6  with CRC scrambling by PS-RNTI and reported minimum time gap before the start of drx\_onDurationTimer 2. Indication of UE whether  or not to start drx\_OnDuration timer for the next DRX cycle by detection of DCI format 2\_6 3. Configured UE wakeup or not when DCI format 2\_6 is not detected at all monitoring occasions outside Active time 4. Configured  periodic CSI report apart from L1-RSRP when  impacted by DCI format 2\_6 that drx\_OnDurationTimer does not start for the next DRX cycle 5. Configured periodic L1-RSRP report when  impacted by DCI format 2\_6 that drx\_OnDurationTimer does not start for the next DRX cycle | N/A | | Yes | | N/A |  | Per UE | No | Yes | N/A | The minimum time gap between the end of the slot of last DCI format 2\_6 monitoring occasion and the beginning of the slot where the UE would start the drx\_onDurationTimer is a UE capability based on subcarrier spacing.   * The reporting is per SCS in units of slots of the respective SCS * The candidate value set for 15kHz SCS: {1,3} slots * The candidate value set for 30kHz SCS: {1,6} slots * The candidate value set for 60kHz SCS: {1,12} slots * The candidate value set for 120kHz SCS: {2,24} slots   UE is not required to monitor PDCCH for detection of DCI format 2\_6 during the minimum time gap  Note:  FR1 bit set to 'yes' means support of DCI 2\_6 monitoring on primary cell in FR1  FR2 bit set to 'yes' means support of DCI 2\_6 monitoring on primary cell in FR2  Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as “per UE” | Optional with capability signalling |
| 19-2 | Cross Slot Scheduling | 1. Dynamic indication of applicable minimum scheduling restriction by  DCI format 0\_1 and 1\_1 2. minimumSchedulingOffset K0 configuration for PDSCH and aperiodic CSI-RS triggering offset 3. minimumSchedulingOffset K2 configuration for PUSCH 4. Support of extended value range for aperiodic CSI-RS triggering offset | |  | | Yes | N/A | Dynamic adaptation of the minimum value of K0min/K2min for cross-slot scheduling is not supported | Per UE | No | No | N/A | Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as “per UE” | Optional with capability signalling |
| 19-3 | Maximum MIMO Layer Adaptation | 1. Support of maximum number of MIMO layer configuration  per DL BWP | | See Note | | Yes | N/A |  | Per UE | No | Yes | N/A | This capability is indicated only if UE supports the network configuration of maxMIMO-Layers according to maxLayersMIMO-Indication | Optional with capability signalling |
| 19-4a | UE assistance information | Support of reporting preferred minimum K0/K2 via UE assistance information   * 15kHz/30kHz SCS: {1, 2, 4, 6} slots * 60kHz/120kHz SCS: {2, 4, 8, 12} slots | | 19-2 | | Yes | N/A |  | Per UE | No | No | N/A | The minimum applicable value of K0 (K2) for an active DL (UL) BWP for the carrier where PDSCH(PUSCH) is transmitted | Optional with capability signalling |
|  |  |  |  | |  | |  |  |  |  |  |  |  |  |  |

1. NR\_IAB

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
|  | 20-2 | Inter-IAB-node discovery and measurements: SSB reception configuration | Support up to 4 SMTCs configured for an IAB node MT per frequency location, including IAB-specific SMTC window periodicities | |  | | Yes | N/A | Separate configuration of SMTC windows for Inter-IAB node discovery and measurement is not possible | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Mandatory with capability signalling |
| 20-3 | Extension of RACH occasions and periodicities for backhaul RACH resources | Support RACH configuration for IAB-MT separately from the RACH configuration for UE access, including new IAB-specific offset and scaling factors | |  | | Yes | N/A | Separate configuration of RACH transmissions for access UEs and IAB nodes is not possible | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling |
| 20-5a | UL-Flexible-DL slot formats | Support semi-static configuration/indication of UL-Flexible-DL slot formats for IAB-MT resources | | 5-1a | | Yes | N/A | Only Rel-15 slot formats can be configured for backhaul links | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling |
| 20-5b | UL-Flexible-DL slot formats | Support dynamic indication of UL-Flexible-DL slot formats for IAB-MT resources | | 3-6 | | Yes | N/A | Dynamic indication of UL-Flexible-DL slot formats for IAB-MT resources is not supported | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling |
| 20-6 | Dynamic indication of soft resource availability | Support monitoring DCI Format 2\_5 scrambled by AI-RNTI for indication of soft resource availability to an IAB node | |  | | Yes | N/A | Explicit indication of soft resource availability is not supported | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling. |
| 20-7 | Case 1 OTA timing alignment | Support T\_delta reception. | |  | | Yes | N/A | Case-1 OTA timing alignment is not supported | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling. |
|  | 20-8 | Guard symbols | 1)  Support DesiredGuardSymbols reporting  2) Support ProvidedGuardSymbols reception | |  | | Yes | N/A | Guard symbols reporting and reception is not supported | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2 | IAB-MT impact | Optional with capability signalling. |
|  |  |  |  | |  | |  |  |  |  |  |  |  |  |  |

1. Mobility Enhancement

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 21. Mobility Enhancement | 21-1a | Intra-frequency DAPS HO | Support of  intra-frequency DAPS-HO     1. Support of simultaneous DL reception of PDCCH and PDSCH from source and target cell in DAPS-HO 2. Support of PDCCH blind decoding capability in the first MCG and second MCG. 3. Support of cancelling UL transmission to the source cell for intra-frequency DAPS-HO | | DAPS  (Note: RAN2 feature) | | Yes | N/A | The network cannot configure UE with intra-frequency DAPS HO | Per FS | No | N/A | N/A |  | Optional with capability signalling |
| 21-1b | Inter-frequency DAPS HO | Support of  inter-frequency DAPS-HO    1) Support of simultaneous DL reception of PDCCH and PDSCH from source and target cell in DAPS-HO    2) Support of PDCCH blind decoding capability in the first MCG and second MCG. | | DAPS  (Note: RAN2 feature) | | Yes | N/A | The network cannot configure UE with inter-frequency DAPS HO | Per BC | No | N/A | N/A |  | Optional with capability signalling |
| 21-2 | Semi-static UL power sharing mode 1 for DAPS HO | Support of semi-static power sharing mode1 between source and target cells of same FR for inter-frequency DAPS HO | | DAPS, 21-1b  (Note: RAN2 feature) | | Yes | N/A | UE is not expected to simultaneously transmit PRACH/PUSCH/PUCCH/SRS to source and target cell that overlap in time domain | Per BC | No | N/A | N/A |  | Optional with capability signalling |
| 21-2a | Semi-static UL power sharing mode 2 for DAPS HO | Support of semi-static power sharing mode 2 between source and target cells of same FR for inter-frequency DAPS HO | | 21-2, 21-1b | | Yes | N/A |  | Per BC | No | N/A | N/A | only applicable to DAPS HO in synchronous scenarios | Optional with capability signalling |
| 21-2b | Dynamic UL power sharing for DAPS HO | Support of dynamic power sharing between source and target cells of same FR for inter-frequency DAPS HO  1) T\_offset | | 21-2, 21-1b | | Yes | N/A |  | Per BC | No | N/A | N/A | Candidate values for (1) are {short, long} | Optional with capability signalling |
| 21-2d | UL transmission cancellation | Indicates support of cancelling UL transmission to the source cell for inter-frequency DAPS-HO | | 21-1b | | Yes | N/A | UE does not support scheduling of overlapping PUSCH/PUCCH/SRS transmissions to source and target cells for inter-frequency DAPS-HO | per band combination | No | N/A | N/A |  | Optional with capability signalling |

1. Potential change/update on existing UE features for Rel-16 UE

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 8. UL TPC | 8-1 | Dynamic power sharing for LTE-NR DC | When total transmission power exceeds Pcmax, UE scales NR transmission power. | | EN-DC | | No | N/A |  | Per UE | No | No |  |  | Mandatory with capability signalling set to 1 |

1. New FGs that are not dedicated to a specific Rel-16 work item/TEI

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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**  **(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 |
| 22. NR Others | 22-1 | Indicating supported option for UL Tx switching for inter-band UL CA | Indicating supported option for UL Tx switching for inter-band UL CA   * Candidate values set is {option1, option2, both option 1 and option 2} | 6-6 and RAN4 FG 7-1 (Tx switching period between two uplink carriers) | Yes | N/A |  | Per BC | N/A | N/A (FR1 only) | N/A | It has been agreed in RAN1 that UE can report support of one of the three candidates {option1, option2, both option1 and option2}. It is up to RAN2 to design the corresponding UE capability signalling. | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in inter-band UL CA band combinations in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |
| 22. NR Others | 22-2 | Indicating supported option for UL Tx switching for EN-DC | Indicating supported option for UL Tx switching for EN-DC   * Candidate values set is {option1, option2} | EN-DC and RAN4 FG 7-1 (Tx switching period between two uplink carriers) | Yes | N/A |  | Per BC | N/A | N/A (FR1 only) | N/A |  | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in EN-DC in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |
| 22. NR Others | 22-3a | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 2 | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3b | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3c | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3d | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3e | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 2 | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3f | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3g | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-3h | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4a | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 1 | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4b | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4c | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4d | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4e | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 1 | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4f | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4g | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-4h | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | Yes | N/A |  | Per FS | N/A | N/A |  | This capability is necessary for each SCS | Optional with capability signalling |
| 22. NR Others | 22-5a | Simultaneous transmission of SRS for antenna switching and SRS for CB/NCB /BM for intra-band UL CA | 1.     Support transmission of SRS for xTyR (x<y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for intra-band UL CA  2.     Support transmission of SRS for xTyR (x=y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for intra-band UL CA |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  Note: For component 1 and 2, a UE not reporting this component does not support the feature |
| 22. NR Others | 22-5b | Simultaneous transmission of SRS for antenna switching and SRS for CB/NCB /BM for inter-band UL CA | 1.     Support transmission of SRS for xTyR (x<y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for inter-band UL CA  2.     Support transmission of SRS for xTyR (x=y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for inter-band UL CA |  | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signaling  Note: For component 1 and 2, a UE not reporting this component does not support the feature |
| 22. NR Others | 22-5c | Simultaneous transmission of SRS for antenna switching and SRS for antenna switching for intra-band UL CA | 1.     Support transmission of SRS for antenna switching and SRS for antenna switching on different CCs in overlapped symbol(s) for intra-band UL CA |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling |
| 22. NR Others | 22-5d | Simultaneous transmission of SRS for antenna switching and SRS for antenna switching for inter-band UL CA | 1.     Support transmission of SRS for antenna switching and SRS for antenna switching on different CCs in overlapped symbol(s) for inter-band UL CA |  | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signaling |
| 22. NR Others | 22-6 | Support of up to three different numerologies in the same NR PUCCH group for NR part of EN-DC, NGEN-DC, NE-DC and NR-CA where UE is not configured with two NR PUCCH groups | Support of up to three different numerologies in the same NR PUCCH group for NR-CA where UE is not configured with two NR PUCCH groups  1) Which NR Carrier type(s) that can transmit NR PUCCH |  | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate values   1. One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission   Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission | Optional with capability signalling |
| 22. NR Others | 22-6a | Support of up to four different numerologies in the same NR PUCCH group for NR part of EN-DC, NGEN-DC, NE-DC and NR-CA where UE is not configured with two NR PUCCH groups | Support of up to four different numerologies in the same NR PUCCH group for NR-CA where UE is not configured with two NR PUCCH groups  1) Which NR Carrier type(s) that can transmit NR PUCCH |  | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate values   1. One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission   Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission | Optional with capability signalling |
| 22. NR Others | 22-7 | Support two PUCCH groups for NR-CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} | For the BC, the UE reports one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} where for each supported configuration,   * + the “primary PUCCH group config” includes following information:     - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} mapped to the primary PUCCH group     - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission in the primary PUCCH group   + the “secondary PUCCH group config” includes following information:     - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} mapped to the secondary PUCCH group     - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission in the secondary PUCCH group   + Note: for each {primary PUCCH group config, secondary PUCCH group config}, each carrier type of {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} is mapped to either or both of the primary PUCCH group config and the secondary PUCCH group config. |  | Yes | N/A |  | Per BC | N/A | N/A | N/A | Note: For a band combination with SUL, the SUL band is counted as one of the bands for the condition of FG22-7.  Note: For a band combination with SDL, the SDL band is counted as one of the bands for the condition of FG22-7  -SDL is indicated as ‘FR1 licensed FDD’ carrier type when FG22-7 is applied to SDL carrier  -Note: Per UE capabilities that are TDD only are not applicable to SDL  Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission  Note: When the carrier type of NUL is indicated for one PUCCH group config, the SUL in the same cell as in the NUL can also be configured for the PUCCH group  Note: If UE indicating this FG does not support FG 22-7a, the UE can only be configured with the same SCS across NR PUCCH groups. | Optional with capability signalling |
| 22. NR Others | 22-7a | Different numerology across NR PUCCH groups | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerology between two NR PUCCH groups for data/control channel at a given time | 22-7 | Yes | N/A |  | Per BC | N/A | N/A | N/A |  | Optional with capability signaling |
| 22. NR Others | 22-7b | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of smaller SCS | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time | 22-7 | Yes | N/A |  | Per BC | N/A | N/A | N/A | NR PUCCH is sent on a carrier with SCS not larger than SCS of any DL carriers corresponding to the NR PUCCH group. | Optional with capability signaling |
| 22. NR Others | 22-7c | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of larger SCS | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with larger SCS for data/control channel at a given time | 22-7 | Yes | N/A |  | Per BC | N/A | N/A | N/A | NR PUCCH is sent on a carrier with SCS not smaller than SCS of any DL carriers corresponding to the NR PUCCH group. | Optional with capability signaling |
| 22. NR Others | 22-8 | For SRS for CB PUSCH and antenna switching on FR1 with symbol level offset for aperiodic SRS transmission | For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | Yes | N/A |  | Per FS  (applicable to FR1 only) | n/a | n/a | n/a |  | Optional with capability signalling |
| 22. NR Others | 22-8a | PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | 1. For a given UE, all search space configurations are within the same span of 3 consecutive OFDM symbols in the slot  2. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | Yes | N/A |  | Per FS  (applicable to FR1 only) | n/a | n/a | n/a |  | Optional with capability signalling |
| 22. NR Others | 22-8b | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | 1. For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2  2. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | Yes | N/A |  | Per FS  (applicable to FR1 only) | n/a | n/a | n/a |  | Optional with capability signalling |
| 22. NR Others | 22-8c | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a DCI gap and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | 1. For type 1 CSS with dedicated RRC configuration, type 3 CSS and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2, with minimum time separation (including the cross-slot boundary case) between two DL unicast DCIs, between two UL unicast DCIs, or between a DL and an UL unicast DCI in different monitoring occasions where at least one of them is not the monitoring occasions of FG-3-1, for a same UE as   * 2OFDM symbols for 15kHz * 4OFDM symbols for 30kHz * 7OFDM symbols for 60kHz with NCP * 11OFDM symbols for 120kHz   2. Up to one unicast DL DCI and up to one unicast UL DCI in a monitoring occasion except for the monitoring occasions of FG 3-1.  3. In addition for TDD the minimum separation between the first two UL unicast DCIs within the first 3 OFDM symbols of a slot can be zero OFDM symbols.  4. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 3-5a, 2-53 | Yes | N/A |  | Per FS  (applicable to FR1 only) | n/a | n/a | n/a |  | Optional with capability signalling |
| 22. NR Others | 22-8d | All PDCCH monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a span gap and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | PDCCH monitoring occasions of FG-3-1, plus additional PDCCH monitoring occasion(s) can be any OFDM symbol(s) of a slot for Case 2, and for any two PDCCH monitoring occasions belonging to different spans, where at least one of them is not the monitoring occasions of FG-3-1, in same or different search spaces, there is a minimum time separation of X OFDM symbols (including the cross-slot boundary case) between the start of two spans, where each span is of length up to Y consecutive OFDM symbols of a slot. Spans do not overlap. Every span is contained in a single slot. The same span pattern repeats in every slot. The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans. Every monitoring occasion is fully contained in one span. In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value} except possibly the last span in a slot which can be of shorter duration. A particular PDCCH monitoring configuration meets the UE capability limitation if the span arrangement satisfies the gap separation for at least one (X, Y) in the UE reported candidate value set in every slot, including cross slot boundary.  For the set of monitoring occasions which are within the same span:  - Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for FDD  - Processing one unicast DCI scheduling DL and two unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  - Processing two unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  The number of different start symbol indices of spans for all PDCCH monitoring occasions per slot, including PDCCH monitoring occasions of FG-3-1, is no more than floor(14/X) (X is minimum among values reported by UE).  The number of different start symbol indices of PDCCH monitoring occasions per slot including PDCCH monitoring occasions of FG-3-1, is no more than 7.  The number of different start symbol indices of PDCCH monitoring occasions per half-slot including PDCCH monitoring occasions of FG-3-1 is no more than 4 in SCell.  For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | Yes | N/A |  | Per FS  (applicable to FR1 only) | n/a | n/a | n/a | This capability is necessary for each SCS.  Candidate value set for (X, Y):  {(7, 3),  (4, 3) and (7, 3),  (2, 2) and (4, 3) and (7, 3)} | Optional with capability signalling |
| 22. NR Others | 22-9 | Cancellation of PUCCH, PUSCH or PRACH with a DCI scheduling a PDSCH or CSI-RS or a DCI format 2\_0 for SFI | A UE supports the partial cancellation of the PUCCH or PUSCH or PRACH configured transmission:   1. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to detection of a DCI format 2\_0 with a slot format value other than 255 that indicates a slot format with a subset of symbols from the set of symbols as downlink or flexible 2. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to a DCI format 2\_0 being configured but not detected, when either a subset of symbols from the set of symbols are indicated as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, or *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* are not provided to the UE. 3. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to the detection of a DCI format 1\_0, DCI format 1\_1, DCI format 1\_2 or DCI format 0\_1 and DCI format 0\_2 indicating to the UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols. |  | Yes | N/A |  | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |
| 22. NR Others | 22-10 | Support of pdcch-MonitoringAnyOccasionsWithSpanGap in case of cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell | Support of pdcch-MonitoringAnyOccasionsWithSpanGap in case of cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell   * Candidate values: {Interpretation2, Interpretation3} | 3-5b, 18-5 | Yes | N/A |  | Per UE | No | No | N/A | Candidate values: {Interpretation2, Interpretation3}  If UE indicates Interpretation2, it supports 22-10 as long as pdcch-MonitoringAnyOccasionsWithSpanGap is supported for the band of the scheduling/triggering/indicating cell.  If UE indicates Interpretation3, it supports 22-10 as long as pdcch-MonitoringAnyOccasionsWithSpanGap is supported in both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell.  **For *pdcch-MonitoringAnyOccasionsWithSpanGap*, the supported set (set1, set2 or set 3) for cross-carrier scheduling with the different SCSs in the scheduling cell and the scheduled cell is still based on the indicated value for the band of the scheduling cell.** | Optional with capability signalling |
| 22. NR Others | 22-11 | Support of ‘cri-RI-CQI’ report without non-PMI-PortIndication | UE supports CSI-ReportConfig with the higher layer parameter reportQuantity set to ‘cri-RI-CQI’ and the higher layer parameter non-PMI-PortIndication is not configured | 2-35 | Yes | N/A |  | Per UE | N/A | Yes | N/A |  | Optional with capability signalling |