**3GPP TSG RAN WG1 #117 R1-24nnnnn**

**Fukuoka City, Fukuoka, Japan, May 20th—24th, 2024**

**Agenda Item: 8.2.2**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for other Rel-18 work items (Topics B)**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion [117-R18-UE\_features] during RAN1 #117. According to the Chair’s Notes:

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| [117-R18-UE\_features] Email discussion on Rel-18 UE features – Hiroki (DOCOMO), Ralf (AT&T)   * To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc |

The following was discussed and/or agreed during RAN1 #117 within the scope of [117-R18-UE\_features]. All proposals are based on the latest RAN1 UE features list for Rel-18 in [1] and [2].

# Summary of Contributions Submitted to RAN1 #117

The following is the moderator’s summary of contributions submitted to RAN1 #117 in this agenda item.

## NR\_MIMO\_evo\_DL\_UL

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-1 | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured joint TCI states per CC per BWP  2. Maximum number of activated joint TCI states across all CCs | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate values: {2, 4, 6, 8, 16, 32}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-7 | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 1. Support of mTRP operation for M-DCI with joint TCI state  3. Maximum number of configured joint TCI states per BWP per CC  4. Maximum number of activated joint TCI states across all CCs per ‘coresetPoolIndex’ value  5. One MAC-CE activates one joint TCI-states per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values {intra-cell, intra-cell and inter-cell}  Component 3 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {1, 2, 4, 8, 16}  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions  Note: FG 16-2a-6 can be used to indicate support of two default beams | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | The prerequisite of FG 40-1-1 and FG 40-1-7 is FG 23-1-1, where “across all CC(s) in a band” is clearly described. Therefore, it is reasonable that “across all CCs” in FG 40-1-1 and FG 40-1-7 means “across all CC(s) in a band”.  **Proposal MIMO-2: support that “across all CCs” in FG 40-1-1 and FG 40-1-7 means “across all CC(s) in a band”.** |
| Intel Corporation [4] |  |
| Samsung [5] | For FG 40-1-1 and FG 40-1-7 which are related to joint TCI framework considering single-DCI and multi-DCI based multi-TRP, respectively, both FGs need a pre-requisite as FG 23-1-1 which is defined in Rel-17 unified TCI for joint TCI framework and per band reporting. In component 5 in FG 23-1-1, as highlighted above, it is mentioned as “The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band”, which clearly clarifies the meaning of across all CC(s) in a band. Since a component 2 of FG 40-1-1 and a component 4 of FG 40-1-7 are inherited with a component 5 in FG 23-1-1, “across all CCs” in FG 40-1-1 and FG 40-1-7 can be clarified as “across all CCs in a band” as well.  **Proposal 4:** In FG 40-1-1 and FG 40-1-7, clarify the meaning of “across all CCs” as “in a band”, which is similar with a component 5 of FG 23-1-1.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-1-1 | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured joint TCI states per CC per BWP  2. Maximum number of activated joint TCI states across all CCs in a band | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate values: {2, 4, 6, 8, 16, 32}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40-1-7 | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 1. Support of mTRP operation for M-DCI with joint TCI state  3. Maximum number of configured joint TCI states per BWP per CC  4. Maximum number of activated joint TCI states across all CCs in a band per ‘coresetPoolIndex’ value  5. One MAC-CE activates one joint TCI-states per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values {intra-cell, intra-cell and inter-cell}  Component 3 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {1, 2, 4, 8, 16}  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions  Note: FG 16-2a-6 can be used to indicate support of two default beams | Optional with capability signaling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | In our understanding, these components are analogous to the prerequisite FG 23-1-1 component 5, where “across all CC(s) in a band” is clearly described. Therefore, we think same clarification can be made (i.e., component 2 in FG 40-1-1 and component 4 in FG 40-1-7 above report the values applied “across all CC(s) in a band”).   |  |  |  | | --- | --- | --- | | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals)  2. The maximum number of configured joint TCI states per BWP per CC in a band  3. One MAC-CE activated joint TCI state per CC in a band  4. TCI state indication for update and activationa) MAC CE based TCI state indication for one active TCI state  5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |   **Proposal 1: Regarding Topic 3 asked by RAN2 LS [3], inform RAN2 of the following:**   * **For FG 40-1-1/2/2a/7/9, “across all CCs” in components mean “across all CCs in the band”** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is ambiguous for a capability that is reported per band or per FS. In our understanding, the interpretation of the statement “across all CCs” means “across all CCs in a band”. We propose to clarify this in FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5:   1. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-1 | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured joint TCI states per CC per BWP  2. Maximum number of activated joint TCI states across all CCs in a band | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate values: {2, 4, 6, 8, 16, 32}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-7 | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 1. Support of mTRP operation for M-DCI with joint TCI state  3. Maximum number of configured joint TCI states per BWP per CC  4. Maximum number of activated joint TCI states across all CCs in a band per ‘coresetPoolIndex’ value  5. One MAC-CE activates one joint TCI-states per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values {intra-cell, intra-cell and inter-cell}  Component 3 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {1, 2, 4, 8, 16}  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions  Note: FG 16-2a-6 can be used to indicate support of two default beams | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2 | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured DL TCI states per CC per BWP  2. Maximum number of configured UL TCI states per CC per BWP  3. Maximum number of activated DL TCI states across all CCs  4. Maximum number of activated UL TCI states across all CCs | 40-1-1, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {4,8,12,16,24,32,48,64,128}  Component 2 candidate values: {4,8,12,16,24,32,48,64}  Component 3 candidate values: {2,4,8,16}  Component 4 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC | 1. TCI state indication for update and activation  a) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) with DL assignment  b) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) without DL assignment  2. Maximum number of activated DL TCI states across all CCs  3. Maximum number of activated UL TCI states across all CCs | 40-1-2 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {2,4,8,16}  Component 3 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-9 | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 0. Support of mTRP operation for M-DCI with separate DL/UL TCI state  1. Maximum number of configured DL TCI states per BWP per CC  2. Maximum number of configured UL TCI states per BWP per CC  3. Maximum number of activated DL TCI states across all CC  4. Maximum number of activated UL TCI states across all CC  5. One MAC-CE activated DL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value.  6. One MAC-CE activated UL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value. | 40-1-7, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 0 candidate values {intra-cell, intra-cell and inter-cell}  Component 1 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 3 candidate values: {1, 2, 4, 8, 16}  Component 4 candidate values: {1, 2, 4, 8, 16} | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Similarly, the prerequisite of FG 40-1-2/2a/9 is FG 23-10-1, where “across all CC(s) in a band” is clearly described. Therefore, it is reasonable that “across all CCs” in FG 40-1-2/2a/9 means “across all CC(s) in a band”.  **Proposal MIMO-3: support that “across all CCs” in 40-1-2/2a/9 means “across all CC(s) in a band”.** |
| Intel Corporation [4] |  |
| Samsung [5] | FG 40-1-2, FG 40-1-2a, and FG 40-1-9 are related to separate TCI framework. Among them, FG 40-1-2 and FG 40-1-2a are related to single-DCI based multi-TRP, and FG 40-1-9 is related to multi-DCI based multi-TRP, respectively. FG 40-1-2 and FG 40-1-9 need a common pre-requisite as FG 23-10-1 which is defined in Rel-17 unified TCI for separate TCI framework and per band reporting. In component 7 and 8 in FG 23-10-1, as highlighted above, it is mentioned as “The maximum number of MAC-CE activated DL TCI states across all CC(s) in a band” and “The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band”, which clearly clarifies the meaning of across all CC(s) in a band. Since components 3 and 4 in FG 40-1-2, component 2 and 3 in FG 40-1-2a, and component 3 and 4 in FG 40-1-9 are inherited with a component 7 and 8 in FG 23-10-1, “across all CCs” in FG 40-1-2, FG 40-1-2a, and FG 40-1-9 can be clarified as “across all CCs in a band” as well.  **Proposal 5:** In FG 40-1-2/2a/9, clarify the meaning of “across all CCs” as “in a band”, which is similar with a component 7 and 8 of FG 23-10-1.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-1-2 | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured DL TCI states per CC per BWP  2. Maximum number of configured UL TCI states per CC per BWP  3. Maximum number of activated DL TCI states across all CCs in a band  4. Maximum number of activated UL TCI states across all CCs in a band | 40-1-1, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {4,8,12,16,24,32,48,64,128}  Component 2 candidate values: {4,8,12,16,24,32,48,64}  Component 3 candidate values: {2,4,8,16}  Component 4 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40-1-2a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC | 1. TCI state indication for update and activation  a) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) with DL assignment  b) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) without DL assignment  2. Maximum number of activated DL TCI states across all CCs in a band  3. Maximum number of activated UL TCI states across all CCs in a band | 40-1-2 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {2,4,8,16}  Component 3 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40-1-9 | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 0. Support of mTRP operation for M-DCI with separate DL/UL TCI state  1. Maximum number of configured DL TCI states per BWP per CC  2. Maximum number of configured UL TCI states per BWP per CC  3. Maximum number of activated DL TCI states across all CC in a band  4. Maximum number of activated UL TCI states across all CC in a band  5. One MAC-CE activated DL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value.  6. One MAC-CE activated UL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value. | 40-1-7, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 0 candidate values {intra-cell, intra-cell and inter-cell}  Component 1 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 3 candidate values: {1, 2, 4, 8, 16}  Component 4 candidate values: {1, 2, 4, 8, 16} | Optional with capability signaling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | For FG 40-1-2/2a/9 below, there are similar components to above, i.e., “maximum number of TCI states across all CCs”. The difference is that they focus on DL or UL TCI states (not joint TCI states). We believe they are also analogous to the prerequisite FG 23-10-1 component 7/8, where “across all CC(s) in a band” is clearly described. So, the same clarification can be made (i.e., “across all CC(s) in a band”).  **Proposal 1: Regarding Topic 3 asked by RAN2 LS [3], inform RAN2 of the following:**   * **For FG 40-1-1/2/2a/7/9, “across all CCs” in components mean “across all CCs in the band”** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is ambiguous for a capability that is reported per band or per FS. In our understanding, the interpretation of the statement “across all CCs” means “across all CCs in a band”. We propose to clarify this in FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5:   1. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2 | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured DL TCI states per CC per BWP  2. Maximum number of configured UL TCI states per CC per BWP  3. Maximum number of activated DL TCI states across all CCs in a band  4. Maximum number of activated UL TCI states across all CCs in a band | 40-1-1, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {4,8,12,16,24,32,48,64,128}  Component 2 candidate values: {4,8,12,16,24,32,48,64}  Component 3 candidate values: {2,4,8,16}  Component 4 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC | 1. TCI state indication for update and activation  a) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) with DL assignment  b) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) without DL assignment  2. Maximum number of activated DL TCI states across all CCs in a band  3. Maximum number of activated UL TCI states across all CCs in a band | 40-1-2 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {2,4,8,16}  Component 3 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-9 | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 0. Support of mTRP operation for M-DCI with separate DL/UL TCI state  1. Maximum number of configured DL TCI states per BWP per CC  2. Maximum number of configured UL TCI states per BWP per CC  3. Maximum number of activated DL TCI states across all CC in a band  4. Maximum number of activated UL TCI states across all CC in a band  5. One MAC-CE activated DL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value.  6. One MAC-CE activated UL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value. | 40-1-7, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 0 candidate values {intra-cell, intra-cell and inter-cell}  Component 1 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 3 candidate values: {1, 2, 4, 8, 16}  Component 4 candidate values: {1, 2, 4, 8, 16} | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-2-8 | Maximum number of TAGs across all CCs | Maximum number of TAGs across all CCs | 40-2-1 or 40-2-2 | yes | n/a | Maximum number of TAGs across all CCs is unknown when UE supports two TAGs per CC | Per BC | n/a | n/a | n/a | Component candidate values: {2,3,4}  Note: UE only supports the configuration where all UL CCs of the same frequency band are configured with up to 2 Timing Advance Group ID  Note: The same description of “supportedNumberTAG” in 38.306 applies to this FG as well | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] | For FG 40-2-8, since this is per BC reporting, based on RAN2’s understanding, it is clear on “across all CCs” meaning across all CCs in a band combination (i.e., across all CCs in all bands in a band combination), which is same with us.  **Proposal 8:** In FG 40-2-8, clarify the meaning of “across all CCs” as “in a BC”.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-2-8 | Maximum number of TAGs across all CCs | Maximum number of TAGs across all CCs in a BC | 40-2-1 or 40-2-2 | yes | n/a | Maximum number of TAGs across all CCs is unknown when UE supports two TAGs per CC | Per BC | n/a | n/a | n/a | Component candidate values: {2,3,4}  Note: UE only supports the configuration where all UL CCs of the same frequency band are configured with up to 2 Timing Advance Group ID  Note: The same description of “supportedNumberTAG” in 38.306 applies to this FG as well | Optional with capability signaling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | For FG 40-2-8, since this is per-BC FG, it is clear that it means “across all CCs in the band combination”.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 40-2-8 | Maximum number of TAGs across all CCs | Maximum number of TAGs across all CCs | 40-2-1 or 40-2-2 | Per BC | Component candidate values: {2,3,4}  Note: UE only supports the configuration where all UL CCs of the same frequency band are configured with up to 2 Timing Advance Group ID  Note: The same description of “supportedNumberTAG” in 38.306 applies to this FG as well |   **Proposal 1: Regarding Topic 3 asked by RAN2 LS [3], inform RAN2 of the following:**   * **For FG 40-2-8, “across all CCs” in components mean “across all CCs in the band combination”** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is ambiguous for a capability that is reported per band or per FS. In our understanding, the interpretation of the statement “across all CCs” means “across all CCs in a band”. We propose to clarify this in FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5:   1. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-2-8 | Maximum number of TAGs across all CCs | Maximum number of TAGs across all CCs in a band combination | 40-2-1 or 40-2-2 | yes | n/a | Maximum number of TAGs across all CCs is unknown when UE supports two TAGs per CC | Per BC | n/a | n/a | n/a | Component candidate values: {2,3,4}  Note: UE only supports the configuration where all UL CCs of the same frequency band are configured with up to 2 Timing Advance Group ID  Note: The same description of “supportedNumberTAG” in 38.306 applies to this FG as well | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1 | Basic feature for Rel-16-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of mode 2 for Rel-16 eType-II codebook refinement for multi-TRP CJT  2. Support for PMI subband R=1.  3. Support of parameter combinations with L=2,4  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-16-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-16-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 5 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel. 16 based type-II CJT must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1a | Support of mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with L=2,4  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-1 | Yes | N/A | Mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-3 | Support R=2 for Rel-16-based CJT codebook | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subbands R=2  2. {Max # of Tx ports in one resource set, Max # of resource sets, total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-1-1 | Yes | N/A | R=2 for Rel-16-based CJT codebook is not supported | Per band  Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4,8,12,16,24,32}  b) {2 to 64}  c) {4 to 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5 | Basic feature for Rel-17-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT  2. Support of PMI subband R=1.  3. Support of parameter combinations with M=1  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-17-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-17-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel 17 based type-II CJT must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5a | Support of mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with M=1  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-5 | Yes | N/A | Mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-7 | Support of M=2 and R=1 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with M=2 and PMI subband R=1  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with M=2 and R=1 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | M=2 and R=1 for Rel-17-based CJT codebook are not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-8 | Support R=2 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=2.  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | R=2 for Rel-17-based CJT codebook is not supported | Per band and Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1 | Support of Rel-16-based doppler CSI | 1. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  2. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  3. Support parameter combinations with L=2,4  4. Support for rank = 1,2  5. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously  7. Value of Y for CPU occupation (OCPU = Y.N4), when P/SP-CSI-RS is configured for CMR  8. Value of Y for CPU occupation (OCPU = Y.K), when A-CSI-RS is configured for CMR  9. Support for the size of DD-basis, N4=1  10. Scaling factor for active resource counting Kp | 2-35 | Yes | N/A | Rel-16 based Type II doppler codebook is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 5 candidate values  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 7 candidate values: {1, 2, 3}  Component 8 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 4}  Note: When N4=1, OCPU =4  Note: OCPU ≥ 4 when P/SP-CSI-RS is configured for CMR  Note: when K=12, OCPU =8  Note: A UE that supports CSI enhancement for Rel. 16 based type-II doppler must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1a | Support of Rel-16-based doppler measurement with N4>1 | 1. Support for the size of DD-basis, N4>1  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR | 40-3-2-1 | Yes | N/A | Rel-16 based Type II doppler codebook with N4>1 is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 2 candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 3 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-2 | Support R=2 for Rel-16-based doppler codebook | A list of supported combinations {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-2-1 | Yes | N/A | R=2 for Rel-16-based doppler codebook is not supported | Per band and per BC | N/A | 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 |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-5 | Support of M=2 and R=1 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with M=2 and PMI subband R=1  2. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | M=2 and R=1 for Rel-17-based doppler codebook is not supported | Per-band  and Per-BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-6 | Support R=2 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with PMI subbands R=2  2. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | R=2 for Rel-17-based doppler codebook is not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-1 | TDCP (Time Domain Channel Properties) report | 1. Support of Y=1 delay value for TDCP report 2. Basic delay value, component candidate value <= D\_basic = 1 slot  3. Support of amplitude report  4. Value of X for CPU occupation (OCPU=(Y+1).X)  5. Support to configure KTRS = 1 TRS resource set  6. Maximum number of simultaneously active CSI-RS resources for TDCP across all CCs | 2-35 | Yes | N/A | Time Domain Channel Properties report is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values: {1,2}  Component 6, candidate values {4, 6, 8, 10, 12, 14, 16, 18, 20, 22, …, 60, 62, 64}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-5 | Number of CSI-RS resources for TDCP | 1. Maximum number of configured CSI-RS resources for TDCP per CC  2. Maximum number of configured CSI-RS resources for TDCP across all CCs  3. Maximum number of simultaneously active CSI-RS resources for TDCP per CC | 40-3-3-1 | Yes | N/A | Number of CSI-RS resources for TDCP is not reported | Per band and Per BC | N/A | N/A | N/A | Component 1 candidate values: {2, 4, 6, 8, 10, 12}  Component 2 candidate values: {2, 4, 6, 8, 12, … 64}  Component 3 candidate values: {2, 4, 6, 8, 12, 16, 20, 24, 28, 32}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] | The following is about FG 40-3-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, and FG 40-3-3-1/5.  First, FG 40-3-1/1a/3/5/5a/7/8 are related to Rel-18 CJT CSI which are all defined as both per band and per BC signaling.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-3-1-1 | Basic feature for Rel-16-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of mode 2 for Rel-16 eType-II codebook refinement for multi-TRP CJT  2. Support for PMI subband R=1.  3. Support of parameter combinations with L=2,4  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-16-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-16-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 5 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel. 16 based type-II CJT must support this FG | Optional with capability signaling | | 40-3-1-1a | Support of mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with L=2,4  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-1 | Yes | N/A | Mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40-3-1-3 | Support R=2 for Rel-16-based CJT codebook | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subbands R=2  2. {Max # of Tx ports in one resource set, Max # of resource sets, total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-1-1 | Yes | N/A | R=2 for Rel-16-based CJT codebook is not supported | Per band  Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4,8,12,16,24,32}  b) {2 to 64}  c) {4 to 256} | Optional with capability signaling | | 40-3-1-5 | Basic feature for Rel-17-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT  2. Support of PMI subband R=1.  3. Support of parameter combinations with M=1  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-17-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-17-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel 17 based type-II CJT must support this FG | Optional with capability signaling | | 40-3-1-5a | Support of mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with M=1  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-5 | Yes | N/A | Mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40-3-1-7 | Support of M=2 and R=1 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with M=2 and PMI subband R=1  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with M=2 and R=1 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | M=2 and R=1 for Rel-17-based CJT codebook are not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40-3-1-8 | Support R=2 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=2.  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | R=2 for Rel-17-based CJT codebook is not supported | Per band and Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |   Second, FG 40-3-2-1/1a/2/5/6 are related to Rel-18 Doppler CSI which are all defined as both per band and per BC signaling.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-3-2-1 | Support of Rel-16-based doppler CSI | 1. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  2. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  3. Support parameter combinations with L=2,4  4. Support for rank = 1,2  5. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously  7. Value of Y for CPU occupation (OCPU = Y.N4), when P/SP-CSI-RS is configured for CMR  8. Value of Y for CPU occupation (OCPU = Y.K), when A-CSI-RS is configured for CMR  9. Support for the size of DD-basis, N4=1  10. Scaling factor for active resource counting Kp | 2-35 | Yes | N/A | Rel-16 based Type II doppler codebook is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 5 candidate values  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 7 candidate values: {1, 2, 3}  Component 8 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 4}  Note: When N4=1, OCPU =4  Note: OCPU ≥ 4 when P/SP-CSI-RS is configured for CMR  Note: when K=12, OCPU =8  Note: A UE that supports CSI enhancement for Rel. 16 based type-II doppler must support this FG | Optional with capability signaling | | 40-3-2-1a | Support of Rel-16-based doppler measurement with N4>1 | 1. Support for the size of DD-basis, N4>1  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR | 40-3-2-1 | Yes | N/A | Rel-16 based Type II doppler codebook with N4>1 is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 2 candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 3 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256} | Optional with capability signaling | | 40-3-2-2 | Support R=2 for Rel-16-based doppler codebook | A list of supported combinations {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports}, across all CCs simultaneously, with R=2 | 40-3-2-1 | Yes | N/A | R=2 for Rel-16-based doppler codebook is not supported | Per band and per BC | N/A | 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 | | 40-3-2-5 | Support of M=2 and R=1 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with M=2 and PMI subband R=1  2. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | M=2 and R=1 for Rel-17-based doppler codebook is not supported | Per-band  and Per-BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40-3-2-6 | Support R=2 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with PMI subbands R=2  2. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | R=2 for Rel-17-based doppler codebook is not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |   Third, FG 40-3-3-1/5 are related to Rel-18 TDCP reporting which are all defined as both per band and per BC signaling.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-3-3-1 | TDCP (Time Domain Channel Properties) report | 1. Support of Y=1 delay value for TDCP report 2. Basic delay value, component candidate value <= D\_basic = 1 slot  3. Support of amplitude report  4. Value of X for CPU occupation (OCPU=(Y+1).X)  5. Support to configure KTRS = 1 TRS resource set  6. Maximum number of simultaneously active CSI-RS resources for TDCP across all CCs | 2-35 | Yes | N/A | Time Domain Channel Properties report is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values: {1,2}  Component 6, candidate values {4, 6, 8, 10, 12, 14, 16, 18, 20, 22, …, 60, 62, 64}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling | | 40-3-3-5 | Number of CSI-RS resources for TDCP | 1. Maximum number of configured CSI-RS resources for TDCP per CC  2. Maximum number of configured CSI-RS resources for TDCP across all CCs  3. Maximum number of simultaneously active CSI-RS resources for TDCP per CC | 40-3-3-1 | Yes | N/A | Number of CSI-RS resources for TDCP is not reported | Per band and Per BC | N/A | N/A | N/A | Component 1 candidate values: {2, 4, 6, 8, 10, 12}  Component 2 candidate values: {2, 4, 6, 8, 12, … 64}  Component 3 candidate values: {2, 4, 6, 8, 12, 16, 20, 24, 28, 32}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling |   For all FGs above, they are defined per band and per BC signaling separately, and include “across all CCs”. Since those two per band and per BC for each FG can be used together, the meaning of “across all CCs” in per band signaling could be “in a band”, and in per BC signaling could be “in a BC” so that gNB can understand what the UE’s capability per band and per BC, considering each of BCs.  **Proposal 9:** In FG 40-3-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, and FG 40-3-3-1/5, which are defined as per band and per band BC, clarify the meaning of “across all CCs” in per band signaling as “in a band” and in per BC signalling as “in a BC”. |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | For FG 40-3-1-1/1a/3/5/5a/7/8, 40-3-2-1/1a/2/5/6, 40-3-3-1/5 below (i.e., CSI-related), all of them are per-band and per-BC capabilities, and their reading should be straightforward such that the “across all CCs” component in per-band signaling and per-BC signaling implies “across all CCs in the band” and “across all CCs in the band combination”, respectively.  **Proposal 1: Regarding Topic 3 asked by RAN2 LS [3], inform RAN2 of the following:**   * **For FG 40-3-1-1/1a/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, *mTRP-CSI-EnhancementPerBand-r17,* and *mTRP-CSI-EnhancementPerBC-r17,* “across all CCs” in components mean:**   + **“across all CCs in the band” for per-band signaling.**   + **“across all CCs in the band combination” for per-BC signaling.** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is ambiguous for a capability that is reported per band or per FS. In our understanding, the interpretation of the statement “across all CCs” means “across all CCs in a band”. We propose to clarify this in FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5:   1. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1 | Basic feature for Rel-16-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of mode 2 for Rel-16 eType-II codebook refinement for multi-TRP CJT  2. Support for PMI subband R=1.  3. Support of parameter combinations with L=2,4  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-16-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-16-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 5 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel. 16 based type-II CJT must support this FG | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1a | Support of mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with L=2,4  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-1 | Yes | N/A | Mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-3 | Support R=2 for Rel-16-based CJT codebook | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subbands R=2  2. {Max # of Tx ports in one resource set, Max # of resource sets, total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-1-1 | Yes | N/A | R=2 for Rel-16-based CJT codebook is not supported | Per band  Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4,8,12,16,24,32}  b) {2 to 64}  c) {4 to 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5 | Basic feature for Rel-17-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT  2. Support of PMI subband R=1.  3. Support of parameter combinations with M=1  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-17-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-17-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel 17 based type-II CJT must support this FG | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5a | Support of mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with M=1  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-5 | Yes | N/A | Mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-7 | Support of M=2 and R=1 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with M=2 and PMI subband R=1  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with M=2 and R=1 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | M=2 and R=1 for Rel-17-based CJT codebook are not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-8 | Support R=2 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=2.  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | R=2 for Rel-17-based CJT codebook is not supported | Per band and Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1 | Support of Rel-16-based doppler CSI | 1. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  2. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  3. Support parameter combinations with L=2,4  4. Support for rank = 1,2  5. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band simultaneously  7. Value of Y for CPU occupation (OCPU = Y.N4), when P/SP-CSI-RS is configured for CMR  8. Value of Y for CPU occupation (OCPU = Y.K), when A-CSI-RS is configured for CMR  9. Support for the size of DD-basis, N4=1  10. Scaling factor for active resource counting Kp | 2-35 | Yes | N/A | Rel-16 based Type II doppler codebook is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 5 candidate values  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 7 candidate values: {1, 2, 3}  Component 8 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 4}  Note: When N4=1, OCPU =4  Note: OCPU ≥ 4 when P/SP-CSI-RS is configured for CMR  Note: when K=12, OCPU =8  Note: A UE that supports CSI enhancement for Rel. 16 based type-II doppler must support this FG | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1a | Support of Rel-16-based doppler measurement with N4>1 | 1. Support for the size of DD-basis, N4>1  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band simultaneously  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR | 40-3-2-1 | Yes | N/A | Rel-16 based Type II doppler codebook with N4>1 is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 2 candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 3 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-2 | Support R=2 for Rel-16-based doppler codebook | A list of supported combinations {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-2-1 | Yes | N/A | R=2 for Rel-16-based doppler codebook is not supported | Per band and per BC | N/A | 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 | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-5 | Support of M=2 and R=1 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with M=2 and PMI subband R=1  2. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | M=2 and R=1 for Rel-17-based doppler codebook is not supported | Per-band  and Per-BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-6 | Support R=2 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with PMI subbands R=2  2. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | R=2 for Rel-17-based doppler codebook is not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-1 | TDCP (Time Domain Channel Properties) report | 1. Support of Y=1 delay value for TDCP report 2. Basic delay value, component candidate value <= D\_basic = 1 slot  3. Support of amplitude report  4. Value of X for CPU occupation (OCPU=(Y+1).X)  5. Support to configure KTRS = 1 TRS resource set  6. Maximum number of simultaneously active CSI-RS resources for TDCP across all CCs in a band | 2-35 | Yes | N/A | Time Domain Channel Properties report is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values: {1,2}  Component 6, candidate values {4, 6, 8, 10, 12, 14, 16, 18, 20, 22, …, 60, 62, 64}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-5 | Number of CSI-RS resources for TDCP | 1. Maximum number of configured CSI-RS resources for TDCP per CC  2. Maximum number of configured CSI-RS resources for TDCP across all CCs in a band  3. Maximum number of simultaneously active CSI-RS resources for TDCP per CC | 40-3-3-1 | Yes | N/A | Number of CSI-RS resources for TDCP is not reported | Per band and Per BC | N/A | N/A | N/A | Component 1 candidate values: {2, 4, 6, 8, 10, 12}  Component 2 candidate values: {2, 4, 6, 8, 12, … 64}  Component 3 candidate values: {2, 4, 6, 8, 12, 16, 20, 24, 28, 32}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-5 | Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching | Support of maximum 2 SP SRS resource sets and maximum 1 periodic SRS resource set for 8T8R antenna switching | 40-5-4 | Yes | n/a | Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching is not supported | Per FS | n/a | n/a | n/a | Note: If UE does NOT support this feature, support maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS  Note: The two SP-SRS resource sets are not activated at the same time | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | We have the following analysis for UE-feature outcome from RAN1#116bis meeting on SRS enhancement targeting TDD CJT and 8 TX operation:   * For FG 40-5-5, the consequence if the feature is not supported by the UE should be ‘maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS is supported’, and the first note can be removed;   ***Proposal 1-1:*** *For FGs family 40-5 of ‘SRS enhancement targeting TDD CJT and 8 TX operation’, the following modifications are proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-5-5 | Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching | Support of maximum 2 SP SRS resource sets and maximum 1 periodic SRS resource set for 8T8R antenna switching | 40-5-4 | Yes |  | ~~Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching is not supported~~  Maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS is supported | Per FS | n/a | n/a | n/a | ~~Note: If UE does NOT support this feature, support maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS~~  Note: The two SP-SRS resource sets are not activated at the same time | Optional with capability signalling | |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1a | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—noncodebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—noncodebook  3. Support of two SRS resource sets with usage set to 'noncodebook'  4. Maximum number of SRS resources in one SRS resource set  5. Maximum number of layers of each panel for Single-DCI STx2P with SDM  8. Maximum number of simultaneous transmitted SRS resources from one SRS resource set at one symbol | 2-15 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,3, 4}  Component 5 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-2a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook | 2.Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SFN and sTRP  3. 1 PTRS port for single-DCI based STx2P SFN scheme for PUSCH—noncodebook  4. Support of two SRS resource sets with usage set to 'noncodebook'  5. Maximum number of SRS resources in one SRS resource set  6. Maximum number of MIMO layers of each SRS resource set for NCB PUSCH with SFN scheme  8. Maximum number of simultaneous transmitted SRS resources from one SRS resource set at one symbol | 2-15 | Yes | n/a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook is not supported | Per FSPC | n/a | FR2 only | n/a | Component 5 candidate values: {1, 2 ,3, 4}  Component 6 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | We have the following analysis for updated UE features list from RAN1#115 meeting on Rel-18 STxMP UL transmission:   * + For FG 40-6-1a, the number of component-8 should be editorially changed to component-6. Besides, given that up to two SRS resource sets can be configured to the UE when STx2P SDM scheme for NCB based PUSCH, this case should be captured accordingly.   + For FG 40-6-2a, similarly, the number of component-8 should be editorially changed to component-7. Then, given that up to two SRS resource sets can be configured to the UE when STx2P SFN scheme for NCB based PUSCH, this case should be captured accordingly.   ***Proposal 1-2:*** *For FGs family 40-6 of ‘Rel-18 STxMP UL’, the following modification is proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1a | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—noncodebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—noncodebook  3. Support of two SRS resource sets with usage set to 'noncodebook'  4. Maximum number of SRS resources in one SRS resource set  5. Maximum number of layers of each panel for Single-DCI STx2P with SDM  ~~8~~6. Maximum number of simultaneous transmitted SRS resources from one or two SRS resource set(s) at one symbol | 2-15 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,3, 4}  Component 5 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-2a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook | 2.Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SFN and sTRP  3. 1 PTRS port for single-DCI based STx2P SFN scheme for PUSCH—noncodebook  4. Support of two SRS resource sets with usage set to 'noncodebook'  5. Maximum number of SRS resources in one SRS resource set  6. Maximum number of MIMO layers of each SRS resource set for NCB PUSCH with SFN scheme  ~~8~~7. Maximum number of simultaneous transmitted SRS resources from one or two SRS resource set(s) at one symbol | 2-15 | Yes | n/a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook is not supported | Per FSPC | n/a | FR2 only | n/a | Component 5 candidate values: {1, 2 ,3, 4}  Component 6 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling | |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-5 | Support grouped-based beam reporting for STx2P | 1. Support group based L1-RSRP reporting for STxMP based transmission  2. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  3. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  4. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs | 23-5-1 | Yes | n/a | Grouped-based beam reporting for STx2P is not supported | Per Band | n/a | FR2 only | n/a | Component 1 candidate values: {JointULandDL, ULOnly, both}  Component 2 candidate values: {1,2,3,4}  Component 3 candidate values: {2,3,4,8,16,32,64}  Component 4 candidate values: {8, 16, 32, 64, 128}  Note: components 3 and 4 are also counted in FG 16-1g, 16-1g-1, and 23-5-1 | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For FG 40-6-5 (the maximum number of SSB/CSI-RS resources for L1-RSRP measurement in both CMR sets w/o within a slot across all CCs), there is a similar FG 2-24 with the following note   | ***beamManagementSSB-CSI-RS***  Defines support of SS/PBCH and CSI-RS based RSRP measurements. The capability comprises signalling of  - *maxNumberSSB-CSI-RS-ResourceOneTx* indicates maximum total number of configured one port NZP CSI-RS resources and SS/PBCH blocks that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE). On FR2, it is mandatory to report >=8; On FR1, it is mandatory with capability signalling to report >=8.  - *maxNumberCSI-RS-Resource* indicates maximum total number of configured NZP-CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] across all serving cells (see NOTE). It is mandated to report at least n8 for FR1.  - *maxNumberCSI-RS-ResourceTwoTx* indicates maximum total number of two ports NZP CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE).  - *supportedCSI-RS-Density* indicates density of one RE per PRB for one port NZP CSI-RS resource for RSRP reporting, if supported. On FR2, it is mandatory to report either "three" or "oneAndThree"; On FR1, it is mandatory with capability signalling to report either "three" or "oneAndThree".  - *maxNumberAperiodicCSI-RS-Resource* indicates maximum number of configured aperiodic CSI-RS resources across all serving cells (see NOTE). For FR1 and FR2, the UE is mandated to report at least n4.  NOTE: If the UE sets a value other than *n0* in an FR1 band, it shall set that same value in all FR1 bands. If the UE sets a value other than *n0* in an FR2 band, it shall set that same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. | Band | Yes | N/A | FD | | --- | --- | --- | --- | --- |   In our understanding, the above highlighted note indicates FG 2-24 is actually a per-FR or Per UE reporting. The intention was to define a capability across all bands in ejther FR1 or FR2. Therefore, one possible way is to add the same note to FG 40-6-5.  **Proposal MIMO-4: support to add a same note in FG 2-24 to FG 40-6-5.** |
| Intel Corporation [4] |  |
| Samsung [5] | As a note, both FG 40-6-5 and FG 23-5-1 have a note that components including across all CCs are also counted in FG 16-1g and FG 16-1g-1.  The granularity of FG 16-1g (*maxTotalResourcesForOneFreqRange-r16*) and FG 16-1g-1 (*maxTotalResourcesForAcrossFreqRanges-r16*) is per UE, and based on description in TS38.306, it is per FR and across FRs, respectively, based on the following descriptions in TS38.306.   |  |  | | --- | --- | | ***(FG 16-1g) maxTotalResourcesForOneFreqRange-r16***  Indicates the maximum total number of SSB/CSI-RS/CSI-IM resources for beam management, pathloss measurement, BFD, RLM and new beam identification for one frequency range that the UE supports.  The capability signalling includes the following:   * *maxNumberResWithinSlotAcrossCC-OneFR-r16* indicates 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 * *maxNumberResAcrossCC-OneFR-r16* indicates 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.   gNB takes into conjunction of this feature and the features *beamManagementSSB-CSI-RS, maxNumberCSI-RS-BFD, maxNumberSSB-BFD* and *maxNumberCSI-RS-SSB-CBD* when configuring SSB/CSI-RS/CSI-IM resources for beam management, pathloss measurement, BFD, RLM and new beam identification across one frequency range.  NOTE 1: The reference slot duration is the shortest slot duration defined for the reported FR supported by the UE.  NOTE 2: For RS configured for new beam identification, they are always counted regardless of beam failure event.  NOTE 3: The *maxNumberResWithinSlotAcrossCC-AcrossFR-r16* only counts those in active BWP but the *maxNumberResAcrossCC-AcrossFR-r16* counts all configured including both active and inactive BWP.  NOTE 4: The "configured to measure" RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted.  NOTE 5: Regarding the "configured to measure" RS counting   * (basic usage 1): If one resource is used for one or multiple of BFD/RLM, it is counted as one. * (basic usage 2): If one resource is used for one or multiple of New Beam Identification/PL-RS/L1-RSRP, add 1. * 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 *trs-Info* 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*'. | ***(FG 16-1g-1) maxTotalResourcesForAcrossFreqRanges-r16***  ndicates the maximum total number of SSB/CSI-RS/CSI-IM resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges (both FR1 and FR2) that the UE supports.  The capability signalling includes the following:   * *maxNumberResWithinSlotAcrossCC-AcrossFR-r16* indicates maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs across all frequency ranges for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification. * *maxNumberResAcrossCC-AcrossFR-r16* indicates maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs across all frequency ranges for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification.   gNB takes into conjunction of this feature and the features *maxTotalResourcesForOneFreqRange-r16****,*** *beamManagementSSB-CSI-RS, maxNumberCSI-RS-BFD, maxNumberSSB-BFD* and *maxNumberCSI-RS-SSB-CBD* when configuring SSB/CSI-RS/CSI-IM resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges. The signalled values apply to the shortest slot duration defined in any FR(s) that are supported by the UE.  NOTE 1: The "configured to measure" RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted.  NOTE 2: Regarding the "configured to measure" RS counting   * (basic usage 1): If one resource is used for one or multiple of BFD/RLM, it is counted as one. * (basic usage 2): If one resource is used for one or multiple of New Beam Identification/PL-RS/L1-RSRP, add 1. * 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 trs-Info 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'. |   Also, the above FG 16-1g and FG 16-1g-1 have common pre-requisites as FG 2-24 (*beamManagementSSB-CSI-RS*) and FG 2-31 (*maxNumberCSI-RS-BFD, maxNumberSSB-BFD, maxNumberCSI-RS-SSB-CBD*) which are related to the number of reference signals for channel measurement, beam failure detection, and new beam identification.  The granularity of FG 2-24 and FG 2-31 is per band, and based on the following descriptions in TS38.306, it seems per FR reporting since a UE reports the same value for all bands in an FR.   |  |  | | --- | --- | | ***(FG 2-24) beamManagementSSB-CSI-RS***  Defines support of SS/PBCH and CSI-RS based RSRP measurements. The capability comprises signalling of   * *maxNumberSSB-CSI-RS-ResourceOneTx* indicates maximum total number of configured one port NZP CSI-RS resources and SS/PBCH blocks that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE). On FR2, it is mandatory to report >=8; On FR1, it is mandatory with capability signalling to report >=8. * *maxNumberCSI-RS-Resource* indicates maximum total number of configured NZP-CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] across all serving cells (see NOTE). It is mandated to report at least n8 for FR1. * *maxNumberCSI-RS-ResourceTwoTx* indicates maximum total number of two ports NZP CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE). * *supportedCSI-RS-Density* indicates density of one RE per PRB for one port NZP CSI-RS resource for RSRP reporting, if supported. On FR2, it is mandatory to report either "three" or "oneAndThree"; On FR1, it is mandatory with capability signalling to report either "three" or "oneAndThree". * *maxNumberAperiodicCSI-RS-Resource* indicates maximum number of configured aperiodic CSI-RS resources across all serving cells (see NOTE). For FR1 and FR2, the UE is mandated to report at least n4.   NOTE: If the UE sets a value other than *n0* in an FR1 band, it shall set that same value in all FR1 bands. If the UE sets a value other than *n0* in an FR2 band, it shall set that same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. | ***(FG 2-31)***  ***maxNumberCSI-RS-BFD***  Indicates maximal number of CSI-RS resources across all CCs, and across MCG and SCG in case of NR-DC, for UE to monitor PDCCH quality. In this release, the maximum value that can be signalled is 16. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. It is mandatory with capability signalling for FR2 and optional for FR1.  ***maxNumberSSB-BFD***  Defines maximal number of different SSBs across all CCs, and across MCG and SCG in case of NR-DC, for UE to monitor PDCCH quality. In this release, the maximum value that can be signalled is 16. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. It is mandatory with capability signalling for FR2 and optional for FR1.  ***maxNumberCSI-RS-SSB-CBD***  Defines maximal number of different CSI-RS [and/or SSB] resources across all CCs, and across MCG and SCG in case of NR-DC, for new beam identifications. In this release, the maximum value that can be signalled is 128. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. It is mandatory with capability signalling for FR2 and optional for FR1. The UE is mandated to report at least 32 for FR2. |   To sum up, the meaning of the reported values from FG 2-24 and FG 2-31 defined in Rel-15, FG 16-1g defined in Rel-16 are same as per FR, even though their reporting granularity defined in current specification is per band for FG 2-24 and FG 2-31, and per UE for FG 16-1g.  Hence, our view is that similar treatment could be applied to FG 23-5-1 and FG 40-6-5.   * For FG 40-6-5, we can put a note that “If the UE includes values for component 3 and 4 in an FR2 band, it shall set the same value in all FR2 bands”, since this is an FG related to STx2P which is only defined in FR2. * For FG 23-5-1, we can put a note that “If the UE includes values for component 2 and 3 in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes values for component 2 and 3 in an FR2 band, it shall set the same value in all FR2 bands”.   **Proposal 6:** In FG 40-6-5 and FG 23-5-1, clarify the meaning of “across all CCs” based on the added note meaning the value of component 3 and 4 in FG 40-6-5 and component 2 and 3 in FG 23-5-1 are same for all bands in each of FRs (i.e., per FR reporting).   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-6-5 | Support grouped-based beam reporting for STx2P | 1. Support group based L1-RSRP reporting for STxMP based transmission  2. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  3. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  4. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs | 23-5-1 | Yes | n/a | Grouped-based beam reporting for STx2P is not supported | Per Band | n/a | FR2 only | n/a | Component 1 candidate values: {JointULandDL, ULOnly, both}  Component 2 candidate values: {1,2,3,4}  Component 3 candidate values: {2,3,4,8,16,32,64}  Component 4 candidate values: {8, 16, 32, 64, 128}  Note: components 3 and 4 are also counted in FG 16-1g, 16-1g-1, and 23-5-1  Note: If the UE includes values for component 3 and 4 in an FR2 band, it shall set the same value in all FR2 bands | Optional with capability signaling |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | Yes |  | Group based L1-RSRP reporting enhancements are not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: {2,3,4,8,16,32,64}  Component 3 candidate values: {8, 16, 32, 64, 128}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1  Note: If the UE includes values for component 2 and 3 in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes values for component 2 and 3 in an FR2 band, it shall set the same value in all FR2 bands. | Optional with capability signalling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | For FG 40-6-5 component 3 and its prerequisite FG 23-5-1 component 2 (which are also asked for clarification by RAN2), the situation may not be very clear. 23-5-1 doesn’t have a prerequisite FG so no reference exists.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | *mTRP-GroupBasedL1-RSRP-r17*  *{*  *maxNumBeamGroups-r17,*  *maxNumRS-WithinSlot-r17,*  *maxNumRS-AcrossSlot-r17*  *}* | *MIMO-ParametersPerBand* | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: {2,3,4,8,16,32,64}  Component 3 candidate values: {8, 16, 32, 64, 128}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 |   Those two are related to (group-based) L1-RSRP reporting (one for Rel-18 STxMP, the other for Rel-17 mTRP). In Rel-15, the maximum number of SSB/CSI-RS resources for L1-RSRP measurement is reported by FG 2-24 (*beamManagementSSB-CSI-RS*), which is per-band mandatory FG with capability signaling. However, it has the following note.   | ***beamManagementSSB-CSI-RS***  Defines support of SS/PBCH and CSI-RS based RSRP measurements. The capability comprises signalling of  - *maxNumberSSB-CSI-RS-ResourceOneTx* indicates maximum total number of configured one port NZP CSI-RS resources and SS/PBCH blocks that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE). On FR2, it is mandatory to report >=8; On FR1, it is mandatory with capability signalling to report >=8.  - *maxNumberCSI-RS-Resource* indicates maximum total number of configured NZP-CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] across all serving cells (see NOTE). It is mandated to report at least n8 for FR1.  - *maxNumberCSI-RS-ResourceTwoTx* indicates maximum total number of two ports NZP CSI-RS resources that are supported by the UE to measure L1-RSRP as specified in TS 38.215 [13] within a slot and across all serving cells (see NOTE).  - *supportedCSI-RS-Density* indicates density of one RE per PRB for one port NZP CSI-RS resource for RSRP reporting, if supported. On FR2, it is mandatory to report either "three" or "oneAndThree"; On FR1, it is mandatory with capability signalling to report either "three" or "oneAndThree".  - *maxNumberAperiodicCSI-RS-Resource* indicates maximum number of configured aperiodic CSI-RS resources across all serving cells (see NOTE). For FR1 and FR2, the UE is mandated to report at least n4.  NOTE: If the UE sets a value other than *n0* in an FR1 band, it shall set that same value in all FR1 bands. If the UE sets a value other than *n0* in an FR2 band, it shall set that same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. | Band | Yes | N/A | FD | | --- | --- | --- | --- | --- |   Our understanding on the highlighted note is that, the value reported by the corresponding component (which is the max. number of resources across all CCs) is actually the summation across all the bands that the UE supports in either FR1 or FR2. In other words, it is more like a per-FR reporting, not per-band reporting.  Given above, we think RAN1 should clarify whether the components with “across all CC(s)” reporting in FG 23-5-1 and 40-6-5 follows the same intention as for similar components in Rel-15 beamManagementSSB-CSI-RS above. If it is the case, assuming the ones in FG 23-5-1 and 40-6-5 will be the summation across bands in either FR1 or FR2, similar clarification note may need to be added in 38.306 and/or 38.331, which can be recommended to RAN2 once confirmed in RAN1.  **Proposal 2: Regarding Topic 3 asked by RAN2 LS [3], discuss the implication of “across all CCs” in the following FGs:**   * + **Alt-1: Since they are per-band FG, it means “across all CCs in the band”**   + **Alt-2: Similar to FG 2-24, it means “across all CCs in all the bans in either FR1 or FR2”** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is ambiguous for a capability that is reported per band or per FS. In our understanding, the interpretation of the statement “across all CCs” means “across all CCs in a band”. We propose to clarify this in FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5:   1. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-1-1/2/2a/7/9, FG 40-2-8, FG, 40-3-1-1/1a/3/5/5a/7/8, FG 40-3-2-1/1a/2/5/6, FG 40-3-3-1/5, FG 40-6-5.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-5 | Support grouped-based beam reporting for STx2P | 1. Support group based L1-RSRP reporting for STxMP based transmission  2. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  3. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs in a band  4. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs in a band | 23-5-1 | Yes | n/a | Grouped-based beam reporting for STx2P is not supported | Per Band | n/a | FR2 only | n/a | Component 1 candidate values: {JointULandDL, ULOnly, both}  Component 2 candidate values: {1,2,3,4}  Component 3 candidate values: {2,3,4,8,16,32,64}  Component 4 candidate values: {8, 16, 32, 64, 128}  Note: components 3 and 4 are also counted in FG 16-1g, 16-1g-1, and 23-5-1 | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-4 | SRS 8 Tx ports—antenna switching | 1. Support of 8T8R for antenna switching  2. Downgrade antenna switching configurations  3. Report the entry number of the first-listed band with UL in the band combination that affects this DL  4. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-53 | Yes | n/a | SRS with 8 Tx ports—antenna switching is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: {noTDM, TDM and noTDM}  Component 2 candidate value: combination (including empty) of {1T1R, 1T2R, 1T4R, 1T6R, 1T8R, 2T2R, 2T4R, 2T6R, 2T8R, 4T4R, 4T8R}  Component 3 candidate value: {1,2,…,32}  Component 4 candidate value: {1,2,…,32}  Note: UE reports support of SRS with 8 Tx ports and Comb8 mapping —antenna switching via FG 23-8-8 | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1 | Basic features for Codebook-based 8Tx PUSCH | 1. Maximum number of PUSCH MIMO layers for codebook based PUSCH  2. Maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook’ for codebook-based 8Tx PUSCH  3. SRS 8 Tx ports—codebook |  | Yes | n/a | Codebook-based 8Tx PUSCH is not supported | Per FSPC | No | No | No | Component 1 candidate values: {1,2 ,3,4 ,5,6,7,8}  Component 2 candidate values: {1,2}  Component 3 candidate values: {noTDM, TDM and noTDM}  A UE that supports FG 40-7-1 must support at least one of FGs 40-7-1a/b/c/d | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | 2. Component candidate values: {(4,1), (2,2), both} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1b | Codebook-based 8Tx PUSCH—codebook2 | Support of codebook-based 8Tx PUSCH—codebook2 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook2 is not supported | Per FSPC | No | No | No |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1c | Codebook-based 8Tx PUSCH—codebook3 | Support of codebook-based 8Tx PUSCH—codebook3 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook3 is not supported | Per FSPC | No | No | No |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1d | Codebook-based 8Tx PUSCH—codebook4 | Support of codebook-based 8Tx PUSCH—codebook4 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook4 is not supported | Per FSPC | No | No | No |  | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] | In [1], RAN4 kindly sent additional LS reply on relative phase/power error requirements within port groups for 8TX UE. The part of LS reply is captured as follows:   |  | | --- | | Additionally, RAN4 further discussed coherence between PUSCH and 8-ports SRS with partial dropping. The approved reply LS of R4-2321728 says that “Some UEs may be capable to achieve coherence across TDM’d SRS and some UE may not” in the answer for Question 1. It is RAN4’s understanding that the current capability wouldn’t allow a UE to indicate that the UE supports codebook 1 with not TDMed SRS, while the same UE can also support codebook 2, 3, or 4 with TDM’d SRS. If the RAN4 understanding is correct, RAN4’d like to request RAN1 to consider allowing UE to indicate the above mentioned cases, details are up to RAN1. |   The current capabilities relevant on highlighted part above are captured as follows:   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-1 | Basic features for Codebook-based  8Tx PUSCH | 1. Maximum number of PUSCH MIMO layers for codebook based PUSCH  2. Maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook’ for codebook-based 8Tx PUSCH  3. SRS 8 Tx ports—codebook |  | Yes | n/a | Codebook-based 8Tx PUSCH  is not supported | Per  FSPC | No | No | No | Component 1 candidate values:  {1,2, 3, 4, 5, 6, 7, 8}    Component 2 candidate values: {1,2}    Component 3 candidate values:  {noTDM, TDM and noTDM}    A UE that supports FG 40-7-1 must support at least one of FGs 40-7-1a/b/c/d | Optional with capability signaling |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH —codebook1 is not supported | Per  FSPC | No | No | No | 2. Component candidate values:  {(4,1), (2,2), both} | Optional with capability signaling | | 40-7-1b | Codebook-based 8Tx PUSCH—codebook2 | Support of codebook-based 8Tx PUSCH—codebook2 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH —codebook2 is not supported | Per  FSPC | No | No | No |  | Optional with capability signaling | | 40-7-1c | Codebook-based 8Tx PUSCH—codebook3 | Support of codebook-based 8Tx PUSCH—codebook3 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH —codebook3 is not supported | Per  FSPC | No | No | No |  | Optional with capability signaling | | 40-7-1d | Codebook-based 8Tx PUSCH—codebook4 | Support of codebook-based 8Tx PUSCH—codebook4 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH —codebook4 is not supported | Per  FSPC | No | No | No |  | Optional with capability signaling |   By using Component 3 in FG 40-7-1 above, a UE can report whether it supports non-TDM based 8-port SRS only, or both non-TDM and TDM based 8-port SRS. And corresponding supported codebook type can be reported from UE by using at least one of FG 40-7-1a, FG 40-7-1b, FG 40-7-1c, and FG 40-7-1d. But as RAN4 mentioned, current UE capability FG 40-7-1a, FG 40-7-1b, FG 40-7-1c, and FG 40-7-1d cannot distinguish the possibly supported codebook types for each of non-TDM based 8-port SRS and TDM based 8-port SRS, which means that gNB can understand this UE capability as only one combination of supported codebook types which is commonly applied to both non-TDM and TDM based 8-port SRS.  However, due to the different nature of non-TDM and TDM based 8-port SRS and also RAN4 mentioned (e.g., partial dropping and power scaling in time domain is possible for TDM based 8-port SRS), whether to support codebook1, which is corresponding to full-coherent antenna structure, for noTDM only, or both TDM and noTDM, could be different for each of UEs. Hence, we would like to add a new component in FG 40-7-1a to report whether codebook1 is applied to noTDM only, or both TDM and noTDM. For other codebook types (i.e., codebook2, codebook3, and codebook4), additional indications whether to support noTDM only, or both TDM and noTDM, are not needed since partial dropping and power scaling can happen by a unit of 4 SRS ports.  **Proposal 2:** *Add Component 3 into FG 40-7-1a to indicate whether codebook1 can be applied to the UE supporting noTDM only, or supporting both TDM and noTDM.*   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1  3. SRS 8 Tx ports—codebook | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH —codebook1 is not supported | Per  FSPC | No | No | No | 2. Component candidate values:  {(4,1), (2,2), both}  3. Component candidate values:  {noTDM, TDM and noTDM} | Optional with capability signaling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] | In RAN1#113 meeting, the following was agreed for SRS power scaling of 8 ports TDMed SRS.   |  | | --- | | *Agreement*  *For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and with TDM factor s > 1, the UE splits a linear value of SRS transmission power equally across the SRS ports configured on each OFDM symbol, if the UE is capable of transmitting at per OFDM symbol with 8/s ports, where is specified in the current specifications.*   * *Note: This may be captured in the specification in a few different but equivalent ways, and it is up to the editor to decide.* |   In current 38.213, the UE splits a linear value of SRS transmission power equally across the SRS ports configured on each OFDM symbol. However, this can only be applied to a UE capable of transmitting at per OFDM symbol. For a UE without this capability, the UE behaviour is not defined, and the transmit power in one symbol may exceed the maximal power supported by UE. Considering the limited time for maintenance, a simple solution with minimized standardization effort is preferred. For example, TDM-based 8Tx SRS (s=2) is not supported by UE not capable of transmitting at PCMAX per OFDM symbol with 8/s ports.  ***Proposal 1: A UE supporting TDMed 8 ports SRS should be able to transmit at per OFDM symbol with 4 ports and applied the following note:***  Based on current UE feature, capability for different codebook types are independently reported. If UE reports capability for a codebook type, UE should support it regardless of non-TDMed and TDMed SRS. However, according to RAN4’s LS[1], a UE supporting codebook1 for non-TDMed SRS may not be able to achieve coherency across TDMed SRS. For a UE supporting codeobok1 for non-TDMed SRS, additional UE feature is needed to indicate whether codebook1 is also supported for TDMed SRS. Furthermore, considering coherent SRS antenna ports are transmitted in the same symbol for partial coherent UE even with TDMed SRS, it is not need to differentiate TDMed SRS and non-TDMed SRS for codebook2/3/4. A UE cannot report capability of TDMed SRS if it doesn’t support any codebook type for TDMed SRS.  ***Proposal 3: Modify current FG 40-7-1a to support UE to report one of the following UE features:***   * ***UE supports codebook1 for both non-TDMed SRS and TDMed SRS*** * ***UE supports codebook1 for non-TDMed SRS and not for TDMed SRS***   ***Note: Whether UE supports codebook 2/3/4 or not for TDMed and non-TDMed SRS is up to FG 40-7-1.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-5-4 | SRS 8 Tx ports—antenna switching | 1. Support of 8T8R for antenna switching  2. Downgrade antenna switching configurations  3. Report the entry number of the first-listed band with UL in the band combination that affects this DL  4. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-53 | Yes | n/a | SRS with 8 Tx ports—antenna switching is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: {noTDM, TDM and noTDM}  Component 2 candidate value: combination (including empty) of {1T1R, 1T2R, 1T4R, 1T6R, 1T8R, 2T2R, 2T4R, 2T6R, 2T8R, 4T4R, 4T8R}  Component 3 candidate value: {1,2,…,32}  Component 4 candidate value: {1,2,…,32}  Note: UE reports support of SRS with 8 Tx ports and Comb8 mapping —antenna switching via FG 23-8-8  Note: UE reporting support of TDM SRS should be able to transmit at *P\_CMAX* per OFDM symbol with 4 ports | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1 | Basic features for Codebook-based 8Tx PUSCH | 1. Maximum number of PUSCH MIMO layers for codebook based PUSCH  2. Maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook’ for codebook-based 8Tx PUSCH  3. SRS 8 Tx ports for codebook2/ codebook 3/ codebook 4 |  | Yes | n/a | Codebook-based 8Tx PUSCH is not supported | Per FSPC | No | No | No | Component 1 candidate values: {1,2 ,3,4 ,5,6,7,8}  Component 2 candidate values: {1,2}  Component 3 candidate values: {noTDM, TDM and noTDM}  A UE that supports FG 40-7-1 must support at least one of FGs 40-7-1a/b/c/d  Note: UE reporting support of TDM SRS should be able to transmit at *P\_CMAX* per OFDM symbol with 4 ports | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1  3. SRS 8 Tx ports for codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | Component 2 candidate values: {(4,1), (2,2), both}  Component 3 candidate values: {noTDM, TDM and noTDM} | Optional with capability signaling | |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | We have the following analysis for UE-feature outcome from RAN1#116bis meeting SRI/TPMI enhancement for enabling 8 TX UL transmission:   * For FG 40-7-1a, a new component ‘8-port SRS for codebook 1’ should be added. Based on RAN4’s reply LS R1-2401958, the coherency between TDMed 8-port SRS and 8-port fully coherent PUSCH is determined by UE capability. Therefore, for FG 40-7-1a, a new component ‘8-port SRS for codebook 1’ is needed, and the candidate values for this new component should be ‘non-TDM, TDM and non-TDM’. Note that, this new component is not needed for codebook2, codebook3, and codebook4, because the coherency naturally holds between TDMed 8-port SRS and non-coherent/partially coherent PUSCH.   ***Proposal 1-3:*** *For FGs family 40-5 of ‘SRS enhancement targeting TDD CJT and 8 TX operation’, the following modifications are proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1  3. 8-port SRS for codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | Component 2 candidate values: {(4,1), (2,2), both}  Component 3 candidate values: {non-TDM, TDM and non-TDM} | Optional with capability signaling | |
| NTT DOCOMO, INC. [14] | There is a RAN4 LS reply [4] on relative phase/power error requirements within port groups for 8TX UE. Based on RAN4’s reply, UE capability on coherency of TDMed SRS could be different for different codebook types.   |  | | --- | | Additionally, RAN4 further discussed coherence between PUSCH and 8-ports SRS with partial dropping. The approved reply LS of R4-2321728 says that “Some UEs may be capable to achieve coherence across TDM’d SRS and some UE may not” in the answer for Question 1. It is RAN4’s understanding that the current capability wouldn’t allow a UE to indicate that the UE supports codebook 1 with not TDMed SRS, while the same UE can also support codebook 2, 3, or 4 with TDM’d SRS. If the RAN4 understanding is correct, RAN4’d like to request RAN1 to consider allowing UE to indicate the above mentioned cases, details are up to RAN1. |   To achieve the UE capability reporting of above cases requested by RAN4, following two options can be considered. Note that the support of TDM and/or nonTDM 8TX ports SRS in FG 40-7-1 could be deleted if any of following options is adopted.   * Option 1: Add component on support of TDM and/or nonTDM 8TX ports SRS for FGs of each codebook type. * Option 2: Add separate FGs on support of TDM and/or nonTDM 8TX ports SRS for different codebook types.   Either option could work. Considering that Option 1 is simpler, Option 1 is slightly preferred, and corresponding UE FGs can be updated as follows.  **Proposal 3: For FG 40-7-1/1a/1b/1c/1d, adopt the following updates:**   * **FG 40-7-1: Remove candidate values for component 3 (i.e., {noTDM, TDM and noTDM})** * **FG 40-7-1a/1b/1c/1d: Introduce a new component for each, which indicates one of {noTDM, TDM and noTDM} for each codebook**  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 40-7-1 | Basic features for Codebook-based 8Tx PUSCH | 1. Maximum number of PUSCH MIMO layers for codebook based PUSCH  2. Maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook’ for codebook-based 8Tx PUSCH  3. SRS 8 Tx ports—codebook |  | Yes | n/a | Component 1 candidate values: {1,2 ,3,4 ,5,6,7,8}  Component 2 candidate values: {1,2}  ~~Component 3 candidate values: {noTDM, TDM and noTDM}~~  A UE that supports FG 40-7-1 must support at least one of FGs 40-7-1a/b/c/d | | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1  3. SRS 8TX ports for codebook 1 | 40-7-1 | Yes | n/a | 2. Component candidate values: {(4,1), (2,2), both}  Component 3 candidate values: {noTDM, TDM and noTDM} | | 40-7-1b | Codebook-based 8Tx PUSCH—codebook2 | 1. Support of codebook-based 8Tx PUSCH—codebook2  2. SRS 8TX ports for codebook 2 | 40-7-1 | Yes | n/a | Component 2 candidate values: {noTDM, TDM and noTDM} | | 40-7-1c | Codebook-based 8Tx PUSCH—codebook3 | 1. Support of codebook-based 8Tx PUSCH—codebook3  2. SRS 8TX ports for codebook 3 | 40-7-1 | Yes | n/a | Component 2 candidate values: {noTDM, TDM and noTDM} | | 40-7-1d | Codebook-based 8Tx PUSCH—codebook4 | 1. Support of codebook-based 8Tx PUSCH—codebook4  2. SRS 8TX ports for codebook 4 | 40-7-1 | Yes | n/a | Component 2 candidate values: {noTDM, TDM and noTDM} | |
| Ericsson [15] | **Regarding the components for 40-7-1a,** the IE defining the codebook in the current version of the RRC spec (CodebookTypeUL, copied below) can be codebook1=ng1n4n1 and/or codebook1=ng1n4n1. These two codebooks are also identified as codebook1=ng1n4n1 and/or codebook1=ng1n2n2 in 38.211.   |  | | --- | | CodebookTypeUL-r18 ::= CHOICE {  codebook1-r18 ENUMERATED {ng1n4n1, ng1n2n2},  codebook2-r18 ENUMERATED {ng2},  codebook3-r18 ENUMERATED {ng4},  codebook4-r18 ENUMERATED {ng8}  } |  |  | | --- | | ***codebookTypeUL***  Configures a codebook and the corresponding number of antenna port groups for codebook-based transmission of PUSCH with 8 antenna ports, see TS 38.211 [16], tables 6.3.1.5-9 to 6.3.1.5-47, and table 6.3.1.5-8 respectively). The values *ng1n4n1* and *ng1n2n2* correspond to codebooks with one antenna port group (Ng=1), while *ng2, ng4*, and *ng8* correspond to codebooks with Ng=2, 4, and 8 antenna port groups, respectively. |   Furthermore, the following agreement was reached in RAN1#116bis to remove the reference to a non-existent RRC parameter *ULcodebookFC-N1N2*, since the codebook configurations are fully identified by the parameter *CodebookTypeUL*.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Agreement**  Adopt the following correction to TS 38.212, TS 38.214   * Reason for change: Remove the reference to the non-existent RRC parameter ULcodebookFC-N1N2 * Summary of change: Delete instances of referencing in section 7.3.1.1.2 of 38.212, and section 6.1.1.1 of 38.214. * Consequences if not approved: Incorrect description of the UE procedure.   **38.212**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | -------------------------------------------Unchanged parts are omitted-------------------------------------------  - 7 bits according to Table 7.3.1.1.2-5B for 8 antenna ports, if *CodebookTypeUL=~~C~~codebook1*, transform precoder is disabled, *maxRank-n8* = 8, and according to *~~ULcodebookFC-N1N2~~ codebook1=ng1n4n1 or ng1n2n2*;  - 7 bits according to Table 7.3.1.1.2-5C for 8 antenna ports, if *CodebookTypeUL=~~C~~codebook1*, transform precoder is disabled, *maxRank-n8* =7, and according to *~~ULcodebookFC-N1N2~~ codebook1=ng1n4n1 or ng1n2n2*;  **Table 7.3.1.1.2-5B: Precoding information and number of layers, for 8 antenna ports, if transform precoder is disabled, *maxRank-n8* = 8, and *CodebookTypeUL*=*~~C~~codebook1***   |  |  |  |  | | --- | --- | --- | --- | | **Bit field mapped to index** | ***~~ULcodebookFC-N1N2~~* ~~= (4, 1)~~**  **codebook1=ng1n4n1** | **Bit field mapped to index** | ***~~ULcodebookFC-N1N2 = (2, 2)~~***  **codebook1=ng1n2n2** | | 0 | 1 layer: TPMI=0 | 0 | 1 layer: TPMI=0 | | 1 | 1 layer: TPMI=1 | 1 | 1 layer: TPMI=1 | | … | … | … | … |   … |   **38.214**   |  | | --- | | -------------------------------------------Unchanged parts are omitted-------------------------------------------  A UE does not expect to be configured by *CodebookTypeUL* with a value of *CodebookTypeUL* that does not correspond to one of the values of *UL\_8TX\_Ng* reported in its capability. ~~A UE can be configured by~~ *~~ULcodebookFC-N1N2~~* ~~subject to UE capability, when higher layer parameter~~ *~~CodebookTypeUL~~* ~~is set to 'Codebook1' corresponding to Ng=1, where Ng represents the number of antenna port groups.~~  -------------------------------------------Unchanged parts are omitted------------------------------------------- | |   However, 40-7-1a is described as follows (here we add the highlighting to draw attention to component 2; it is not highlighted in the current feature list):   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | 2. Component candidate values: {(4,1), (2,2), both} |   Since there is no description of what (N1,N2) is for an 8 Tx UL MIMO codebook in the RAN1 specs, it is not clear which codebooks are supported with component values (4,1) and (2,2). Therefore, it should be clarified that these refer to codebook1=ng1n4n1 codebook1=ng1n2n2, respectively. The tabular format above lacks some of the description in 38.306, and so we explain the changes using the 38.306 text below.   | ***codebookParameter8TxPUSCH-r18***  Indicates whether the UE supports codebook-based 8Tx PUSCH.  The UE shall include *codebook-8TxBasic-r18* to indicate basic features of 8Tx PUSCH codebook. This capability signaling comprises the following parameters:  - *maxNumberPUSCH-MIMO-Layer-r18* defines the maximum number of PUSCH MIMO layers for codebook based PUSCH.  - *maxNumberSRS-Resource-r18* defines the maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook' for codebook-based 8Tx PUSCH.  - *srs-8TxPorts-r18* defines SRS 8 Tx ports—codebook. Value '*noTDM'* indicates noTDM. Value '*both*' indicates TDM and noTDM.  A UE that supports *codebook-8TxBasic-r18* must support at least one of *codebook1-8TxPUSCH-r18*, *codebook2-8TxPUSCH-r18*, *codebook3-8TxPUSCH-r18*, and *codebook4-8TxPUSCH-r18*.  - *codebook1-8TxPUSCH-r18* indicates whether the UE supports (N1, N2) codebook-based 8Tx PUSCH—codebook1. Value n4-1 corresponds to (4,1) codebook1=ng1n4n1, value n2-2 corresponds to (2,2) codebook1=ng1n2n2, value both corresponds to both codebooks.  - *codebook2-8TxPUSCH-r18* indicates whether the UE supports codebook-based 8Tx PUSCH—codebook2.  - *codebook3-8TxPUSCH-r18* indicates whether the UE supports codebook-based 8Tx PUSCH—codebook3.  - *codebook4-8TxPUSCH-r18* indicates whether the UE supports codebook-based 8Tx PUSCH—codebook4.  … | | --- |   This can be captured in the feature list as follows:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | 2. Component candidate values: {~~(4,1)~~ng1n4n1,  ~~(2,2)~~ng1n2n2, both} |  1. Correct the description of FG 40-7-1a 8 Tx codebook1 for component 2 to indicate what codebooks are actually supported and to align with RRC as follows: “2. Component candidate values: {~~(4,1),~~ ng1n4n1, ~~(2,2)~~ng1n2n2, both}”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | 2. Component candidate values: {ng1n4n1, ng1n2n2, both} | Optional with capability signaling | |
| Qualcomm Incorporated [16] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g | UL full power transmission mode 2 with 1/2/4 resources | 1. Support of UL full power transmission mode of fullpowerMode2 when UE is capable of 8 Tx codebook based PUSCH operation  2. Maximum number of SRS resources in one SRS resource set with usage set to 'codebook' for 8Tx codebook based PUSCH for Mode 2 | 40-7-1 | yes | n/a | UL full power transmission mode 2 is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4}  Note: A UE that supports FG 40-7-1g supports at least full power operation with single port | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | yes | n/a | SRS resources for UL full power transmission mode 2 cannot be signaled | Per FSPC | n/a | n/a | n/a | Component 1 candidate values: 3 bit bitmap {b0, b1, b2}  b0 indicates whether SRS resource can be configured with 1 port  b1 indicates whether SRS resource can be configured with 2 port  b2 indicates whether SRS resource can be configured with 4 port | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-2 | TPMI group(s) which delivers full power for codebook2 | 1. TPMI group(s) which delivers full power when UE is capable of and configured with 8 Tx codebook based PUSCH operation with codebook2 | 40-7-1g | yes | n/a | TPMI group(s) which delivers full power is unknown | Per FSPC | n/a | n/a | n/a | Component 1 candidate values: {first coherent antenna port group, second coherent antenna port group} | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] | In Rel-16, full power mode 2 is supported for 2/4Tx with the following FGs:   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 16-5c | UL full power transmission *fullpowerMode2* | 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 | 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 |   For 8Tx, similar two FGs (40-7-1g/40-7-1g-1) were introduced as below with the same functionality. In RAN1#117 meeting, a note was added similar to 2/4Tx to clarify that full power operation with single port is mandatory for UE supporting full power mode 2 with 8Tx. However, in FG 40-7-1g-1, there is still one bit (b0) to indicate whether SRS resource can be configured with one port for full power mode 2. It is redundant considering the newly added note and can be deleted.  ***Proposal 2: The following can be applied to UE feature for 8Tx PUSCH transmission:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g | UL full power transmission mode 2 with 1/2/4 resources | 1. Support of UL full power transmission mode of fullpowerMode2 when UE is capable of 8 Tx codebook based PUSCH operation  2. Maximum number of SRS resources in one SRS resource set with usage set to 'codebook' for 8Tx codebook based PUSCH for Mode 2 | 40-7-1 | yes | n/a | UL full power transmission mode 2 is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4}  Note: A UE that supports FG 40-7-1g supports at least full power operation with single port | Optional with capability signalling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | yes | n/a | SRS resources for UL full power transmission mode 2 cannot be signaled | Per FSPC | n/a | n/a | n/a | Component 1 candidate values: ~~3~~2 bit bitmap {b0, b1~~, b2~~}  b0 indicates whether SRS resource can be configured with ~~1~~2 port  b1 indicates whether SRS resource can be configured with ~~2~~4 port  ~~b2 indicates whether SRS resource can be configured with 4 port~~ | Optional with capability signalling | |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] | **Regarding the TPMI group definitions in full power mode 2 in 40-7-1g-1**,  The component values for UL FPTx Mode 2 SRS resources are current defined with a bitmap as follows (highlighting added here is not in the feature list):   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | Component 1 candidate values: 3 bit bitmap {b0, b1, b2}  b0 indicates whether SRS resource can be configured with 1 port  b1 indicates whether SRS resource can be configured with 2 port  b2 indicates whether SRS resource can be configured with 4 port |   For 8 Tx, UL FPTx Mode 2 with different numbers of SRS ports in an SRS resource set behaves as described in the agreement and in the 38.214 section 6.1.1.1 excerpt below. It can be seen that an 8 port SRS resource is always configured and that 1, 2, or 4 ports may be configured in the set.   |  | | --- | | **Agreement (RAN1#114)**  For an 8TX UE, configured for full power transmission with ‘fullpowerMode2’,   * Subject to UE capability, a maximum of 2 or 4 SRS resources are supported in an SRS resource set with usage set to 'codebook', * An SRS resource set can be configured with one or more of 1-, 2-, 4-, or 8-port SRS resources. |  |  | | --- | | When higher layer parameter *ul-FullPowerTransmission* is set to 'fullpowerMode2*'* and the higher layer parameter *CodebookTypeUL* is set to *'*Codebook2' or *'*Codebook3', and the *SRS-resourceSet* with *usage* set to 'codebook' includes one SRS resource with 8 ports, and at least one SRS resource with 2 ports or 4 ports, subject to UE capability,  - when *CodebookTypeUL* is set to *'*Codebook2', the *codebookSubset* associated with the 2-port SRS resource is 'nonCoherent'.  - when *CodebookTypeUL* is set to *'*Codebook2', the *codebookSubset* associated with the 4-port SRS resource can be configured as 'partialAndNonCoherent' or 'nonCoherent', subject to UE capability.  - when *CodebookTypeUL* is set to *'*Codebook3', the *codebookSubset* associated with 4 ports SRS resources is 'nonCoherent'. |   Furthermore, FG 40-7-1g was updated in RAN1#116bis to capture that full power operation for single port is always supported by UEs that support UL FTPTx Mode 2 with 1/2/4 SRS resources:   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-1g | UL full power transmission mode 2 with 1/2/4 resources | 1. Support of UL full power transmission mode of fullpowerMode2 when UE is capable of 8 Tx codebook based PUSCH operation  2. Maximum number of SRS resources in one SRS resource set with usage set to 'codebook' for 8Tx codebook based PUSCH for Mode 2 | 40-7-1 | yes | n/a | UL full power transmission mode 2 is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4}  Note: A UE that supports FG 40-7-1g supports at least full power operation with single port |  1. For 8 Tx UL full power Mode 2 with different numbers of SRS resources per set, an 8 port SRS resource must be configured in the set, while 1, 2, or 4 port resources may be configured. This implies that the bit b0 in component 1 of 40-7-1g-1 is incorrect, and that 40-7-1g-1 should identify that 8 SRS ports must be in the SRS resource set.   The SRS resource size combinations in Rel-16 UL FPTx Mode 2 FG 16-5c-2 are straightforwardly identified as combinations of Rel-16 SRS resource sizes, listed as {1\_2, 1\_4, and 1\_2\_4} and as shown below.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 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 | 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. |   For 8 Tx Mode 2 FG 40-7-1g-1, supporting either or both of 2 or 4 port SRS resources as is done with the current bitmap, but requiring support for 1 port and 8 port SRS resources, leads to the combinations {1\_8, 1\_2\_8, 1\_4\_8, 1\_2\_4\_8}. Since the capability for the maximum number of SRS resources for UL FP Tx Mode 2 is also 2 or 4 for 8 Tx, we extend the Rel-16 note to be ‘Note: Any of the above states can be used if 40-7-1g is reported as 2 or 4.’ Therefore, we suggest that FG 40-7-1g-1 be updated as follows.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | ~~Component 1 candidate values: 3 bit bitmap {b0, b1, b2}~~  ~~b0 indicates whether SRS resource can be configured with 1 port~~  ~~b1 indicates whether SRS resource can be configured with 2 port~~  ~~b2 indicates whether SRS resource can be configured with 4 port~~  Component (1) candidate values:{1\_8, 1\_2\_8, 1\_4\_8, 1\_2\_4\_8}  1st state (1\_8): each SRS resource can be configured with 1 port or 8 ports  2nd state (1\_2\_8): each SRS resource can be configured with 1 port or 2 ports or 8 ports  3rd state (1\_4\_8): each SRS resource can be configured with 1 port or 4 ports or 4 ports  4th state (1\_2\_4\_8): each SRS resource can be configured with 1 port or 2 ports or 4 ports or 8 ports  Note: Any of the above states can be used if 40-7-1g is reported as 2 or 4. |  1. Update FG 40-7-1g-1 defining SRS port combinations in Component 1 as ‘{1\_8, 1\_2\_8, 1\_4\_8, 1\_2\_4\_8}’, explaining these states/combinations as was done for Rel-16, and adding ‘Note: Any of the above states can be used if 40-7-1g is reported as 2 or 4.’   **Regarding the TPMI group definitions in full power mode 2 in 40-7-1g-2**,   |  | | --- | | **Agreement (RAN1#114)**  For an 8TX UE, configured for full power transmission with ‘fullpowerMode2’ for Ng=2   * UE power capability is indicated per antenna group, where for an indicated group, full power is supported for all ranks   + For when Ng=2, a single bit is used to indicate which of the antenna group has full power capability. |   In RAN1#116, the agreement above from RAN1#114 was captured as follows in FG 40-7-1g-2. How the first and second coherent antenna port group components are defined was left to further discussion.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 40-7-1g-2 | TPMI group(s) which delivers full power for codebook2 | 1. TPMI group(s) which delivers full power when UE is capable of and configured with 8 Tx codebook based PUSCH operation with codebook2 | 40-7-1g | Component 1 candidate values: {first coherent antenna port group, second coherent antenna port group} |   Full power TPMI groups were defined in 38.306 for Rel-16 as follows:   |  |  | | --- | --- | | ID | TPMI groups | | G0 | , | | G1 | , , , | | … |  |   Similar methods are possible for 8 Tx in Rel-18, as sketched below. A UE will indicate support for either TPMI group 0 or 1, and support the precoders in the group for a number of layers up to the maximum number of layers that the UE supports in 40-7-1. Note that the UE transmits on 4 ports for each , and so transmits at least half its maximum power without full power operation. This implies that only the intermediate precoding matrices with a single (non-zero) are the ones that should be used to identify full power operation. Transmitting on 4 ports per also implies that ranks > 4 are always at full power.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **1 Layer** | | **2 Layers** | | **3 Layers** | | **4 Layers** | | | **TPMI group** | **TPMIs** | **Intermediate precoder matrix** | **TPMIs** | **Intermediate precoder matrix** | **TPMIs** | **Intermediate precoder matrix** | **TPMIs** | **Intermediate precoder matrix** | | **0** | 0-15 |  | 0-7 |  | 0-3 |  | 0-1 |  | | **1** | 16-31 |  | 8-15 |  | 4-7 |  | 2-3 |  |  1. Define two groups of 8 Tx full power Mode 2 precoders/TPMIs for FG 40-7-1g-2 according to the maximum rank supported by the UE for 8 Tx, where the full power precoders constitute a single non-zero submatrix in the intermediate precoder matrix from 38.211. The UE indicates support for only one of the groups.   Note that the proposal above for 40-7-1g-2 should be captured directly in 38.306, as was done for Rel-16 UL FPTx Mode 2, since it is not straightforwardly included in the feature lists.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | yes | n/a | SRS resources for UL full power transmission mode 2 cannot be signaled | Per FSPC | n/a | n/a | n/a | Component (1) candidate values:{1\_8, 1\_2\_8, 1\_4\_8, 1\_2\_4\_8}  1st state (1\_8): each SRS resource can be configured with 1 port or 8 ports  2nd state (1\_2\_8): each SRS resource can be configured with 1 port or 2 ports or 8 ports  3rd state (1\_4\_8): each SRS resource can be configured with 1 port or 4 ports or 4 ports  4th state (1\_2\_4\_8): each SRS resource can be configured with 1 port or 2 ports or 4 ports or 8 ports  Note: Any of the above states can be used if 40-7-1g is reported as 2 or 4. | Optional with capability signalling | |
| Qualcomm Incorporated [16] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} across all CCs simultaneously | 40-7-2 | yes | n/a | Association between CSI-RS and SRS for non-codebook case is not supported | Per FSPC | No | No | No | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For FG 40-7-2a, the granularity is FSPC. Therefore, “across all CCs” in component 2 is redundant which should be deleted. We have the following proposal  **Proposal MIMO-5: Support to delete “across all CCs” in component 2 of FG 40-7-2a.** |
| Intel Corporation [4] |  |
| Samsung [5] | FG 40-7-2a is related to association between CSI-RS and SRS for non-codebook 8TX PUSCH operation, which is inherited by FG 2-15a defined in Rel-15 and also has similar descriptions.  One difference between FG 40-7-2a and FG 2-15a is reporting granularity, where FG 40-7-2a is defined as per FSPC, but FG 2-15a is defined as both per band and per BC. We think that the reason why the granularity of FG 40-7-2a is per FSPC is based on RAN2’S guidance that it is recommended to avoid defining capabilities with re-requisite on a finer granularity [3] and the granularity of FG 40-7-2 which is a pre-requisite of FG 40-7-2a is per FSPC.  However, if the intention of introducing FG 40-7-2a is to mimic the structure of that of Rel-15, then our view is that we need to reuse the structure of Rel-15, then at least for “across all CCs”, it should be reported by per BC signaling, which is also separately reported as per BC in FG 2-15a. The granularity of FG 40-7-2a is per FSPC now, so “across all CCs” in per FSPC reporting does not make sense. Hence, we can put a note that component 2 with “across all CCs” can be separately reported as per BC, which the same note is already adopted in Rel-18 NES UE feature (e.g., FG 42-2a).  **Proposal 10:** In FG 40-7-2a, component 2 with “across all CCs” can be separately reported as per BC.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} across all CCs simultaneously | 40-7-2 | yes | n/a | Association between CSI-RS and SRS for non-codebook case is not supported | Per FSPC | No | No | No | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256}  Note: Component 2 is reported per BC. | Optional with capability signalling | |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | For FG 40-7-2 there is also a component with “across all CCs”. Note that this FG is defined per-FSPC.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} across all CCs simultaneously | 40-7-2 | Per FSPC | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256} |   The above is related to CSI-RS resources used for NCB PUSCH transmission by 8Tx feature. There are some points which cause a confusion. For example, this is defined as per-FSPC, so the signaling is provided for a CC in a band in a band combination. Therefore, the range of “all CC(s)” in component 2 over this reporting is not clear per the current definition.  In our view, this FG is analogous to Rel-15 FG 2-15a which has both per-band and per-BC signaling. Therefore, the component 2 may need to follow the same principle, that is, to define signaling for component 2 as per band and per BC instead of per FSPC.  It is also noted that the per-BC signaling in Rel-15 FG 2-15a seems to be shared among multiple Rel-15 FGs which relate to the triplet. There may also be a discussion on how to define per-BC signaling for this 8Tx feature as well, e.g., whether to refer to the existing Rel-15 signaling or create new signaling.  **Proposal 2: Regarding Topic 3 asked by RAN2 LS [3], discuss the implication of “across all CCs” in the following FGs:**   * **For FG 40-7-2a (note: both of the following can be simultaneously considered, similar to FG 2-15a):**    + **Alt-1: It means “across all CCs in the band”.**   + **Alt-2: It means “across all CCs in the band combination”.** |
| Ericsson [15] | RAN2 also mentioned FG 40-7-2a, which is reported with granularity FSPC. Strangely enough, FG 40-7-2a includes the statement “across all CCs”, although the capability is reported per CC: the UE cannot anyway report different values for different CCs in a band. Therefore, we propose to change the reporting granularity to “per FS”:   1. Change the reporting granularity for FG 40-7-2a to “per FS”. 2. Clarify that “across all CCs” means “across all CCs in a band” for FG 40-7-2a.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} across all CCs in a band simultaneously | 40-7-2 | yes | n/a | Association between CSI-RS and SRS for non-codebook case is not supported | Per FS | No | No | No | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256} | Optional with capability signalling | |
| Qualcomm Incorporated [16] |  |

**Other**

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| Company | Summary |
| Huawei/HiSilicon [3] | A RAN2 LS [2] asked RAN1 for clarification for the below UE capabilities with “across all CCs”.   * mTRP-CSI-EnhancementPerBand-r17 * mTRP-CSI-EnhancementPerBC-r17 * mTRP-GroupBasedL1-RSRP-r17 * unifiedJointTCI-mTRP-InterCell-BM-r17 * mTRP-PDCCH-Case2-1SpanGap-r17 * mTRP-PDCCH-legacyMonitoring-r17   In this contribution, we first provide our views on the above Rel-17 UE capability with “across all CCs”, and then provide our views on the Rel-18 UE capability with “across all CCs”.  For *mTRP-CSI-EnhancementPerBC-r17*, it is clear that “across all CCs” means the CCs across the band combination. Since we have the capability across the band combination, it is reasonable that the “across all CCs” in *mTRP-CSI-EnhancementPerBand-r17* means the CCs within the reported band combination.  For *mTRP-GroupBasedL1-RSRP-r17* and *unifiedJointTCI-mTRP-InterCell-BM-r17*, different band can report different UE capability. Therefore, “across all CCs” in *mTRP-GroupBasedL1-RSRP-r17* and *unifiedJointTCI-mTRP-InterCell-BM-r17* means the CCs within the reported band.  **Proposal MIMO-1:**   * **For *mTRP-CSI-EnhancementPerBC-r17,* “across all CCs” means the CCs across the band combination** * **For *mTRP-CSI-EnhancementPerBand-r17, mTRP-GroupBasedL1-RSRP-r17* and *unifiedJointTCI-mTRP-InterCell-BM-r17,* “across all CCs” means the CCs within the reported band.** |
| Intel Corporation [4] |  |
| Samsung [5] | In RAN1#114 and 114bis, the following agreements on PHR enhancement for STx2P were endorsed.   |  | | --- | | **Agreement**  On unified TCI framework extension for S-DCI based MTRP, if *twoPHRMode* is configured, and two SRS resource sets for CB/NCB and *multipanelScheme* for SDM/SFN are configured:   * If the UE determines that one or both Type 1 PHRs are based on an actual PUSCH transmission   + If the actual PUSCH transmission applies both first and second indicated joint/UL TCI states, the UE provides the first {power headroom, configured maximum output power} associated with the first indicated joint/UL TCI state for the actual PUSCH transmission, and the second {power headroom, configured maximum output power} associated with the second indicated joint/UL TCI state for the actual PUSCH transmission   + If the actual PUSCH transmission applies only the first indicated joint/UL TCI state, the UE provides the first {power headroom, configured maximum output power} associated with the first indicated joint/UL TCI state for the actual PUSCH transmission     - FFS: How to provide the second report for a reference PUSCH transmission?   + If the actual PUSCH transmission applies only the second indicated joint/UL TCI state, the UE provides the second {power headroom, configured maximum output power} associated with the second indicated joint/UL TCI state for the actual PUSCH transmission     - FFS: How to provide the first report for a reference PUSCH transmission? * FFS: If the UE determines that both Type 1 PHRs are based on reference PUSCH transmissions, how to provide the first and second reports for reference PUSCH transmissions, respectively?   **Agreement**  On unified TCI framework extension for S-DCI based MTRP, if *twoPHRMode* is configured, and two SRS resource sets for CB/NCB and *multipanelScheme* for SDM/SFN are configured:   * If the UE determines that only one Type 1 PHR is based on an actual PUSCH transmission   + If the actual PUSCH transmission applies only the first indicated joint/UL TCI state, the UE provides the second {power headroom, configured max output power} associated with the second indicated joint/UL TCI state for a reference PUSCH transmission   + If the actual PUSCH transmission applies only the second indicated joint/UL TCI state, the UE provides the first {power headroom, configured max output power} associated with the first indicated joint/UL TCI state for a reference PUSCH transmission * If the UE determines that both Type 1 PHRs are based on reference PUSCH transmissions, the UE provides the first {power headroom, configured max output power} associated with the first indicated joint/UL TCI state for a reference PUSCH transmission, and the second {power headroom, configured max output power} associated with the second indicated joint/UL TCI state for another reference PUSCH transmission * FFS: Whether the configured max output power reported in above cases is per UE or per panel or both * ~~Down-select one of the following alternatives to be reported along with the power headroom for a reference PUSCH transmission:~~   + ~~Alt1: Per-panel configured max output power~~   + ~~Alt2: Per-UE configured max output power~~   + ~~Alt3: Both per-panel configured max output power and per-UE configured max output power~~   + ~~Alt4: None~~ |   So far, it is true that there is no RAN1 agreement for PHR report when *twoPHRmode* is not configured and two SRS resource sets for CB/NCB and *multipanelScheme* for SDM/SFN are configured. This can be interpreted as two folds:   * Interpretation 1. Since we don’t have RAN1 agreement on such case, when a UE supports STx2P scheme, the UE shall support to be configured with *twoPHRmode*. That is, *twoPHRmode* is a basic feature for STx2P. * Interpretation 2. Since *twoPHRmode* is introduced as FG 23-3-1c in Rel-17 which is obviously an optional feature as follows, even for UE supporting STx2P scheme, supporting *twoPHRmode* is an optional as well, hence a new UE capability supporting two PHR mode for Rel-18 STx2P is needed.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |   Our view is aligned with Interpretation 2 that *twoPHRmode* is not a mandatory feature for STx2P. To support *twoPHRmode* for sDCI based STx2P schemes, additional capability might be required. This can be similar to Rel-17 FG for two PHR reporting, FG 23-3-1c which is optional with capability signalling. In addition, we think this UE capability can be used for both sDCI and mDCI based STx2P schemes. Therefore, we suggest to introduce new feature group to report UE capability on *twoPHRmode* for STxMP including both sDCI and mDCI based schemes. Furthermore, it should be clarified which PHR for either the first indicated TCI state or the second indicated TCI state is reported when STx2P is supported but *twoPHRmode* for STx2P is not supported (or not configured). This is because both indicated TCI states are applied for STx2P at a STx2P PUSCH transmission occasion not like Rel-17 mTRP TDMed PUSCH repetition which only PUSCH toward one TRP could be transmitted at a PHR reporting time instance. In our view, the simplest way is to have the UE to report a PHR for an actual PUSCH transmission, and PHR for the first indicated TCI state or PHR associated with coreasePoolIndex0 is reported if actual PUSCH transmission is based on STx2P schemes.  **Proposal 1:** Following capability is introduced to support two PHR mode for both sDCI based schemes and mDCI based schemes:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-1-14 | Two PHR reporting for STx2P | Support of PHR reporting related to STx2P | At least one of 40-6-1, 40-6-1a, 40-6-2, 40-6-2a, 40-6-3a, 40-6-3b | UE will report a PHR for an actual PUSCH transmission and PHR for the first indicated TCI state or PHR associated with coresetPoolIndex0 is reported if actual PUSCH transmission is based on STx2P schemes | Per Band | FR2 only | Note: If gNB does not configure corresponding RRC parameter for this FG, UE will report a PHR for an actual PUSCH transmission and PHR for the first indicated TCI state or PHR associated with coresetPoolIndex0 is reported if actual PUSCH transmission is based on STx2P schemes | Optional with capability signalling |   When the UE can support multi-DCI based STx2P PUSCH+PUSCH, the UE will prepare two TBs in parallel to transmit both PUSCH simultaneously. However, depending on UE’s capability for processing time, additional timeline may be required. Therefore, new processing capability for additional timeline of multi-DCI based STx2P PUSCH+PUSCH can be introduced as follow:  **Proposal 3:** *Introduce new processing capability for additional timeline of multi-DCI based STx2P PUSCH+PUSCH as follow:*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-6-3a-1 | UE STxMP processing capability for codebook | 1. Require additional timeline to process multiple TBs for codebook multi-DCI based STx2P PUSCH+PUSCH for DG+DG  Note. This FG can be applied for CG+DG also if UE can support those FG. | 40-6-3a | UE should process multiple TBs within legacy timeline | Per FSPC | FR2 only | candidate values:  UE reports candidate value independently for each SCS in unit of symbols  For 15kHz SCS: {1,2}  For 30kHz SCS: {1,2,4}  For 60kHz SCS: {2,4,8}  For 120kHz SCS: {4,8,16}  For 480kHz SCS: {16,32,64}  For 960kHz SCS: {32,64,128} | Optional with capability signalling | | 40-6-3b-2 | UE STxMP processing capability for noncodebook | 1. Require additional timeline to process multiple TBs for noncodebook multi-DCI based STx2P PUSCH+PUSCH for DG+DG  Note. This FG can be applied for CG+DG also if UE can support those FG. | 40-6-3b | UE should process multiple TBs within legacy timeline | Per FSPC | FR2 only | candidate values:  UE reports candidate value independently for each SCS in unit of symbols  For 15kHz SCS: {1,2}  For 30kHz SCS: {1,2,4}  For 60kHz SCS: {2,4,8}  For 120kHz SCS: {4,8,16}  For 480kHz SCS: {16,32,64}  For 960kHz SCS: {32,64,128} | Optional with capability signalling |   **Rel-18 UE capabilities**  If we adopt a certain per band capability reporting in future which may be independent with legacy FGs in Rel-15/16/17 and if we add component including “across all CCs”, we would like to show our views on how to interpret the meaning of “across all CCs”, and would like to further discuss which option could be considered from now.   * 1) Component including “across all CCs” in per band reporting can mean that “across all CCs in a band”. This is straightforward way to understand the meaning of component included in per band reporting, and also UE can report band specific values. But if a UE reports like this, depending on the cases of BC configuration, UE may under-report for a certain band. * 2) Component including “across all CCs” in per band reporting can mean that “across all CCs in any BC containing the band”. As in 1), although interpreting this as within each band is feasible, this would put considerable complication at a UE side since what eventually matters would be the total complexity in each BC. Since one band can be included in multiple different BC’s with different number of bands, it is not easy for a UE to decide the capability number within each band considering all possible BCs it belongs to. Hence, we think the interpretation for per band type as ‘across all CCs in any BC including the band’ can be one way. But, based on this way, a UE may report same value for each band included in the same BC, which could be inflexible and redundant.   **Proposal 7:** For per band capability reporting which may have irrelevant structure with legacy FGs in Rel-15/16/17 and even Rel-18, consider between two things.   * 1) Component including “across all CCs” in per band reporting can mean that “across all CCs in a band”. * 2) Component including “across all CCs” in per band reporting can mean that “across all CCs in any BC containing the band”.   **Rel-17 UE capabilities**  We would like to clarify the granularity of “across all CCs” for the below Rel-17 capabilities for correction.  **FG 23-7-1 (mTRP-CSI-EnhancementPerBand-r17, mTRP-CSI-EnhancementPerBC-r17)**  The following table is FG 23-7-1 which is defined as both per band and per BC signaling. Similar with Rel-18 FGs which are defined as both per band and per BC described in Clause 10.6 in this contribution, the meaning of “across all CCs” in per band signaling could be “in a band”, and in per BC signaling could be “in a BC”.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. Supported codebook modes for NCJT CSI |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   Component 5 candidate values: {mode 1, both mode 1 and mode 2} | Optional with capability signalling |   In addition to RAN2 discussion, we think that there are some issues in this FG as follows.   * First, two capabilities (per band and per BC) are supposed to be jointly used, but neither 38.306 nor 38.331 captures it. * For components 1, 2, 3, and 5, an interpretation is needed when a UE declares both per band and per BC signaling.   + For component 2, the minimum number between per band and per BC can be applied for each band.   + For component 1, 3 and 5, some interpretations are necessary, whether an intersection or union of reported values from per band and per BC signaling can be applied for each band (e.g., considering BC1 containing band1 and band2, and for component 3: mode 1 with X=0 and mode 2 are reported by per band for band1 and band2, respectively, but mode 1 with X=0 is reported by per BC for BC1).   **Proposal 11:** For per band and per BC signalling for FG 23-7-1, the followings are further considered.   * Description on joint utilization on per band and per BC signalings * Clarification on component 1, 2, 3, and 5   + For component 2, the minimum number between per band and per BC can be applied for each band.   + For component 1, 3, and 5, an intersection of reported values from per band and per BC signaling can be applied for each band.   **FG 23-5-1 (mTRP-GroupBasedL1-RSRP-r17)**  For our view on FG 23-5-1, please see Clause 10.3 in this contribution.  **FG 23-1-2 (unifiedJointTCI-mTRP-InterCell-BM-r17)**  The following table is about FG 23-1-2.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |   Similar with FG 40-6-5 and FG 23-5-1 discussed in Clause 10.3 in this contribution, FG 23-1-2 has a note that component 4 including across all CCs are also counted in FG 16-1g and FG 16-1g-1. Hence, similar treatment as in FG 23-5-1 and FG 40-6-5 could be applied to FG 23-1-2 as well.  **Proposal 12:** In FG 23-1-2, clarify the meaning of “across all CCs” based on the added note meaning the value of component 4 in FG 23-1-2 is same for all bands in each of FRs (i.e., per FR reporting).   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1  Note: If the UE includes values for component 4 in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes values for component 4 in an FR2 band, it shall set the same value in all FR2 bands. | Optional with capability signalling |   **FG 23-2-1d (mTRP-PDCCH-Case2-1SpanGap-r17)**  The following table is about FG 23-2-1d which has “per FS” reporting granularity.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-2-1d | PDCCH repetition for Case 2 PDCCH monitoring with a span gap | 1. Support of PDCCH repetition for PDCCH monitoring of any occasions with span gap as defined in FG 3-5b.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 3-5b, 23-2-1 | Yes |  | PDCCH repetition for Case 2 PDCCH monitoring with a span gap is not supported | Per FS | n/a | n/a | n/a | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 44, 64, no limit}  Component 4 candidate values: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |   As discussed in Clause 10.4 in this contribution, from the perspective of UE’s implementation, since what eventually matters would be the total complexity in each BC, so even for per FS reporting, two options discussed in Clause 10.4 in this contribution can be considered as well.  **Proposal 13:** For per FS capability reporting, consider between two things.   * 1) Component including “across all CCs” in per FS reporting can mean that “across all CCs in a band”. * 2) Component including “across all CCs” in per FS reporting can mean that “across all CCs in a BC”. |
| Vivo [6] |  |
| Apple [7] | We propose two new FGs to cover whether UE supports Rel-18 Single-DCI based STx2P (SDM or SFN) PUSCH together with Rel-15/16 PUSCH repetition   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1c | Single-DCI based STx2P SDM scheme for PUSCH and repetition in time | 1. Support of single-DCI based STx2P SDM scheme and semi-static indication of PUSCH repetitions over multiple slots  2. Support of single-DCI based STx2P SDM scheme and dynamic indication of repetition Type-A  3. Support of single-DCI based STx2P SDM scheme and dynamic indication of repetition Type-B | 40-6-1 or 40-6-1a | Yes | N/A | UE cannot be indicated to perform single-DCI based STx2P SDM scheme over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-2c | Single-DCI based STx2P SFN scheme for PUSCH and repetition in time | 1. Support of single-DCI based STx2P SFN scheme and semi-static indication of PUSCH repetitions over multiple slots  2. Support of single-DCI based STx2P SFN scheme and dynamic indication of repetition Type-A  3. Support of single-DCI based STx2P SFN scheme and dynamic indication of repetition Type-B | 40-6-2 or 40-6-2a | Yes | N/A | UE cannot be indicated to perform single-DCI based STx2P SFN scheme over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling |   We propose a new FG to cover whether UE supports Rel-18 Multi-DCI based STx2P PUSCH together with Rel-15/16 PUSCH repetition   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3q | multi-DCI based STx2P for PUSCH+PUSCH and repetition in time for at least one of the PUSCHs | 1. Support of multi-DCI based STx2P for PUSCH+PUSCH and semi-static indication of PUSCH repetitions over multiple slots  2. Support of multi-DCI based STx2P for PUSCH+PUSCH and dynamic indication of repetition Type-A  3. Support of multi-DCI based STx2P for PUSCH+PUSCH and dynamic indication of repetition Type-B | 40-6-3a, or 40-6-3b | Yes | N/A | UE cannot be indicated to perform multi-DCI based STx2P PUSCH over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling |   We propose new FG to cover whether UE supports Rel-18 Multi-DCI based STx2P PUSCH together with PUSCH with different L1 priority (feature introduced in Rel-16)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3r | multi-DCI STx2P PUSCH with different PHY priorities | Support of multi-DCI STx2P PUSCH with different PHY priorities | 12-1 | Yes | N/A | Multi-DCI STx2P PUSCH with different PHY priorities is not supported | Per FS | No | FR2 only | n/a |  | Optional with capability signaling | |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | ***mTRP-CSI-EnhancementPerBand-r17/mTRP-CSI-EnhancementPerBC-r17***  These two can be treated in a similar manner to that for Rel-18 CSI related FGs, considering that per-band and per-BC signaling are both defined.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1  2, Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max  3. CSI report mode selection of mode 1 with X=0 and/or mode 2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  b) Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis  c) Maximum total number of CMRs for NCJT measurement  d) Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses  5. Supported codebook modes for NCJT CSI |  | *mTRP-CSI-EnhancementPerBC-r17*  *{*  *maxNumNZP-CSI-RS-r17,*  *cSI-Report-mode-r17,*  *supportedComboAcrossCCs-r17,*  *codebookMode-NCJT-r17*  *}* | *CA-ParametersNR-v1700* | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: {mode 1 with X=0, mode 2, both}  Component 4 candidate values:  a) {2, 4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {2,3,4, …, 256}  Component 5 candidate values: {mode 1, both mode 1 and mode 2} |   ***unifiedJointTCI-mTRP-InterCell-BM-r17***  Since this is related to L1-RSRP beam reporting, as discussed for FG 40-6-5 and 23-5-1 above, RAN1 may need to clarify the intention of component with “across all CCs”.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | *unifiedJointTCI-mTRP-InterCell-BM-r17*  *{*  *maxNumAdditionalPCI-L1-RSRP-r17,*  *maxNumSSB-ResourceL1-RSRP-AcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1 |   The following three FGs (23-2-1d/23-2-1e/55-6h) also have “across all CCs” components, where the signaling is defined per-FS.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 23-2-1d | PDCCH repetition for Case 2 PDCCH monitoring with a span gap | 1. Support of PDCCH repetition for PDCCH monitoring of any occasions with span gap as defined in FG 3-5b.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 3-5b, 23-2-1 | *mTRP-PDCCH-Case2-1SpanGap-r17*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17,*  *scs-60kHz-r17,*  *scs-120kHz-r17*  *}* | *FeatureSetDownlink-v1700* | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 44, 64, no limit}  Component 4 candidate values: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  NOTE:  - Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition.  - The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where "received" and "not been received" is wrt the end of the corresponding span of PDCCH candidate.  - The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16.  - Candidate value "no limit" does not imply BD limit can be exceeded. | | 23-2-1e | PDCCH repetition for Rel-16 PDCCH monitoring | 1. Support of PDCCH repetition with Rel-16 PDCCH monitoring capability as defined in FG 11-2 family.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 11-2, 23-2-1 | *mTRP-PDCCH-legacyMonitoring-r17*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17*  *}* | *FeatureSetDownlink-v1700* | This capability is signalled for SCS 15 kHz and 30 kHz.  Component2: {intra-span, inter-span, both}  Component3: {4, 8, 16, 32, 44, 64, no limit}  Component 4: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  NOTE:  - Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition.  - The limit X is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where "received" and "not been received" is w.r.t. the end of the corresponding span of PDCCH candidate.  - The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16.  - Candidate value "no limit" does not imply BD limit can be exceeded. | | 55-6h | PDCCH repetition for Rel-16 PDCCH monitoring | 1. Support of PDCCH repetition with Rel-16 PDCCH monitoring capability as defined in FG 11-2 family.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | FG23-2-1, and;  FG11-2 for (7, 3) or (4, 4) span based PDCCH monitoring;  FG55-6 for (2, 2) span based PDCCH monitoring with additional restriction(s) | | Per FS | Component 3: {4, 8, 16, 32, 44, 64, no limit}  Component 4: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  NOTE:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit X is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where "received" and "not been received" is w.r.t. the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value "no limit" does not imply BD limit can be exceeded   When a UE reports both FG 23-2-1e and this FG, the value reported in this FG is used if the configured span pattern of any serving cell satisfies FG 55-6  This capability is signalled for SCS 15 kHz and 30 kHz. |   Assuming a UE supporting a band combination {band#A, band#B}, a per-FS capability can be reported to any of band#A and #B independently, between which a component in the per-FS capability may report different values. This situation can be depicted as follows:    Fig.1: Per-FS capability reporting with “across all CCs” value report  In the above case, we identify there may be two different interpretations; 1) the “across all CCs” implies “across all CCs in a band” or 2) “across all CCs in a band combination”. Taking a per-FS capability reported to band#A and band#B, both in a band combination {band#A, band#B}, in Fig.1 as an example,   * If interpretation#1 (the “across all CCs” implies “across all CCs in a band in a band combination”) is taken, N1 and N2 would imply component#1 value across all CCs in Band#A and Band#B, respectively, assuming the band combination{band#A, band#B} (thus N1 and N2 can be different). * If interpretation#2 (the “across all CCs” implies “across all CCs in a band combination”) is taken, both N1 and N2 would imply component#1 value across all CCs in band combination {Band#A, Band#B} (thus N1 and N2 must be the same).   Our understanding is aligned with interpretation#1, i.e., any component in a per-FS report indicates the value applicable to the FS (i.e., the band in the band combination) since the defined Type applies to all the components in the FG unless stated otherwise. Meanwhile, we understand that there may be the ones who rather follows the other interpretation, i.e., interpretation#2, given that per-FS capability, by definition, takes a band combination into consideration. Therefore, we are open for further discussion for the following.  **Proposal 2: Regarding Topic 3 asked by RAN2 LS [3], discuss the implication of “across all CCs” in the following FGs:**   * **For FG 55-6h, *mTRP-PDCCH-Case2-1SpanGap-r17* and *mTRP-PDCCH-legacyMonitoring-r17*:**    + **Alt-1: It means “across all CCs in the band”.**   + **Alt-2: It means “across all CCs in the band combination”.**   **Proposal 2: Regarding Topic 3 asked by RAN2 LS [3], discuss the implication of “across all CCs” in the following FGs:**   * **FG 40-6-6, *mTRP-GroupBasedL1-RSRP-r17* and *unifiedJointTCI-mTRP-InterCell-BM-r17*:**    + **Alt-1: Since they are per-band FG, it means “across all CCs in the band”**   + **Alt-2: Similar to FG 2-24, it means “across all CCs in all the bans in either FR1 or FR2”** |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | There is only a minor issue observed for Rel-18 DMRS. With the following agreement in RAN1 #116bis, UE feature group 40-4-5a “Additional row(s) for antenna ports (0,2,3) for Rel.18 DMRS ports for single-DCI based M-TRP” was clarified that it is for DL only, which is good. But then we need create a similar UE feature for UL.  **Agreement (in RAN1 #116bis): Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a | Additional row(s) for antenna ports (0,2,3) for Rel.18 DL DMRS ports for single-DCI based M-TRP | Support of additional row(s) for antenna ports (0,2,3) for Rel.18 DL DMRS ports for single-DCI based M-TRP | 40-4-5 | Yes | n/a | Additional row(s) for antenna ports (0,2,3) for Rel.18 DL DMRS for single-DCI based M-TRP are not supported | Per FS | No | No | n/a |  | Optional with capability signaling |   With the above reasoning, the following is proposed.    **Proposal 2.1: Introduce the following new UE feature for Rel-18 UL DMRS.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a2 | Additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP | Support of additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP | 40-4-5 | Yes | n/a | Additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP are not supported | Per FS | No | No | n/a |  | Optional with capability signaling |   In the whole process of Rel-18 MIMO standardization, 8 Tx PUSCH and SRS enhancement were discussed independently in two different sub-agendas. Therefore, an aspect on UE capability signaling which requires taking both 8 Tx PUSCH and SRS into consideration was missed. Fortunately, RAN4 sent an LS R4-2321728 “Reply LS on coherence between PUSCH and 8-ports SRS with partial dropping”, which reminds RAN1 to double check UE capability and address this open issue.  In LS R4-2321728, the following is provided to answer the question raised by RAN1.  **RAN1 Question 1:** For a coherent 8Tx PUSCH transmission, can a UE meet the relative phase and power error requirements (defined in RAN 4 specifications) among the 8 SRS ports between the last SRS transmission and the PUSCH transmission over the defined time window, when the SRS is configured with or without TDM and no SRS symbol is dropped?  **RAN4 Answer**: Yes, depending on UE capability. Some UEs may be capable to achieve coherence across TDM’d SRS and some UE may not. The current RAN4 requirements for coherent UL-MIMO are specified for a pair of connectors (two ports/Tx connectors). It is the understanding of RAN4 that a UE supporting full coherent 8Tx should at least meet the specified phase and power error requirements for any pair of two Tx antenna connectors in the current RAN4 specifications.  Based on RAN4 answer “Yes, depending on UE capability. Some UEs may be capable to achieve coherence across TDM’d SRS and some UE may not” in the above answer, it is recognized that achieving coherency across TDMed SRS is a new, and potentially more challenging, requirement for a UE to achieve, rather than the legacy coherency across nonTDMed SRS. Therefore, an 8 Tx UE might be able to achieve coherency with nonTDMed 8-port SRS, while not able to achieve coherency with TDMed 8-port SRS. However, current UE capability framework is not able to distinguish between these two cases.  Current Rel-18 8-Tx UE capability signaling has the following independent signaling of UE feature group:   * SRS 8 Tx ports - codebook: This is the UE capability signaling of 8 Tx SRS for codebook based PUSCH. The component values for this capability signaling are {noTDMed SRS, noTDMed and TDMed SRS} * Support of codebook-based 8Tx PUSCH - codebook1: This is the UE capability signaling to indicate supporting full coherent 8 Tx PUSCH * Support of codebook-based 8Tx PUSCH – codebook2: This is the UE capability signaling to indicate supporting partial coherent 8 Tx PUSCH with two antenna groups (4+4 structure) * Support of codebook-based 8Tx PUSCH – codebook3: This is the UE capability signaling to indicate supporting partial coherent 8 Tx PUSCH with 4 antenna groups (2+2+2+2 structure) * Support of codebook-based 8Tx PUSCH – codebook4: This is the UE capability signaling to indicate supporting non coherent 8 Tx PUSCH   With current independent signaling UE features, for each codebook, a UE can indicate support that codebook with what kind of SRS. For example, with coherent codebook 1, a UE can signal the one of the following 2 combinations.   * Combination 1: the UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS * Combination 2: the UE support coherent 8Tx PUSCH (codebook 1) with noTDMed and TDMed SRS   As another example, with noncoherent codebook 4, a UE can signal the one of the following 2 combinations   * Combination 3: the UE support noncoherent 8 Tx PUSCH (codebook 4) with noTDMed SRS * Combination 4: the UE support noncoherent 8Tx PUSCH (codebook 4) with noTDMed and TDMed SRS   However, what missing is a “joint” capability signaling of coherence type and SRS type. For example, a UE might want to signaling the following:   * The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS.   As mentioned above, the rationale for this signaling is because coherency with TDMed SRS is a newer, and likely more challenging, requirement than coherentcy with nonTDMed (legacy) SRS. A UE can support coherency with legacy nonTDMed SRS may not be able to support coherency with the new TDMed SRS.  In LS R4-2403632, RAN 4 also send the following message to RAN 1.  Additionally, RAN4 further discussed coherence between PUSCH and 8-ports SRS with partial dropping. The approved reply LS of R4-2321728 says that “Some UEs may be capable to achieve coherence across TDM’d SRS and some UE may not” in the answer for Question 1. It is RAN4’s understanding that the current capability wouldn’t allow a UE to indicate that the UE supports codebook 1 with not TDMed SRS, while the same UE can also support codebook 2, 3, or 4 with TDM’d SRS. If the RAN4 understanding is correct, RAN4’d like to request RAN1 to consider allowing UE to indicate the above mentioned cases, details are up to RAN1.  With the above reasoning, it is proposed to add a UE capability signaling to differentiate the coherency with and without TDMed SRS. Taking all 4 codebooks into consideration, we want a “joint” capability signaling of coherence type and SRS type which allows the UE to signaling one of the following.   * Joint signaling value 1: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 2) with TDMed SRS * Joint signaling value 2: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 3) with TDMed SRS * Joint signaling value 3: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS * Joint signaling value 4: The UE support partial coherent 8 Tx PUSCH (codebook 2) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 3) with TDMed SRS * Joint signaling value 5: The UE support partial coherent 8 Tx PUSCH (codebook 2) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS * Joint signaling value 6: The UE support partial coherent 8 Tx PUSCH (codebook 3) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS   One should notice that the existing UE capability can already support signaling values such as “The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, and the UE support coherent 8 Tx PUSCH (codebook 1) with TDMed SRS as well”. Therefore, there is no need to add those values in the new UE capability.  Based on the above analysis, the following proposal is proposed.  **Proposal 2.2: for codebook based 8-Tx PUSCH, add a UE feature group as 40-7-1h under 40-7-1 family. The new UE feature group signals the supported codebook type and SRS type jointly with the following candidate values.**   * **Candidate value 1: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 2) with TDMed SRS** * **Candidate value 2: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 3) with TDMed SRS** * **Candidate value 3: The UE support coherent 8 Tx PUSCH (codebook 1) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS** * **Candidate value 4: The UE support partial coherent 8 Tx PUSCH (codebook 2) with noTDMed SRS, but only support partial coherent 8 Tx PUSCH (codebook 3) with TDMed SRS** * **Candidate value 5: The UE support partial coherent 8 Tx PUSCH (codebook 2) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS** * **Candidate value 6: The UE support partial coherent 8 Tx PUSCH (codebook 3) with noTDMed SRS, but only support noncoherent 8 Tx PUSCH (codebook 4) with TDMed SRS** |

## NR\_pos\_enh2

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| 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | For dedicated RP, there was discussion on PSCCH decoding capability since 15-1 was removed from the prerequisite FG. In our view, the parameter is related to the slot structure of the dedicated RP, where PSCCH candidates are equal to the number of SL-PRS resources, instead of the overall BW.  In our view, two typical values should be enough, and our suggestion is to take {4, 8}.  **Proposal Pos-4: Update FG 41-1-3 as follows**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {4,8}  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling | |
| Intel Corporation [4] | *For the component on number of PSCCH UE can receive in a slot, due to the 1:1 mapping between PSCCH in a given subchannel and associated SL PRS in the slot, it is sufficient for a UE to only support reception of X = floor (NRB /10 RBs) in a slot. This can be directly captured in the component column instead of defining candidates for component 2.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X = floor (NRB /10 RBs) PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  ~~Component 3 candidate values: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}~~  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling | |
| Samsung [5] |  |
| Vivo [6] | But considering the agreement of dedicated resource pool as follows, there is not need to support decoding two PSCCHs for one subchannel since only one-to-one maping is supported between PSCCH and SL PRS. So, we propose only the first candidate value can be supported.   |  | | --- | | Agreement  For dedicated resource pool, with regards to the SL-PRS configuration and/or SL-PRS time assignment information, support Alt. 3.1, i.e.   * support a one-to-one mapping relationship between a PSCCH resource and an associated SL-PRS resource in the same slot.   + Note: In this case, there is no need of an explicit signaling of which SL PRS resource for the same slot   + Note: Same number of PSCCH resource(s) and SL-PRS resource(s) |  * ***Modify candidate values of FG 41-1-3 as follows:***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {[floor (NRB /10 RBs),]}  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  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling | |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling | |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | In previous meetings, the basic FGs have been agreed on sidelink positioning. On top of the agreed FGs, we further provide our views.  For FG 41-1-3, the number of PSCCH in a slot that a UE can receive is still unsettled. The following capabilities in FG 41-1-1 and FG 15-1 may be used as reference:   |  |  | | --- | --- | | **UE feature description** | **Note/Analysis** | | **FG 41-1-1**  2. Maximum number of active SL PRS resources across all configured RPs in a slot assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  Component 2 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64, 128} for each SCS: 60kHz, 120kHz | There is one-to-one mapping relationship between PSCCH resource and SL PRS resource. From this point of view, the maximum number of SL PRS resources that a UE can receive in a slot should be equal to the maximum number of PSCCH that a UE can receive in a slot.  However, the “active SL PRS resource” in component 2: SL PRS resource is considered as active starting at the end of the last symbol of the PSCCH carrying the SCI trigger and the occupancy is released at the end of timeline indicated in component 4 in FG 41-1-4. The number supported in component 2 can not directly be used for FG 41-1-3. | | **FG 15-1**  2) UE can receive X PSCCH in a slot.  Component-2 candidate value set: {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}  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 | The number is related to the number of RBs defined per channel bandwidth and the minimum RB number of a subchannel. |   Based on the above analysis, we support to reuse the number reported in FG 15-1.  ***Proposal 2-1****: For FG 41-1-3,* the candidate value of component 3 is: {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}   * *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   More detailed suggestion can be found as follows where the revised part is marked in tracking mode.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}  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  Component 4 candidate values:  CP length: {NCP,NCP and ECP} | Optional with capability signaling | |
| NTT DOCOMO, INC. [14] | For FG41-1-3, RAN1 agreed to add component 3 and 4 at the last meeting. Component 3 is a same component as FG 15-1, which provides a capability of receiving legacy NR sidelink. We think in sidelink positioning, same candidate value for same component should be reused as much as possible, in terms of the compatibility. Therefore, the candidate value for component 3 should be the same value as FG 15-1, {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}.  **Proposal 4: For FG41-1-3, support to remove the bracket as ~~[~~floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)~~]~~** |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | **Proposal 5.1: With regards to the FG 41-1-3, support the component 3 candidate values captured in the spreadsheet: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 41. NR\_pos\_enh2 | 41-1-2 | Receiving SL-PRS in a shared resource pool | 1. Support SL-PRS in shared resource pool  2. Support receiving SCI format 2D | 15-1 41-1-1 | Yes | No | Receiving SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}  Component 4 candidate values:   * CP length: {NCP,NCP and ECP} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D | 15-2 or 15-3, 41-1-2 | Yes | No | Transmitting SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | The supported resource allocation modes are the same as for communication and signaled in FGs 15-2 and 15-3  Need for location server/UE to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4b | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated SL PRS resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  4. Support receiving DCI format 3\_2  5. Support downlink pathloss based open loop power control of SL-PRS | 41-1-3 | Yes | No | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/UE to know if the feature is supported  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 | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4c | Transmitting SL-PRS mode 2 in a dedicated resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B | at least one of {41-1-8, 41-1-10} | Yes | No | Transmitting SL-PRS mode 2 in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-17 | Open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool | Support of open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool for unicast transmissions | at least one of 41-1-4b or 41-1-4c | Yes | Yes | Open loop SL power control and SL RSRP report for dedicated resource pool is not supported for unicast transmissions | Per band | n/a | n/a | n/a |  | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | For SL-PRS transmission request, there is no interest in introduce a new UE capability, and thus we suggest to capture that in the component of the existing FGs.  **Proposal Pos-3: Update FG 41-1-2, 41-1-3, 41-1-4a, 41-1-4b, 41-1-4c as follows**   |  |  |  |  | | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-2 | Receiving SL-PRS in a shared resource pool | 1. Support SL-PRS in shared resource pool  2. Support receiving SCI format 2D  Note: UE shall also support receiving SL PRS transmission request included SCI format 2D | | 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  Note: UE shall also support receiving SL PRS transmission request included SCI format 1B | | 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D  Note: UE shall also support sending SL PRS transmission request included SCI format 2D | | 41. NR\_pos\_enh2 | 41-1-4b | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated SL PRS resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  4. Support receiving DCI format 3\_2  5. Support downlink pathloss based open loop power control of SL-PRS  Note: UE shall also support sending SL PRS transmission request included SCI format 1B | | 41. NR\_pos\_enh2 | 41-1-4c | Transmitting SL-PRS mode 2 in a dedicated resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  Note: UE shall also support sending SL PRS transmission request included SCI format 1B | |
| Intel Corporation [4] | * *In Rel-17, the feature for open loop power control for sidelink communication was added based on the RAN1 LS in R1-2208121* ***Error! Reference source not found.*** *and thus was not part of the feature list that RAN1 usually gives to RAN2. Thus, there is no FG number representing this feature and it is directly defined in 38.306* ***Error! Reference source not found.****. This feature needs to be added to all Rel-18 sidelink positioning features that required power control as otherwise sidelink positioning might use different power control than sidelink communication when implemented in the same Rel-18 device that supports p0-OLPC-Sidelink-r17. During previous meetings, some concerns have been expressed to make it a prerequisite since it is an optional capability in Rel-17. Accordingly, it is proposed to add the note for FGs 41-1-4a, 41-1-4b, 41-1-17: “If UE indicates support of p0-OLPC-Sidelink-r17, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission”.*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D | 15-2 or 15-3, 41-1-2 | Yes | No | Transmitting SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | The supported resource allocation modes are the same as for communication and signaled in FGs 15-2 and 15-3.  Need for location server/UE to know if the feature is supported  Note: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission. | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-4b | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated SL PRS resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  4. Support receiving DCI format 3\_2  5. Support downlink pathloss based open loop power control of SL-PRS | 41-1-3 | Yes | No | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/UE to know if the feature is supported  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: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission. | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-17 | Open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool | Support of open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool for unicast transmissions | at least one of 41-1-4b or 41-1-4c | Yes | Yes | Open loop SL power control and SL RSRP report for dedicated resource pool is not supported for unicast transmissions | Per band | n/a | n/a | n/a | Note: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission. | Optional with capability signaling | |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | Furthermore, the following proposals were made in the last meeting related to the DL power control of SL PRS and the *p0-OLPC-Sidelink-r17:*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Intel Corporation **Error! Reference source not found.** | *FG 41-1-4a/4b: Add Rel-17 OLPC capability “p0-OLPC-Sidelink-r17” as a prerequisite.*  *In Rel-17, the feature for open loop power control for sidelink communication was added based on the RAN1 LS in R1-2208121* ***Error! Reference source not found.*** *and thus was not part of the feature list that RAN1 usually gives to RAN2. Thus, there is no FG number representing this feature. This feature needs to be added to all Rel-18 sidelink positioning features that required power control as otherwise sidelink positioning might use different power control than sidelink communication when implemented in the same Rel-18 device. Propose to add this by including the parameter “p0-OLPC-Sidelink-r17” to the prerequisite field as this defines the feature in 38.306* ***Error! Reference source not found.****.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D | 15-2 or 15-3, 41-1-2, *p0-OLPC-Sidelink-r17* | Yes | No | Transmitting SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | The supported resource allocation modes are the same as for communication and signaled in FGs 15-2 and 15-3  Need for location server/UE to know if the feature is supported | Optional with capability signaling | | | Intel Corporation **Error! Reference source not found.** | * *Add Rel-17 OLPC capability “p0-OLPC-Sidelink-r17” as a prerequisite.* * *Confirm WA that Reporting type is per band.* * *In Rel-17, the feature for open loop power control for sidelink communication was added based on the RAN1 LS in R1-2208121* ***Error! Reference source not found.*** *and thus was not part of the feature list that RAN1 usually gives to RAN2. Thus, there is no FG number representing this feature. This feature needs to be added to all Rel-18 sidelink positioning features that required power control as otherwise sidelink positioning might use different power control than sidelink communication when implemented in the same Rel-18 device. Propose to add this by including the parameter “p0-OLPC-Sidelink-r17” to the prerequisite field as this defines the feature in 38.306* ***Error! Reference source not found.****.*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-10 | Support of full sensing in a dedicated resource pool | 1. UE can transmit SL-PRS and associated PSCCH using full sensing  2. Support DL pathloss based open loop power control when configured by NR Uu | ~~FFS~~  41-1-3, *p0-OLPC-Sidelink-r17* | Yes | No | UE cannot transmit SL-PRS using full sensing in a dedicated resource pool | WA: Per band] | n/a | n/a | n/a | 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 2 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 signaling | | | Intel Corporation **Error! Reference source not found.** | *Add Rel-17 OLPC capability “p0-OLPC-Sidelink-r17” as a prerequisite.*  *In Rel-17, the feature for open loop power control for sidelink communication was added based on the RAN1 LS in R1-2208121* ***Error! Reference source not found.*** *and thus was not part of the feature list that RAN1 usually gives to RAN2. Thus, there is no FG number representing this feature. This feature needs to be added to all Rel-18 sidelink positioning features that required power control as otherwise sidelink positioning might use different power control than sidelink communication when implemented in the same Rel-18 device. Propose to add this by including the parameter “p0-OLPC-Sidelink-r17” to the prerequisite field as this defines the feature in 38.306* ***Error! Reference source not found.****.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-17 | Open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool | Support of open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool for unicast transmissions | at least one of 41-1-4b or 41-1-4c, *p0-OLPC-Sidelink-r17* | Yes | Yes | Open loop SL power control and SL RSRP report for dedicated resource pool is not supported for unicast transmissions | Per band | n/a | n/a | n/a |  | Optional with capability signaling | |   Based on the above, it was proposed last meeting to include the *p0-OLPC-Sidelink-r17* as a prerequisite in the FGs 41-1-4a/4b/10/17, which are related to transmission of SL PRS and power control. However, if we follow this proposal, the UE would be forced to support the updated RRC range for SL positioning open control, if it wants to support SL positioning, but doesn’t have to support the new range if it only wants to support SL communications. We think that this aspect can be clarified by just adding a note to FGs 41-1-4a/4b/10 (but not 41-1-17 which is related to SL power control):  **Proposal 5.3:** **With regards to FG 41-1-4a/4b/10, and the need for the addition of**  *p0-OLPC-Sidelink-r17* **as a prerequisite, we support to add a corresponding note as follows:**   * **If the UE reports the** *p0-OLPC-Sidelink-r17 ,* **then this feature also applies to each of the FG 41-1-4a/4b/10 SL PRS transmission.** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 41. NR\_pos\_enh2 | 41-1-7a | SL PRS measurement for SL-RSTD | 1. Support SL RSTD measurement based on SL-PRS  2. Support SL RSTD measurement reporting  3. Maximum number of SL RSTD measurement reporting for different SL-PRS reception for the same pair of UEs | 41-1-1 | No | No | UE does not support SL PRS measurement for SL-RSTD | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Compoonent 3 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-7c | SL PRS measurement for UE Rx – Tx time difference without Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting without Tx time stamp  3. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs] | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for Rx – Tx time difference without Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-7d | SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting with Tx time stamp  3. Reporting M Rx-Tx measurements for the same SL-PRS transmission (or reception) and different SL-PRS reception (or transmission) for the same pair of UEs  4. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs] | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values of M={1,2,3,4}  Component 4 candidate values: {1,2,3,4} | Optional with capability signaling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *Correct typo:* Compo~~o~~nent 3 candidate values: {1,2,3,4}*.* |
| Samsung [5] |  |
| Vivo [6] | * ***Remove typos of component 3 for FG41-1-7c and component 4 for FG41-1-7d as follows:***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-7c | SL PRS measurement for UE Rx – Tx time difference without Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting without Tx time stamp  3. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for Rx – Tx time difference without Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {1,2,3,4} | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-7d | SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting with Tx time stamp  3. Reporting M Rx-Tx measurements for the same SL-PRS transmission (or reception) and different SL-PRS reception (or transmission) for the same pair of UEs  4. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values of M={1,2,3,4}  Component 4 candidate values: {1,2,3,4} | Optional with capability signaling | |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 41. NR\_pos\_enh2 | 41-1-10 | Support of full sensing in a dedicated resource pool | 1. UE can transmit SL-PRS and associated PSCCH using full sensing  2. Support DL pathloss based open loop power control when configured by NR Uu |  | Yes | No | UE cannot transmit SL-PRS using full sensing in a dedicated resource pool | Per band | n/a | n/a | n/a | 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 2 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: UE supporting this FG also support receiving SCI format 1B | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In addition, for full sensing, UE should also decode PSCCH for sensing purpose, a component corresponding to PSCCH decoding should also be added.  **Proposal Pos-5: Update FG 41-1-3 as follows**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-10 | Support of full sensing in a dedicated resource pool | 1. UE can transmit SL-PRS and associated PSCCH using full sensing  2. Support DL pathloss based open loop power control when configured by NR Uu  3. UE can receive X PSCCH in a slot |  | Yes | No | UE cannot transmit SL-PRS using full sensing in a dedicated resource pool | Per band | n/a | n/a | n/a | Component 3 candidate values: {4,8}  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 2 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: UE supporting this FG also support receiving SCI format 1B | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 41. NR\_pos\_enh2 | 41-2-6 | Support associating a single Rx-Tx or RSTD measurement with up to N\_sample RSCP/RSCPD measurement | Support associating a single Rx-Tx or RSTD measurement with up to N\_sample RSCP/RSCPD measurement | At least one of {41-2-1, 41-2-1a, or 41-2-2, 41-2-2a} | No | N.A. | The UE can only associate a single Rx-Tx or RSTD measurement with 1 RSCP/RSCPD measurement | Per band | N.A. | N.A. | N.A. | Need for location server to know if the feature is supported. | Optional with capability signaling. |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] | For FG 41-2-6, there is an FFF on the prerequisite feature groups: “FFS At least one of {41-2-1, 41-2-1a, or 41-2-2, 41-2-2a}”. We suggest removing the FFS, since it is clear for a UE that support FG 41-2-6, it needs to support at least one of 41-2-1, 41-2-1a, 41-2-2 and 41-2-2a.  **Proposal 1: For FG 41-2-6, make the following changes:**   * **At least one of {41-2-1, 41-2-1a, or 41-2-2, 41-2-2a}** |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 41. NR\_pos\_enh2 | 41-2-8 | Support to perform legacy measurements inside the indicated time window only for DL TDoA | Support to perform legacy measurements inside the indicated time window only | 13-3a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for legacy measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-2-9 | Support to perform legacy measurements inside the indicated time window only for multi-RTT | Support to perform legacy measurements inside the indicated time window only | 13-4a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for legacy measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-2-10 | Support to perform legacy measurements inside the indicated time window only for DL AoD | Support to perform legacy measurements inside the indicated time window only | 13-2a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for legacy measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] | For the description of legacy measurement, the legacy measurement may include RSTD measurement, RSRP measurement, and RSRPP measurement for DL TDOA. So, we prefer to update the legacy measurement as PRS measurement, and add a note to further explain what is PRS measurement.  Therefore, we propose   * ***Update FG 41-2-8/9/10 as follows***    + ***Replace “ legacy measurement” with “PRS measurement”, and add a note to further explain what is PRS measurement***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-2-8 | Support to perform PRS measurements inside the indicated time window only for DL TDoA | Support to perform PRS measurements inside the indicated time window only for DL TDoA | 13-3a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for PRS measurements for DL TDoA in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported  Note: the PRS measurement includes RSTD measurement at least, and optionally includes RSRP and/or RSRPP measurement, | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-2-9 | Support to perform PRS measurements inside the indicated time window only for multi-RTT | Support to perform PRS measurements inside the indicated time window only for multi-RTT | 13-4a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for PRS measurements for multi-RTT in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported  Note: the PRS measurement includes Rx-Tx measurement at least, and optionally includes RSRP and/or RSRPP measurement, | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-2-10 | Support to perform PRS measurements inside the indicated time window only for DL AoD | Support to perform PRS measurements inside the indicated time window only for DL AoD | 13-2a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for PRS measurements for DL AoD in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported  Note: the PRS measurement includes RSRP measurement at least, and optionally includes RSRPP measurement, | Optional with capability signaling | |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | **Proposal 5.7: With regards to the FG 41-2-8/9/10, remove the word “legacy” as follows:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-2-8 | Support to perform DL PRS-RSRP, DL PRSR-RSRPP, DL RSTDmeasurements inside the indicated time window only for DL TDoA | Support to perform measurements inside the indicated time window only | 13-3a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-2-9 | Support to perform DL PRS-RSRP, DL PRSR-RSRPP, UE Rx-Tx measurements inside the indicated time window only for multi-RTT | Support to perform measurements inside the indicated time window only | 13-4a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-2-10 | Support to perform DL PRS-RSRP, DL PRSR-RSRPP measurements inside the indicated time window only for DL AoD | Support to perform measurements inside the indicated time window only | 13-2a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling | |

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| 41. NR\_pos\_enh2 | 41-2-11 | Finer timing reporting granularity for PRS measurement | Supported ReportingGranularityfactors -1 >= X |  | No | N.A. | Reporting Granularity cannot be signalled | Per band | N.A. | N.A. | N.A. | Component 1 candidate values for X: {-6, -5, -4, -3, -2, -1}  Need for location server to know if the feature is supported | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | The following FG was wrongly captured during the online editing, and we suggest to correct the description.  **Proposal Pos-6: Update FG 41-2-11 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-2-11 | Finer timing reporting granularity for PRS measurement | Supported ReportingGranularityfactors X |  | No | N.A. | Reporting Granularity cannot be signalled | Per band | N.A. | N.A. | N.A. | Component 1 candidate values for X: {-6, -5, -4, -3, -2, -1}  Note: UE shall be able to support the granularity values larger than or equal to X  Need for location server to know if the feature is supported | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] | |  | | --- | | Agreement  From RAN1’s perspective, the granularity with *ReportingGranularityfactor* *k={-1, -2}* for the reporting of DL/UL timing measurements is applicable to all positioning methods.  Agreement  The new *ReportingGranularityfactor* also supports k = {-3, -4, -5, -6} in addition to {-1, -2}   * These k values are applicable for timing measurements for all applicable positioning methods   + Support for both DL and UL   + Support for both FR1 and FR2 * Reply the RAN4 LS R1-2310797, and CC to RAN2 and RAN3. |   Based on the above agreement, we can find the feature is needed when ReportingGranularityfactor k={-1, -2,-3, -4, -5, -6}. But based on the following UE feature, ReportingGranularityfactors can be reported when all the supported values larger than or equal to 0{i.e., ReportingGranularityfactors -1>=-1 if X=-1}.  So, we propose   * ***Update FG 41-2-11 as follows***    + ***Remove “-1” in the description and change the description to “Supported ReportingGranularityfactors>= X”***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-2-11 | Finer timing reporting granularity for PRS measurement | Supported ReportingGranularityfactors>= X |  | No | N.A. | Reporting Granularity cannot be signalled | Per band | N.A. | N.A. | N.A. | Component 1 candidate values for X: {-6, -5, -4, -3, -2, -1}  Need for location server to know if the feature is supported | Optional with capability signaling | |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | In previous meetings, the basic FGs have been agreed for carrier phase positioning. On top of the agreed FGs, we further provide our views.  *Proposal 2-2: For CPP*   * *For FG 41-2-11, the supported ReportingGranularityfactors should be greater than or equal to X.*   More detailed revision can be found as follows where the revised part is marked in tracking mode.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-2-11 | Finer timing reporting granularity for PRS measurement | Supported ReportingGranularityfactors >= X |  | No | N.A. | Reporting Granularity cannot be signalled | Per band | N.A. | N.A. | N.A. | Component 1 candidate values for X: {-6, -5, -4, -3, -2, -1}  Need for location server to know if the feature is supported | Optional with capability signaling | |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

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| 41. NR\_pos\_enh2 | 41-3-3 | Support of PRS measurement in RRC\_IDLE | Support of DL PRS measurement in RRC\_IDLE for Rel. 17 methods the UE supports in RRC\_INACTIVE | 13-1, at least one of {27-18a, 27-18b, 27-6} | No | n/a | PRS measurements in RRC\_IDLE not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling. |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] | |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 27. NR\_pos\_enh | 27-18a | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA - location server | 13-3, 27-6 | No |  | PRS measurement in RRC\_INACTIVE state for DL-TDOA is not supported | per band | n/a | | 27. NR\_pos\_enh | 27-18b | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD - location server | 13-2, 27-6 | No |  | PRS measurement in RRC\_INACTIVE state for DL-AoD is not supported | per band | n/a |   Based on the prerequisite feature 27-18a, 27-18b, the Rel.17 method in 41-3-3 are DL-TDOA and DL-AoD  So, we propose   * ***Update FG 41-3-3 as follows***    + ***Replace the “Rel. 17 methods” with “DL-TDOA and/or DL-AoD”***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-3-3 | Support of PRS measurement in RRC\_IDLE | Support of DL PRS measurement in RRC\_IDLE for DL-TDOA and/or DL-AoD the UE supports in RRC\_INACTIVE | 13-1, at least one of {27-18a, 27-18b, 27-6} | No | n/a | PRS measurements in RRC\_IDLE not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling. | |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | **Proposal 5.6: With regards to the FG 41-3-3, the 27-6 (DL PRS processing capabilities in RRC inactive) should be a prerequisite outside the “at least {}” brackets. That is, support the following change:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-3-3 | Support of PRS measurement in RRC\_IDLE | Support of DL PRS measurement in RRC\_IDLE for Rel. 17 methods the UE supports in RRC\_INACTIVE | 13-1, at least one of {27-18a, 27-18b }, 27-6 | No | n/a | PRS measurements in RRC\_IDLE not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling. | |

**Other**

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| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1 UE feature list, there are some components without candidate values. For example   * Component 8 of FG 41-4-6: Support the same SRS power reduction across aggregated carriers * Component 8 of FG 41-4-7: Support the same SRS power reduction across aggregated carriers * Component 8 of FG 41-4-8: Support the same SRS power reduction across aggregated carriers  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | …  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers | 13-8, 6-6 | Yes | n/a | Positioning SRS bandwidth aggregation in RRC\_CONNECTED is not supported | Per FS | n/a | n/a | n/a | …  Component 7 candidate values:  Periodic: {1,2,3,4,5,6,8,10,12,14}  Aperiodic: {0,1,2,3,4,5,6,8,10,12,14}  Semi-persistent: {0,1,2,3,4,5,6,8,10,12,14}  Note: For component 1, it shall be less than or equal to the maximum number of the component carrier associated with IE ca-BandwidthClassUL-NR.  … | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | …  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  … | 13-8 | Yes | n/a | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED is not supported | Per FS | n/a | n/a | n/a | …  Component 7 candidate values:  Periodic: {1,2,3,4,5,6,8,10,12,14}  Aperiodic: {0,1,2,3,4,5,6,8,10,12,14}  Semi-persistent: {0,1,2,3,4,5,6,8,10,12,14}  Component 9 candidate values: {0, 30, 100, 140, 200} | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-4-8 | Positioning SRS bandwidth aggregation in RRC\_INACTIVE | …  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  … | 27-15b | Yes | n/a | Positioning SRS bandwidth aggregation in RRC\_INACTIVE is not supported | Per band | n/a | n/a | n/a | …  Component 7 candidate values:  Periodic: {1,2,3,4,5,6,8,10,12,14}  Semi-persistent: {0,1,2,3,4,5,6,8,10,12,14}  Component 9 candidate values: {0, 30, 100, 140, 200}  … | Optional with capability signaling |   These components are only for the sake of indicating the mandatory part of the feature group without dedicated signalling, otherwise, it should be another FG.  However, in RAN2 RRC/LPP signalling, RAN2 introduced an optional field supportOfSameSRS-PowerReduction-r18, indicating that UE may be able not to support, which is not aligned with RAN1 intention.  PosSRS-BWA-RRC-Connected-r18 ::= SEQUENCE {  numOfCarriersIntraBandContiguous-r18 ENUMERATED {two, three, twoandthree} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200, mhz300} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800, mhz1000, mhz1200}  OPTIONAL,  maximumAggregatedResourceSet-r18 ENUMERATED {n1, n2, n4, n8, n12, n16} OPTIONAL,  maximumAggregatedResourcePeriodic-r18 ENUMERATED {n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourceAperiodic-r18 ENUMERATED {n0, n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourceSemi-r18 ENUMERATED {n0, n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourcePeriodicPerSlot-r18 ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  maximumAggregatedResourceAperiodicPerSlot-r18 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  maximumAggregatedResourceSemiPerSlot-r18 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  supportOfSameSRS-PowerReduction-r18 ENUMERATED {supported} OPTIONAL,  ...  }  PosSRS-BWA-IndependentCA-RRC-Connected-r18 ::= SEQUENCE {  numOfCarriersIntraBandContiguous-r18 ENUMERATED {two, three, twoandthree} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200, mhz300} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800, mhz1000, mhz1200}  OPTIONAL,  maximumAggregatedResourceSet-r18 ENUMERATED {n1, n2, n4, n8, n12, n16} OPTIONAL,  maximumAggregatedResourcePeriodic-r18 ENUMERATED {n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourceAperiodic-r18 ENUMERATED {n0, n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourceSemi-r18 ENUMERATED {n0, n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourcePeriodicPerSlot-r18 ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  maximumAggregatedResourceAperiodicPerSlot-r18 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  maximumAggregatedResourceSemiPerSlot-r18 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  supportOfSameSRS-PowerReduction-r18 ENUMERATED {supported} OPTIONAL,  guardPeriod-r18 ENUMERATED {ms0, ms30, ms100, ms140, ms200} OPTIONAL,  ...  }  PosSRS-BWA-RRC-Inactive-r18 ::= SEQUENCE {  numOfCarriersIntraBandContiguous-r18 ENUMERATED {two, three, twoandthree} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200} OPTIONAL,  maximumAggregatedBW-TwoCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR1-r18 ENUMERATED {mhz80, mhz100, mhz160, mhz200, mhz300} OPTIONAL,  maximumAggregatedBW-ThreeCarriersFR2-r18 ENUMERATED {mhz50, mhz100, mhz200, mhz400, mhz600, mhz800, mhz1000, mhz1200} OPTIONAL,  maximumAggregatedResourceSet-r18 ENUMERATED {n1, n2, n4, n8, n12, n16} OPTIONAL,  maximumAggregatedResourcePeriodic-r18 ENUMERATED {n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourceSemi-r18 ENUMERATED {n0, n1, n2, n4, n8, n16, n32, n64} OPTIONAL,  maximumAggregatedResourcePeriodicPerSlot-r18 ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  maximumAggregatedResourceSemiPerSlot-r18 ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8, n10, n12, n14} OPTIONAL,  supportOfSameSRS-PowerReduction-r18 ENUMERATED {supported} OPTIONAL,  guardPeriod-r18 ENUMERATED {ms0, ms30, ms100, ms140, ms200} OPTIONAL,  ...  }  In addition, for a FG with multiple components, all components should be mandatory, otherwise, it implies that UE may choose not to support a component.  **Proposal Pos-1: Send an LS to RAN2 that for positioning UE feature**   * **A component in a FG without candidate values means that UE shall support it without any additional signalling.**   1. **For example, component 8 of FG 41-4-6/7/8 does not need any signaling.** * **Components in a FG with candidate values (i.e. requires capability signaling) should be mandatory.**   In RAN1#116bis, the following agreement was reached during the maintenance phase of SL positioning.   |  | | --- | | Agreement  For a band configured with SL CA, confirm the related working assumption from RAN1 #116 with the introduction of the following new UE capabilities:   * + One UE capability for SL PRS transmission for a band configured with SL CA   + One UE capability for SL PRS reception for a band configured with SL CA   + Note: there will not be two separate FG components for shared RP and dedicated RP |   Based on the agreement, we suggest to introduce the following FGs.  **Proposal Pos-2: Introduce the following FGs.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-xx | Supports SL PRS Rx for a band configured with SL CA | 1. Support of SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-2 or 41-1-3}  47-v1 | Yes | No | UE does not support SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-xx | Supports SL PRS Tx for a band configured with SL CA | 1. Support of SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-4a, 41-1-4b or 41-1-4c}  47-v1 | Yes | No | UE does not support SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling | |
| Intel Corporation [4] | *Add two new rows corresponding to* ***FGs 41-1-20a*** *and* ***41-1-20b*** *to capture support of SL PRS transmission and reception (respectively) for a band configured with SL CA.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-20a | SL PRS transmission for a band configured with SL CA | Support SL PRS transmission for a band configured with SL CA | 47-v1 | Yes | Yes | SL PRS transmission for a band configured with SL CA is not supported | Per band | N.A. | N.A. | N.A. | Need for location server/UE to know if the feature is supported.  Note: In a shared SL PRS resource pool in a single SL carrier: Tx power control follows the rule defined for SL CA in NR Rel-18.  Note: In a dedicated SL PRS resource pool in a single SL carrier when the slots (pre)configured for the dedicated SL PRS resource pool do not collide with the slots (pre)configured for any other resource pool or S-SSB resource(s) in other carriers. | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-20b | SL PRS reception for a band configured with SL CA | Support SL PRS reception for a band configured with SL CA | 47-v1 | Yes | Yes | SL PRS reception for a band configured with SL CA is not supported | Per band | N.A. | N.A. | N.A. | Need for location server/UE to know if the feature is supported.  Note: In a shared SL PRS resource pool in a single SL carrier: Tx power control follows the rule defined for SL CA in NR Rel-18.  Note: In a dedicated SL PRS resource pool in a single SL carrier when the slots (pre)configured for the dedicated SL PRS resource pool do not collide with the slots (pre)configured for any other resource pool or S-SSB resource(s) in other carriers. | Optional with capability signaling | |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | An LTE or LTE V2X device might support NR SL Positioning without having to do NR SL communications. In that case, the UE will have to report the SL PRS capabilities through the LTE network, i.e., through the LTE UE feature list. We propose to capture a subset of the sidelink positioning features as LTE features as was done for sidelink communications in previous releases.  **Proposal 5.2: Capture the following FGs in the LTE UE feature list: 41-1-1, 41-1-1a, 41-1-2, 41-1-3, 41-1-4c, 41-1-4d, 41-1-5, 41-1-7x, 41-1-8, 41-1-10, 41-1-11, 41-1-12, 41-1-12, 41-1-13, 41-1-13b, 41-1-14, 41-1-18, 41-1-19, 41-1-20a, 41-1-20b.**  Furthmore, the following agreement was reached last meeting:   |  | | --- | | Agreement  For a band configured with SL CA, confirm the related working assumption from RAN1 #116 with the introduction of the following new UE capabilities:   * + One UE capability for SL PRS transmission for a band configured with SL CA   + One UE capability for SL PRS reception for a band configured with SL CA   + Note: there will not be two separate FG components for shared RP and dedicated RP |   Based on the above, we make the following proposal:  **Proposal 5.4: Introduce the following 2 new FGs related to SL PRS transmission/reception in a band configured with SL**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-20a | Supports SL PRS reception for a band configured with SL CA | 1. Support of SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-2 or 41-1-3}, 47-v1 | Yes | No | UE does not support SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling | | 41. NR\_pos\_enh2 | 41-1-20b | Supports SL PRS tranmsission for a band configured with SL CA | 1. Support of SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-4a, 41-1-4b or 41-1-4c}, 47-v1 | Yes | No | UE does not support SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling |   With regards to the introduction or not of a dedicated FG for “SL-PRS transmission request in physical layer”, we make the following Notes:   * The following was agreed related to the SL PRS lower layer request:  |  |  | | --- | --- | | Agreement  In Scheme 2, with regards to the SCI-based triggering of SL-PRS, the following WA is confirmed:   |  | | --- | | Working assumption  In Scheme 2, with regards to the triggering of SL-PRS, for the SCI-based triggering, the SL-PRS request, in either SCI-1B or SCI-2D, is an explicit field   * If (pre-)configured per resource pool, then 1 bit is used, otherwise, it is 0 bits | |  * Independent of whether there is a separate FG for this request or not, we need to come to a common understanding on how the “SL PRS triggering” would work, especially related to the following scenarios:   + In the case of SL-TDOA (DL-like SL-TDOA),     - if a receiving target UE does not support transmission of SL-PRS (i.e.only supports receiving of SL-PRS), how can that UE ask an anchor to start transmitting SL-PRS?     - If an anchor doesn’t support SL-PRS reception and the target UE supports SL-PRS transmission, how can the anchor receive the request from a target UE?   + If a resource pool is deployed with the SL PRS triggering bit to 0, then, if in the future, that resource pool is intended to be used for RTT, then, it will not be possible, unless there is a higher layer mechanism also specified.   **Observation 5.1: With regards to the introduction or not of a dedicated FG for “SL-PRS transmission request in physical layer”, an LS needs to be sent to RAN2 to inquire whether there is a higher layer mechanism for a UE to request the SL PRS transmission from another UE.**  **Proposal 5.5: With regards to the “SL-PRS transmission request in physical layer”,**   * **support the introduction of such a FG:**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-21 | SL-PRS transmission request in physical layer | 1. Support transmitting SL-PRS transmission request via SCI  2. Support receiving SL-PRS transmission request via SCI |  | No | Yes | SL-PRS transmission request in physical layer cannot be signalled | Per band | No | No | No |  | Optional with capability signaling |  * **Send an LS to RAN2 to inquire on the specification support of higher layer mechanism for a UE to request the SL PRS transmission from another UE.** |

## Netw\_Energy\_NR

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 42. Netw\_Energy\_NR | 42-1 | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for periodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values: SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values: SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUSCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUCCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values:  SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values:  SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values:  SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12} | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2 | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 2 candidate value: {2,3,4}  Component 4 candidate value: {1, 2, 3 … 32}  Component 5 candidate value: {8, 16, 24, … 128 }  Component 6 candidate value: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4} | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting  1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128 }  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4,5,6,7,8,9,10,11,12}  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting on PUCCH  1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128}  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4}  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128 }  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-8 | simultaneousCSI-SubReportsPerCC-r18 | Indicates the number of CSI report(s) for which the UE can measure and process reference signals simultaneously in a CC of the band for which this capability is provided. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsPerCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports | FFS | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per Band | No | No | N/A | Component 1 candidate values: {1, 2, 3, 4, 5, 6, 7, 8}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsPerCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-9 | simultaneousCSI-SubReportsAllCC-r18 | Indicates whether the UE supports CSI report framework and the number of CSI report(s) which the UE can simultaneously process across all CCs, and across MCG and SCG in case of NR-DC. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsAllCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports. This parameter may further limit *simultaneousCSI-SubReportsPerCC-r18* in MIMO-ParametersPerBand and Phy-ParametersFRX-Diff for each band in a given band combination | FFS | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per BC | No | No | N/A | Component 1 candidate values: {5, 6, 7, ..., 32}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsAllCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | **Comments:**   1. Regarding the prerequisite feature groups,    * For FG 42-1/42-1b/42-2/42-2b, since periodic CSI reporting and aperiodic CSI reporting are mandatory capability for NR UEs, and we specifically design the NES feature with willingness of supporting different values from a legacy CSI report capability, there does not expect strong dependences among these FGs, it is not necessary to take FG 2-32 (Basic CSI feedback) and FG 2-35(CSI report framework) as prerequisite feature groups.    * For FG 42-1a/42-1c/42-2a/42-2c, since semi-persistent CSI reporting is optional capability for NR UEs, FG 2-32b (Semi-persistent CSI report on PUSCH) can be added as prerequisite feature groups for 42-1a/42-2a and FG 2-32a (Semi-persistent CSI report on PUCCH) can be added as prerequisite feature groups for 42-1c/42-2c.    * For FG 42-8/42-9, one of FG 42-1/1a/1b/1c/2/2a/2b/2c can be added as prerequisite feature groups as the note.   **Proposal Nes-1: For** **the prerequisite feature groups,**   * **For FG 42-1/42-1b/42-2/42-2b, No prerequisite feature groups are needed.** * **For FG 42-1a/42-2a, add FG 2-32b as the prerequisite feature group.** * **For FG 42-1c/42-2c, add FG 2-32a as the prerequisite feature group.** * **For FG 42-8/42-9, add “one of FG 42-1/1a/1b/1c/2/2a/2b/2c” as the prerequisite feature groups.**  1. Regarding the reporting type, in [2], RAN2 thinks the definition of “across all CCs” for a feature group with “per BC” granularity is clear, but further clarification of “across all CCs” is needed if the feature group’s granularity is per band or per FS. We have raised the same concern in our paper [3] by suggesting reporting the components related to “across all CCs” per BC while other components per band, similar to the legacy UE capability FG 2-33. In RAN1 #115 meeting, the following agreement was reached [4] and the LS [5] had been sent to RAN2.  |  | | --- | | **Agreement: For FGs 42-1/42-1a/42-1b/42-2/42-2a/42-2b**   * **The type is “Per band”** * **Include in the LS to RAN2 that RAN1 kindly asks RAN2 to design the following components per BC**   + **Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs**   + **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs** * **Add the following note: “Note: Components [x] and [y] are signaled per BC” where the values of x and y differ for each FG 42-1/42-1a/42-1b/42-2/42-2a/42-2b**   + **Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs**   + **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs** |     **Proposal Nes-2: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.**  1. Regarding the components 4/5/6/7 for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, the same value should be reported regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).   **Proposal Nes-3: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, add the following note:**   * **Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).**  1. Regarding the component 9) for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,    * In FG 2-35, UE reports the maximum number of CSI report setting supported for different CSI report type (periodic/aperiodic/semi-persistent) individually. So we suggest using “periodic/aperiodic/semi-persistent CSI report” instead of “CSI report” for component 9). For example, the component 9) for FG 42-1 should be: “9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP”.    * For the value of Component 9), the same value should be reported for the same type of CSI report, which means the same value for 41-1/42-1 (periodic CSI report), 42-1b/42-2b (aperiodic CSI report) and 42-1a/42-1c/42-2a/42-2c (semi-persistent CSI report) individually. Moreover, the value reported for 42-1a/42-1c/42-2a/42-2c should be total number of the semi-persistent CSI reporting on PUSCH and PUCCH.   **Proposal Nes-4: For FG 42-1 and FG 42-2, add the following note:**   * **Note: UE shall report the same value for component 9) of FG 42-1 and FG 42-2 (if supported).**   **Proposal Nes-5: For FG 42-1b and FG 42-2b, add the following note:**   * **Note: UE shall report the same value for component 9) of FG 42-1b and FG 42-2b (if supported).**   **Proposal Nes-6: For FG 42-1a/42-1c/42-2a/42-2c, add the following note:**   * **Note: UE shall report the same value for component 9) of FG 42-1a/42-1c/42-2a/42-2c (if supported). And the value should be total number of the semi-persistent CSI reporting on PUSCH and PUCCH.**  1. For FGs 42-1a/1c and 2a /2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. However, If 2. Lmax reported for PUSCH is less than the value of Lmax reported for PUCCH; and 3. the SP-CSI report originally triggered on PUCCH is to be piggybacked on the PUSCH according to the rules in 38.213, when PUCCH carrying SP-CSI report collides with a PUSCH.   it is unclear which restriction/capability (of PUCCH and PUSCH) shall apply for determining the Lmax and N. Hence, to avoid complexity without sacrificing advantages, we propose that Lmax reported for PUSCH should be equal or larger than the value of Lmax reported for PUCCH. And the same restriction should be applied for N.  **Proposal Nes-7: For FG 42-1c, add the following note:**   * **Notes: The value reported for Components 2 and 3 is no larger than the value reported for Components 2 and 3 in FG 42-1a (if supported), respectively.**   **Proposal Nes-8: For FG 42-2c, add the following note:**   * **Notes: The value reported for Components 2 and 3 is no larger than the value reported for Components 2 and 3 in FG 42-2a (if supported), respectively.**  1. For the following two notes of 42-1/42-1a/42-1c/42-1b, it is more accurate to update “configuration” to “all sub-configurations”    * Note: SD-type1 refers to configuration contains one port subset    * Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs   **Proposal Nes-9: For FG 42-1/42-1a/42-1c/42-1b, update the following note:**   * **Note: SD-type1 refers to all sub-configurations contain~~s~~ one port subset** * **Note: SD-type2 refers to all sub-configurations contain~~s~~ list of CSI-RS resource IDs** |
| Intel Corporation [4] |  |
| Samsung [5] | - Regarding limits in FG42-6 for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-6 for joint operation of power domain and spatial domain adaptation. The remaining issue is how to determine limits for the joint operation. If a UE has different capabilities between SD and PD adaptation, i.e., different values for corresponding components between SD and PD adaptation, we prefer to set the limit as a minimum one between different values in order to minimize UE burden.  **Proposal 14: Add a note in FG 42-6 for joint operation of power and spatial domain adaptation that ‘Note: The limit for the joint operation is set as a minimum between values for corresponding components in each SD and PD adaptation’.**  - Regarding FFS in Prerequisite feature groups for FG42-1, FG42-1a/b/c, FG42-2 and FG42-2a/b/c  FG2-33 and FG2-35 can be reused for all FGs related to SD and PD adaptation as baseline. Hence we suggest to include FG2-33 and FG2-35 as prerequisite feature groups of all FGs related to SD and PD adaptation.  **Proposal 15: For all FGs related to SD and PD adaptation, add FG2-33 and FG2-35 as prerequisite feature groups.**  - Regarding Component 9 in FG42-1, FG42-1a/b/c, FG42-2, FG42-2b and Component 8 in FG42-2a/c  Regarding the component 8/9 (“the total number of reporting setting”) in FGs, it is clear that the value is for each report type, and this is associated with UE capability defined in FG2-35. The value of component 8/9 will be used instead of the values for component 1 and 2 in FG2-35, when CSI reporting with sub-configuration for SD and PD adaptation is configured. In case of UE is configured with Rel-18 NES CSI report and legacy CSI report, to be clear the intention of component 8/9, we propose to add Note for component 9 (in FG42-1, FG42-1a/b/c, FG42-2 and FG42-2b) and component 8 (in FG42-2a/c).  **Proposal 16:**  **- Add a note in FG42-1, FG42-1a/b/c, FG42-2 and FG42-2b that ‘Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations’.**  **- Add a note in FG42-2a/c that ‘Note: the value reported in component 8 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations’.**  - Regarding limits in FG42-1a/c and FG42-2a/c when PUCCH and PUSCH are configured  It was agreed in RAN1#116 that FG42-1a and FG42-2a are further split for PUCCH and PUSCH, respectively. The remaining issue is how to determine limits when PUCCH and PUSCH are configured for BWP. We’d like to avoid that both FG42-1a/c have component 9 and both FG42-2a/c have component 8 implying that the number of sub-configurations are counted towards separate limits for PUCCH and PUSCH, which is undesirable for UE complexity.  **Proposal 17:**  **- Add a note in FG42-1a/c that ‘Note: A UE shall declare the same value for component 9 to indicate the combined total limit for PUCCH and PUSCH’.**  **- Add a note in FG42-2a/c that ‘Note: A UE shall declare the same value for component 8 to indicate the combined total limit for PUCCH and PUSCH’.**  - Regarding Component 4, 5, 6, 7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and Component 3, 4, 5, 6 in FG42-2a/c  First of all, it is clear the values in Component 4, 5, 6, 7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and Component 3, 4, 5, 6 in FG42-2a/c are related to Component 4, 5, 6, 7 in FG2-33. Those values in Rel-18 FGs will be used instead of the values for Component 4~7 in FG2-33, when CSI reporting setting(s) with sub-configurations is configured. In case of UE is configured with Rel-18 NES CSI report and legacy CSI report, to be clear the intention of Rel-18 FGs, we propose to add Note for FG42-1, FG42-1a/b/c, FG42-2, FG42-2b and FG42-2a/c.  **Proposal 18:**  **- Add the following notes in FG42-1, 42-1a/b/c, 42-2, 42-2b:**  **= ‘The value reported in component 4 or 5 is used for CC when CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations’.**  **= ‘The value reported in component 6 or 7 is used when CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations’**  **- Add the following notes in 42-2a/c:**  **= ‘The value reported in component 3 or 4 is used for CC when CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations’.**  **= ‘The value reported in component 5 or 6 is used when CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations’**  In terms of components related to maximum number of simultaneous NZP-CSI-RS resource and maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC or in active BWPs across all CCs, it is still unclear how to determine maximum value and how to count number of simultaneous NZP-CSI-RS resource and CSI-RS ports per CC or in active BWPs across all CCs not only when both Rel-18 CSI report and legacy CSI report are configured but also when different types of adaptations or CSI reporting are configured on each CCs and/or each active BWPs in a CC. First, to count NZP-CSI-RS resource and CSI-RS ports, it would be reasonable to count all NZP-CSI-RS resource and CSI-RS ports for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation which is similar as component 9 of FG42-1, FG42-1a/b/c, FG42-2, FG42-2b.  Regarding to determine maximum value of components, we propose to use one value for all these FGs. It would be straightforward way to inherit the philosophy applied for FG2-33 which is a legacy counterpart of all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c.  **Proposal 19:**  **Add a note in all FGs that ‘Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports’.** |
| Vivo [6] |  |
| Apple [7] | At a glance, the issues and proposals we would like to address are:   * Issue 1/ To clarify ‘periodic/semi-persistent/aperiodic’ in CSI report setting   + => Supported total number periodic/semi-persistent/aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic/semi-persistent/aperiodic CSI report settings with sub-configurations per BWP * Issue 2/ Duplicated parameters that should be used commonly across FGs   + => Introduce a new FG “Supported maximum number of simultaneous NZP-CSI-RS resources and total CSI-RS ports”     - 1. Supported maximum number of simultaneous NZP-CSI-RS resources per CC     - 2. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC     - 3. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs     - 4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs   + => Delete above components 1, 2, 3 and 4 from FGs * Issue 3/ Values between semi-persistent CSI reporting on PUSCH and PUCCH   + => UE shall report the same values. * Issue 4/ Values between SD and PD adaptations   + => Minimum values between SD and PD adaptations are assumed.   **Proposal 3-1**:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 42. Netw\_Energy\_NR | 42-1 | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for periodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUSCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-static CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: If UE supports both FG 42-1a and 42-1c,   * UE shall report the same value for component 1 across the FGs. * The minimum values between FGs are assumed for component 2, 3, 8, 9. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUCCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-static CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4}  Note: If UE supports both FG 42-1a and 42-1c,   * UE shall report the same value for component 1 across the FGs. * The minimum values between FGs are assumed for component 2, 3, 8, 9. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across aperiodic CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2 | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 2 candidate value: {2,3,4}  Component 9 candidate values: {2, 3, 4} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting  1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4,5,6,7,8,9,10,11,12}  Note: If UE supports both FG 42-2a and 42-2c,   * UE shall report the same value for component 1 across the FGs. * The minimum values between FGs are assumed for component 2, 8, 9. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting on PUCCH  1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4}  Note: If UE supports both FG 42-2a and 42-2c,   * UE shall report the same value for component 1 across the FGs.   The minimum values between FGs are assumed for component 2, 8, 9. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across aperiodic CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-3 | Supported maximum number of simultaneous NZP-CSI-RS resources and total CSI-RS ports | 1. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  2. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  3. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs | At least one of FG 42-1/1a/1b/1c/2/2a/2b/2c | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {1, 2, 3 … 32}  Component 2 candidate values: {8, 16, 24, … 128}  Component 3 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 4 candidate values: {8, 16, 24, …, 248, 256}  Note: Components 3 and 4 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-4 | Cell DTX and/or DRX operation based on RRC configuration | Support of cell DTX and/or DRX operation by RRC configuration |  | Yes |  | UE does not support Cell DTX and/or DRX operation | Per band | No | No | N/A | Component 1 candidate values: {cell DTX only, cell DRX only, both}  Note: RAN2 may add additional details | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-5 | Cell DTX/DRX operation triggered by DCI format 2\_9 | 1) Support of Cell DTX/DRX configuration activation and deactivation via DCI 2\_9 | 42-4 | Yes |  | UE does not support dynamic Cell DTX/DRX operation triggered by DCI format 2\_9 | Per band | No | No | N/A |  | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-6 | Joint operation of power domain and spatial domain adaptation | Support of joint operation of power domain and spatial domain adaptation | one of {{42-1 and 42-2} or {42-1a and 42-2a} or {42-1b and 42-2b} or {42-1c and 42-2c}} | Yes |  | UE does not support joint operation of power domain and spatial domain adaptation | Per UE | No | No | N/A | Note 1: When UE reports this FG, the same values for component 1 shall be reported   * between {42-1 and 42-2} * between {42-1a and 42-2a} * between {42-1b and 42-2b} * between {42-1c and 42-2c}   Note2: When UE reports this FG, the minimum values for each component 1, 2, 3, 8, 9 shall be assumed   * between {42-1 and 42-2} * between {42-1a and 42-2a} * between {42-1b and 42-2b} * between {42-1c and 42-2c} | Optional with capability signaling | |
| CATT [8] |  |
| Nokia [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 42. Netw\_Energy\_NR | 42-1 | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for periodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support spatial domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values: SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values: SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUSCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUCCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support spatial domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values:  SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values:  SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values:  SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2 | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support power domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 2 candidate value: {2,3,4}  Component 4 candidate value: {1, 2, 3 … 32}  Component 5 candidate value: {8, 16, 24, … 128 }  Component 6 candidate value: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4} | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting  1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128 }  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4,5,6,7,8,9,10,11,12}  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting on PUCCH  1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128}  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4}  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |  | Yes |  | UE does not support power domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128 }  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-8 | simultaneousCSI-SubReportsPerCC-r18 | Indicates the number of CSI report(s) for which the UE can measure and process reference signals simultaneously in a CC of the band for which this capability is provided. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsPerCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports |  | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per Band | No | No | N/A | Component 1 candidate values: {1, 2, 3, 4, 5, 6, 7, 8}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsPerCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-9 | simultaneousCSI-SubReportsAllCC-r18 | Indicates whether the UE supports CSI report framework and the number of CSI report(s) which the UE can simultaneously process across all CCs, and across MCG and SCG in case of NR-DC. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsAllCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports. This parameter may further limit *simultaneousCSI-SubReportsPerCC-r18* in MIMO-ParametersPerBand and Phy-ParametersFRX-Diff for each band in a given band combination |  | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per BC | No | No | N/A | Component 1 candidate values: {5, 6, 7, ..., 32}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsAllCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling | |
| OPPO [10] |  |
| LG Electronics [11] | * Prerequisite FG   One remaining FFS point is to decide prerequisite FG for NES FGs. Prerequisite FG doesn’t seem to be needed for FGs related to periodic or aperiodic CSI reporting, since FG 2-32 for periodic or aperiodic CSI reporting is a mandatory Rel-15 FG. On the other hand, considering that semi-persistent CSI reporting is an optional Rel-15 FG, prerequisite FG for FGs related to semi-persistent CSI reporting can be corresponding FG defined for periodic or aperiodic CSI reporting for NES. Similarly, as FG 2-35 is a mandatory Rel-15 FG, prerequisite of FGs 42-8 and 42-9 might not be needed.  **Proposal #1: The prerequisite FGs for NES FG 42-1/42-2/42-8/42-9 are defined as follows:**   * **FG 42-1 (SD and P-CSI reporting): NO prerequisite** * **FG 42-1a (SD and SP-CSI reporting on PUSCH): FG 42-1 or 42-1b as prerequisite** * **FG 42-1c (SD and SP-CSI reporting on PUCCH): FG 42-1 or 42-1b as prerequisite** * **FG 42-1b (SD and AP-CSI reporting): NO prerequisite** * **FG 42-2 (PD and P-CSI reporting): NO prerequisite** * **FG 42-2a (PD and SP-CSI reporting on PUSCH): FG 42-2 or 42-2b as prerequisite** * **FG 42-2c (PD and SP-CSI reporting on PUCCH): FG 42-2 or 42-2b as prerequisite** * **FG 42-2b (PD and AP-CSI reporting): NO prerequisite** * **FG 42-8/42-9: NO prerequisite** * Limits on CSI-RS resource/port or CSI report settings   Another remaining issue is how to handle limits on CSI-RS resource/port or CSI report settings. In detail, the following components are currently defined individually per FG.   * Supported maximum number of simultaneous NZP-CSI-RS resources per CC * Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC * Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs * Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs   It is observed that FG 2-33 components related to CSI-RS resource/port counting are not defined for each of CSI reporting types but defined commonly for all CSI reporting types (i.e., for P/SP/AP-CSI reporting). However, for NES, above limits are reported separately for each of FGs 42-1/1a/1b/1c/2/2a/2b/2c. This makes gNB complicated to understand which value will be applied if more than one FGs are indicated to be supported by a UE. For instance, if a UE indicates supporting FGs 42-1 and 42-2, and reports A or B for the maximum number of simultaneous NZP-CSI-RS resources per CC for FG 42-1 or FG 42-2, respectively, gNB may be difficult to decide whether to apply A or B for joint operation of SD and PD adaptations. To mitigate this sort of complexity, it is suggested to add a NOTE that UE shall report the same value for above limits across FGs 42-1/1a/1b/1c/2/2a/2b/2c.  Alternatively, a new FG can be introduced for UE to report above limits commonly applicable to all of FGs 42-1/1a/1b/1c/2/2a/2b/2c, as suggested in [2].  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, adopt one of two alternatives and Alt 2 is preferred as a cleaner solution. If Alt 2 is taken, the relevant components in FGs 42-1/1a/1b/1c/2/2a/2b/2c are to be removed.**   * **Alt 1: Add a NOTE that “UE shall report the same value for the below components across FGs 42-1/1a/1b/1c/2/2a/2b/2c”.**   + **Supported maximum number of simultaneous NZP-CSI-RS resources per CC**   + **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC**   + **Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs**   + **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs** * **Alt 2: Add a NEW FG, as follows**   + **Feature group**     - **Supported maximum number of simultaneous NZP-CSI-RS resources and total CSI-RS ports**   + **Components**     - **1. Supported maximum number of simultaneous NZP-CSI-RS resources per CC**     - **2. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC**     - **3. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs**     - **4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs**   + **Prerequisite feature groups**     - **At least one of FG 42-1/1a/1b/1c/2/2a/2b/2c**   + **Consequence if the feature is not supported by the UE**     - **UE does not support spatial or power domain adaptation.**   + **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)**     - **Per band**   + **Note**     - **Component 1 candidate values: {1, 2, 3 … 32}**     - **Component 2 candidate values: {8, 16, 24, … 128}**     - **Component 3 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}**     - **Component 4 candidate value: {8, 16, 24, …, 248, 256}** |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | In Rel-15, basic CSI feedback capability FG2-32 covers periodic/aperiodic CSI reporting, while FG2-32a/b for semi-persistent CSI reporting are optional capabilities. Therefore, for FG42-1 family, we prefer to have FG42-1 or FG42-1b as prerequisite FG for FG42-1a/1c, while FG42-1 and FG42-1b would not require any prerequisite FG as basic CSI reporting capability FG2-32 is anyway mandatory. Same proposal is applied to FG42-2 family.  Regarding FG42-8/9, these FGs intend to report larger value on maximum number of CSI reports for which the UE can measure and process simultaneously in a CC or across all CCs than those reported in 2-35. Based on the intention, prerequisite FG of FG42-8/9 should be 2-35, and the value reported in FG42-8/9 is applicable if the UE is configured with CSI report setting with sub-configuration. In addition, UE supporting at least one of FG42-1/1a/1b/1c/2/2a/2b/2c shall report FG42-8/9.  **Proposal 5: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-1: None (i.e., no prerequisite FG)** * **FG42-1a: One of {42-1, 42-1b}** * **FG42-1c: One of {42-1, 42-1b}** * **FG42-1b: None (i.e., no prerequisite FG)** * **FG42-2: None (i.e., no prerequisite FG)** * **FG42-2a: One of {42-2, 42-2b}** * **FG42-2c: One of {42-2, 42-2b}** * **FG42-2b: None (i.e., no prerequisite FG)**   **Proposal 6: FG42-8 and 42-9 are updated as below.**   * **Prerequisite FG of FG42-8/9 is 2-35.** * **Following notes are added in FG42-8/9.**   + **“UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c must report this FG.”** |
| Ericsson [15] | In **Error! Reference source not found.**, RAN2 brings up an issue related to the wide-spread use of the term “across all CCs”. This statement is somewhat ambiguous, but in our understanding, this statement “across all CCs” refer to all CCs of the signalled granularity. For a “per band” or a “per FS” feature, “across all CCs” mean “across all CCs in the band”, and for a “per BC” feature, “across all CCs” mean “across all CCs in the band combination”. The relevant components in NES FG 42-1/1a/1b/2/2a/2b are reported per BC, and we propose to clarify that:   1. Clarify that “across all CCs” means “across all CCs in a band combination” for FG 42-1/1a/1b/2/2a/2b.   In last meeting, several variant proposals were discussed to clarify when the per-CC and across-all-CCs limits of port/resource counting (e.g., components 4,5,6,7) would apply. The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. We would also be OK with adding notes in the Note column to reflect the NES conditions, and such notes were proposed in [4] and we are OK to reflect such updates into the FGs.   1. Add the following notes to FG 42-1/1a/1b/1c/2/2b to clarify when the per-CC and all-CC cases    1. Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.    2. Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. 2. Add the following notes to FG 42-2a/2c to clarify when the per-CC and all CC cases    1. Note 1: The value reported in component 3 or 4 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.    2. Note 2: The value reported in component 5 or 6 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.     One issue that was also discussed in last meeting was that case of a scenario where UE indicates support of multiple 42-x FGs related to SD/PD adaptation. For example, UE indicates support of FG 42-1b (SD for aperiodic CSI reporting) and FG 42-1 (SD for periodic CSI reporting). The issue was about what limits would apply when such a UE is configured with both SD for periodic and aperiodic reporting? We think that the minimum value amongst the per-CC (or across CC, respectively) limits of both FG 42-1b and FG 42-1 should apply in such cases. For example, if UE indicates in FG 42-1 with component 5 = 32 ports, and FG 42-1b with component 5 = 48 ports, then if UE is configured with both periodic CSI reporting and aperiodic CSI reporting with sub-configurations, then the minimum value amongst the two limits would apply, implying a net maximum of 32 ports. We think this would be a straightforward conclusion for the components 4,5,6,7, but we are also open to alternative wording or a note in the FG list if needed.   1. For NES FGs 42-1/1a/1b/1c/2/2a/2b/2c, if the UE reports multiple such FGs, when the UE is configured with CSI report settings with sub-configurations where the capability for active ports/resources for each CSI report setting is according to FG 42-n1, 42-n2,.. (n1, n2,.. from 1,1a,1b,1c,2,2a,2b,2c), for each of the following component, the minimum value of corresponding component across FG 42-n1, FG 42-n2,.. is used.    1. Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 42. Netw\_Energy\_NR | 42-1 | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for periodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values: SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values: SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUSCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUCCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support spatial domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to configuration contains one port subset  Note: SD-type2 refers to configuration contains list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4}  Component 4 candidate values:  SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values:  SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values:  SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values:  SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12}  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2 | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 2 candidate value: {2,3,4}  Component 4 candidate value: {1, 2, 3 … 32}  Component 5 candidate value: {8, 16, 24, … 128 }  Component 6 candidate value: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4}  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting  1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128 }  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4,5,6,7,8,9,10,11,12}  Note: Components 5 and 6 are signaled per BC  Note 1: The value reported in component 3 or 4 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 5 or 6 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting on PUCCH  1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128}  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4}  Note: Components 5 and 6 are signaled per BC  Note 1: The value reported in component 3 or 4 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 5 or 6 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations. | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | FFS | Yes |  | UE does not support power domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128 }  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC  Note 1: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note 2: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations | Optional with capability signaling | |
| Qualcomm Incorporated [16] | The supported total number of periodic CSI reporting settings should depend on the reporting types (periodic, semi-persistent, aperiodic) as being specified in the existing specs. Furthermore, from our perspectives, there is no need to further split the number for semi-persistent CSI reporting on PUCCH and number for semi-persistent CSI reporting on PUSCH.  **Proposal 1.1: Update component 9 in the FGs as follows in red:**   * **For FG 42-1/2, Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP** * **For FG 42-1a/1c/2a/2c, Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP** * **For FG 42-1b/2b, Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across aperiodic CSI report settings with sub-configurations per BWP**   On prerequisite for the feature groups. From our perspectives, the following prerequisites should be adopted:   * FG 2-35 is prerequisite for FGs 42-1/1a/1b/1c/2/2a/2b/2c. The report in FG 2-35 is needed for determining the supported total number of sub-configurations across CSI report settings with sub-configurations per BW. For example, FG 42-1 has a component that “Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP”. Based on the reported component 1 in FG 2-35, the supported total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP can be determined. * Additionally, FG 2-32a is prerequisite for FG 42-1c/2c, and FG 2-32b is prerequisite for FG 42-1a/2a. * FG 2-35 is prerequisite for FGs 42-8/9 since the reported numbers X and Y in components 4 and 5 of FG 2-35 are needed for determining the number of CSI sub-reports.   **Proposal 1.2: Adopt the following prerequisites as follows:**   * **FG 2-35 is prerequisite for FGs 42-1/1a/1b/1c/2/2a/2b/2c/8/9.** * **Additionally, FG 2-32a is prerequisite for FG 42-1c/2c, and FG 2-32b is prerequisite for FG 42-1a/2a.**   Currently the capabilities related to CSI-RS resource counting (e.g., components 4-7 in FG 42-1) are reported per FG. However, we should discuss how they are counted toward overall total numbers across different FGs including legacy FGs and FGs in other Rel-18 WIs. From our perspective, FG 2-33 can be used as overall counting numbers for resource counting. Alternatively, we are open to define a new FG for counting active CSI-RS resources/ports, which can function as the overall limits for legacy CSI reporting and CSI reporting with sub-configurations.  **Proposal 1.3: Add the following notes to all spatial/power domain adaptation feature groups. Alternatively, define a new FG for the active CSI-RS port resource/port counting.**   * **Note: For any slot, the CSI-RS resource/port counting in Components 4-7 is also accounted towards the following components in FG 2-33, respectively:** * **Supported maximum number of simultaneous NZP-CSI-RS resources per CC** * **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC** * **Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs** * **Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs**   Another open discussion is how UE should report CSI-RS resource counting (e.g., components 4-7 in FG 42-1) and CSI reporting settings (e.g., component 9 in FG 42-1) in joint spatial and power domain adaptation operation. We suggest that UE should on report the components 4-7 and 9 for either spatial domain adaptation or power domain adaptation:  **Proposal 1.4: Add the following notes to all spatial/power domain adaptation feature groups.**   * **Note: For joint spatial and power domain adaptation operation, the UE reports Components 4-7 and 9 for either spatial domain adaptation or power domain adaptation.** |

## NR\_Mob\_enh2

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| 45. NR\_Mob\_enh2 | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum number of LTM CSI report configs | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | Per BC | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 4 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4, 6, 8, 9, 12, 16}  Component 5 candidate values:  Aperiodic: {0,1,2,3,4}  Periodic: {1,2,3,4}  Semi-persistent: {0,1,2,3,4} | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | At the RAN1#116bis meeting, UE features for mobility enhancement were discussed, and there is no remaining FFS in the latest version of the UE features list. On the other hand, there were following remaining proposals in the FL summary at the RAN1#116bis [2].   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  ~~4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement~~  3. Maximum number of candidate cells in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  4. Maximum number of beams per candidate cell in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum total number of beams per in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  ~~5~~6. Maximum number of periodic LTM CSI report configs per BWP  7. Maximum number of aperiodic LTM CSI report configs per BWP  8. Maximum number of semi-persistent LTM CSI report configs per BWP | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | Per BC | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component ~~4~~3 candidate values: ~~L:~~ {1, 2,3,4}  Component 4 candidate values: ~~M:~~ {1, 2,3,4}  Component 5 candidate values:  {1,2,3,4, 6, 8, 9, 12, 16}  ~~M × L: {1,2,3,4, 6, 8, 9, 12, 16}~~  Component ~~5~~6 candidate values: ~~Aperiodic:~~ {~~0,~~1,2,3,4}  Component 4 candidate values ~~Periodic~~: {0,1,2,3,4}  Component 4 candidate values ~~Semi-persistent~~: {0,1,2,3,4} | Optional with capability signalling |   For FG45-1, in the last meeting, splitting of component 4 and 5 was proposed to make it clearer. On component 4, how bits are assigned for each combination of M, L, and M  L is not clear because some combinations are not used. Thus, splitting of component 4 would be reasonable. Also, on component 5, splitting for P/SP/AP LTM CSI report would be reasonable to make it clear as in legacy beam reporting configuration. Thus, we propose  **Proposal 7: For FG45-1, support to split original component 4 to new component 3, 4, 5, and to split original component 5 to new component 6, 7, 8, respectively, as table above.** |
| Ericsson [15] | In RAN1#116, most open issues related to UE features for mobility enhancements were closed. Here we bring up a few remaining issues.  FG 45-1 describes the intra-frequency reporting, where component 5 describes the maximum number of LTM CSI report configurations. However, it is not clear if the number of LTM CSI report configuration is per BWP, per serving cell, per band, or per band combination. Here we propose to follow the legacy intra-cell beam reporting , where this is stated per BWP:   1. The capabilities indicate how many LTM CSI reporting configurations of the respective type are supported per BWP.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum number of LTM CSI report configs per BWP | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | Per BC | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 4 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4, 6, 8, 9, 12, 16}  Component 5 candidate values:  Aperiodic: {0,1,2,3,4}  Periodic: {1,2,3,4}  Semi-persistent: {0,1,2,3,4} | Optional with capability signalling | |
| Qualcomm Incorporated [16] |  |

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| 45. NR\_Mob\_enh2 | 45-3 | Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure.  2. Maximum number of configured joint LTM TCI state(s) per candidate cell  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  4. Supported QCL source RS in the LTM TCI-stateconfiguration  5. Maximum number of configured joint LTM TCI state(s) across candidate cells  6. Maximum number of configured cells for joint LTM TCI states | 23-1-1, RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states | Per band | No | No | n/a | Component 2 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: {8, 16, 24, 32, …, 1024}  Component 6 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |
| 45. NR\_Mob\_enh2 | 45-4 | Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure.  2. Maximum number of configured DL TCI state(s) per candidate cell  3. Maximum number of configured UL TCI state(s) per candidate cell  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  5. Supported QCL source RS in the LTM TCI-state configuration  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells  9. Maximum number of configured cells for separate DL/UL LTM TCI states | 23-10-1, RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | Per band | No | No | n/a | Component 2 candidate values: {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate values: {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: {8, 16, 24, 32, …, 1024}  Component 8 candidate values: {4, 8, 12, 16, …, 512}  Component 9 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] | The TCI states (*CandidateTCI-State-r18*) for LTM are designed based on Rel-17 unified TCI framework. This is an additional functionality needed to support LTM TCI states. However, this does not require any relation between the LTM TCI states and the TCI states of the source cell (as well as of the target cell). In other words, the application of LTM TCI states should not be dependent on whether the source cell is using Rel-17 or Rel-15 TCI states. Currently, for FG 45-3, FG 23-1-1 and FG 23 are pre-requisite requiring support of unified TCI states for intra-cell beam management. The support of LTM beam indication should be independent of source cell intra-cell beam management, and therefore, we propose to remove that pre-requisite. Similarly, we propose to remove 23-10-1 from FG 45-4.  **Proposal 4: Adopt the changes proposed in the following table for UE features supporting Rel-18 Mobility.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-3 | Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure.  2. Maximum number of configured joint LTM TCI state(s) per candidate cell  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  4. Supported QCL source RS in the LTM TCI-stateconfiguration  5. Maximum number of configured joint LTM TCI state(s) across candidate cells  6. Maximum number of configured cells for joint LTM TCI states | ~~23-1-1,~~ RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states | Per band | No | No | n/a | Component 2 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: {8, 16, 24, 32, …, 1024}  Component 6 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling | | 45. NR\_Mob\_enh2 | 45-4 | Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure.  2. Maximum number of configured DL TCI state(s) per candidate cell  3. Maximum number of configured UL TCI state(s) per candidate cell  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  5. Supported QCL source RS in the LTM TCI-state configuration  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells  9. Maximum number of configured cells for separate DL/UL LTM TCI states | ~~23-10-1,~~ RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | Per band | No | No | n/a | Component 2 candidate values: {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate values: {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: {8, 16, 24, 32, …, 1024}  Component 8 candidate values: {4, 8, 12, 16, …, 512}  Component 9 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

## NR\_NTN\_enh

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| 44. NR\_NTN\_enh | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources |  | Yes | No | UE does not support PUCCH repetition for common PUCCH resources | Per Band | N/A | N/A | N/A | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1  [Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5 [and HAPS operation bands in Clause 5.2 of TS 38.104] | Optional without capability signaling |
| 44. NR\_NTN\_enh | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period | 13-4, 13-8 | No | No | UE does not support Multi-RTT positioning with single satellite in NTN | Per Band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5  Need for location server to know if the feature is supported | Optional with capability signaling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | For the note of applicable band, it is applicable for both satellite and HAPS, and the remaining issue is whether the FG can also be applied for TN, which is out of scope. Furthermore, as RAN1 has concluded several agreements on the discussion of support for FR2-NTN, FG44-1 should also be applicable for FR2-NTN bands. Thus the Note should be kept and the square brackets be removed.  **Proposal NR NTN-1: The UE feature group of FG 44-1 is updated with red highlights as following considering the following aspects:**   * **The UE feature group of FG 44-1 is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources |  | Yes | No | UE does not support PUCCH repetition for common PUCCH resources | Per Band | N/A | N/A | N/A | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1  ~~[~~Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and ~~[~~TBD for FR2-NTN bands~~]~~ in TS 38.101-5 ~~[~~and HAPS operation bands in Clause 5.2 of TS 38.104~~]~~ | Optional without capability signaling |   An LS **Error! Reference source not found.** has been received from RAN4 and the content of the LS is given as the following:  RAN4 has discussed the requirements for UE Rx-Tx time difference measurement for single satellite based RTT for NW verified location, and agreed that the measurement periods are based on single sample.  RAN4 also discussed the UE capability related to single sample measurement, and concluded that supporting single sample in UE Rx-Tx time difference measurement for single satellite based RTT is a component FG 44-3, and it does not require UE to support reduced sample number for TN positioning measurement (FG 27-3-1).  RAN4 respectfully asks RAN1 and RAN2 to take the above information into account and update the feature list and UE capability as necessary.  Therefore, the single sample measurement to determine the UE Rx-Tx time difference in NTN for network location verification should be captured in the NTN UE location verification feature group, i.e. FG 44-3.  **Proposal NR NTN-2: The UE feature group of FG 44-3 is updated with red highlights as following considering the following aspects:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period  3. Support of 1 (single sample of PRS resource) for UE Rx-Tx time difference measurement. | 13-4, 13-8 | No | No | UE does not support Multi-RTT positioning with single satellite in NTN | Per Band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5  Need for location server to know if the feature is supported | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Samsung [5] | The remaining issue is whether this feature applies to both TN and NTN. While it is understood that FG44-1 can be applied to TN without any modifications, it should be noted that the enhancement is not targeted for TN within the NTN WID. If certain operators desire this feature for their networks, then we are willing to accept. However, if there is no such demand, it would be premature to discuss this matter at present. We can further address this issue during the Rel-19 TEI scope if necessary.  **Proposal 20: Confirm the following note in FG 44-1**   * **Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104** |
| Vivo [6] |  |
| Apple [7] | It is open whether FG 44-1 applies to HAPS operation bands in Clause 5.2 of TS 38.104. Considering that all Rel-17 NR NTN features (i.e., FG 26 series) are applicable to HAPS operation band and that it is mentioned in Rel-18 NR NTN WID that the work item aims at specifying enhancements for NR NTN with implicit compatibility to support HAPS and ATG scenarios, we think FG 44-1 applies to HAPS operation bands in Clause 5.2 of TS 38.104. We also think it is beneficial that FG 44-1 is applicable to FR2-NTN.  ***Proposal 4-1:*** *FG 44-1 applies to FR2-NTN bands and HAPS operation bands in Clause 5.2 of TS 38.104.*  RAN4 sent an LS **Error! Reference source not found.** to RAN1 and RAN2 on UE capability for network verified location. In the LS, it is mentioned that RAN4 agreed that the measurement periods are based on single sample in UE’s Rx-Tx time difference measurement for single satellite based RTT for NW verified location. Furthermore, it is concluded in RAN4 that supporting single sample in UE Rx-Tx time difference measurement for single satellite based RTT is a component FG 44-3. Hence, we have the following proposal.  ***Proposal 4-2:*** *In FG 44-3, the first component is modified to “Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement based on single sample and report for Multi-RTT positioning with single satellite in NTN.”* |
| CATT [8] |  |
| Nokia [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources |  | Yes | No | UE does not support PUCCH repetition for common PUCCH resources | Per Band | N/A | N/A | N/A | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1  Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and Table 5.2.3-1in TS 38.101-5 [and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional without capability signaling | | 44. NR\_NTN\_enh | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period | 13-4, 13-8 | No | No | UE does not support Multi-RTT positioning with single satellite in NTN | Per Band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [Table 5.2.3-1in TS 38.101-5  Need for location server to know if the feature is supported | Optional with capability signaling | |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | FG 44-1, it’s preferred to remove the bracket of the note and the description of FR2-NTN bands. The feature of PUCCH repetition on common PUCCH resource is designed for R18 NTN to mitigate the large path loss. For legacy TN, no coverage issue was identified and no enhancement on common PUCCH was discussed. Therefore, it is preferred to restrict this FG to NTN. Moreover, in RAN1#116bis, it was agreed to remove FR2-NTN bands in FG 44-2. Hence, it is preferred to also remove FR2-NTN bands in FG 44-1 for alignment.  ***Proposal 4-1:*** *The updates on the UE features for NR-NTN listed below should be supported.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources |  | Yes | No | UE does not support PUCCH repetition for common PUCCH resources | Per Band | N/A | N/A | N/A | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1    ~~[~~Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 ~~and [TBD for FR2-NTN bands]~~ in TS 38.101-5 ~~[~~and HAPS operation bands in Clause 5.2 of TS 38.104~~]~~ | Optional without capability signaling | |
| NTT DOCOMO, INC. [14] | For 44-1, this PUCCH repetition can be applied to TN and FR2-NTN as well as FR1-NTN. There is no motivation to preclude it from them. This feature can work in TN/FR2-NTN without any additional mechanism.  For 44-3, capability signaling should be available for FR2-NTN bands. The motivation of this feature is common b/w FR1-NTN and FR2-NTN. There is no motivation to preclude FR2-NTN.  **Proposal 8: Update FG 44-1 as follows.**   |  |  |  |  | | --- | --- | --- | --- | | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1 |   **Proposal 9: Update FG 44-3 as follows.**   |  |  |  |  | | --- | --- | --- | --- | | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and 5.2.3-1 in TS 38.101-5  Need for location server to know if the feature is supported | |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] | RAN4 has sent an LS, R1-2403831 “LS on UE capability for NW verified location”, concerning the UE capability on NW verified location. From the LS, RAN4 has agreed that the measurement periods for UE Rx-Tx time difference measurement for single satellite based RTT for NW verified location are based on single sample. RAN4 also concluded that supporting single sample in UE Rx-Tx time difference measurement for single satellite based RTT is a component of FG 44-3. Consequently, we propose to revise UE feature FG 44-3 as in the following proposal.  **Proposal 6.1: Adopt the following revision to the component 1 of FG 44-3.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement based on single sample and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period | 13-4, 13-8 | No | No | UE does not support Multi-RTT positioning with single satellite in NTN | Per Band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5  Need for location server to know if the feature is supported | Optional with capability signaling | |

## IoT\_NTN\_enh

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| 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | [Rel. 18 2-3a] Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |
| 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | [Rel. 18 2-3b], Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For the highlight part of FG 2-4a and FG 2-4b, according to the agreement in RAN1#111, UE may perform autonomous GNSS measurement if there is no trigger is received.   |  | | --- | | **Agreement**   * For GNSS measurement in RRC connected, if eNB aperiodically triggers connected UE to make GNSS measurement, UE can re-acquire GNSS position fix with a gap * FFS details of gap configuration   The UE may re-acquire GNSS autonomously (when configured by the network) if UE does not receive eNB trigger to make GNSS measurement   * FFS based on configured timing |   There are two cases UE does not receive the trigger, 1) UE support the aperiodic trigger-based GNSS measurement but eNB does not send the trigger; 2) UE do not report the capability of the aperiodic trigger-based GNSS measurement. The autonomous GNSS position fix can be enabled independently of the support of aperiodic GNSS measurement. Thus, FG 2-3a should not be the prerequisite feature group of FG 2-4a.  The similar comments can be applied to FG 2-4b for NB-IoT.  **Proposal IoT NTN-1:** **FG2-3a (FG2-3b) should not be** **the prerequisite feature group of FG 2-4a (FG 2-4b).**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3a]~~ Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | | 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3b],~~ Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] | |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | Rel. 18 2-3a Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | | 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | Rel. 18 2-3b, Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] | The eNB trigger based solution and UE autonomous solution can work independently. It is not preferred to couple the two methods when defining FGs. Therefore, the prerequisite [Rel. 18 2-3a] and [Rel. 18 2-3b] should be removed from FG 2-4a and FG2-4b, respectively.  ***Proposal 3-1:*** *The updates on the UE features for IoT-NTN listed below should be supported.*   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3a]~~ Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | | 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3b]~~, Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] | In RAN1# 115 the following agreement was reached:   |  | | --- | | Agreement  When multiple TBs are scheduled by a single DCI:   * For Option 1 + Option 3 DCI based overridden mechanism, when DCI indicates HARQ feedback enabled, then the NB-IoT UE always wait for an RTT+3ms (i.e., till subframe n+Kmac+3 in TS36.213 section 16.6) before monitoring NPDCCH. |   During RAN1#116, it was clarified that “npdsch-MultiTB-Config” has two different behaviours when the overriding happens, which depends on whether 1TB is scheduled (UE does not wait for an RTT+3ms) or 2TBs are scheduled (“UE always wait for an RTT+3ms”) by a single DCI. This, behaviour was captured through the following agreement: “*The TP 1-1b in section 3 of R1-2401497 is endorsed for TS36.213 clause 16.6*”. The agreement reach in RAN1# 116 also requires an update in FG 2-1g-2.   1. Update FG 2-1g-2 to reflect that when “*npdsch-MultiTB-Config*” is configured the overriding has different behaviours depending on whether 1TB is scheduled (UE does not wait for an RTT+3ms) or 2TBs are scheduled (“UE always wait for an RTT+3ms”) by a single DCI.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-1g-2 | Dynamic HARQ feedback disabling by DCI-based overridden indication for NB-IoT in multi TB case | 1. UE receives DCI indication to override RRC configuration for disabling HARQ feedback  2. For multi TB scheduling a single transport block by single DCI, UE follows NPDCCH monitoring behavior for a HARQ process configured as HARQ feedback disabled by per-HARQ process bitmap signaling and further reversed to HARQ feedback enabled by DCI | At least one of {Rel-16 2-6, 2-7},  Rel. 17 2-1b,  Rel-18 2-1e-2, 2-1f-2 | Yes | N/A | Release 18 NB-IoT UE cannot disable HARQ feedback in multi TB case | Per UE | No | No | Note: this applies to multi-TB case | Optional with capability signalling |     For Rel-18 IoT-NTN, there are two methods for triggering a GNSS measurement gap during RRC connected mode, an “Aperiodic triggering” and an “Autonomous triggering”. During several meetings in a row (including RAN1#116-bis), there have been discussions on whether the “Aperiodic triggering” method should be captured or not as a pre-requisite of the “Autonomous triggering” method. Nonetheless, it has not been possible to reach consensus mainly due to different interpretations of a conclusion touching upon the “pre-requisite” aspect.  The no consensus is preventing the completion of the UE capability report (a.k.a. UE Feature list) for GNSS Enhancements towards performing an Interoperability Development Testing (IoDT). Thus, aiming at moving things forward, we propose the following middle-ground solution:   |  | | --- | | In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its *GNSS-ValidityDuration* plus *ul-TransmissionExtensionValue*(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the GNSS-ValidityDuration. Under the above premises, the “Aperiodic triggering” feature group is a pre-requisite of the “Autonomous triggering” feature group. |  1. For GNSS Enhancements, there is still an open issue impacting FGs 2-3a, 2-4a, 2-3b, 2-4b, which is preventing the completion of GNSS Enhancements towards performing IoDT. 2. For GNSS Enhancements, the open issue is related with whether the “Aperiodic triggering” method should be captured or not as a pre-requisite of the “Autonomous triggering” method. 3. For GNSS Enhancements, what is preventing to reach a consensus is that overall there are two completely opposite views on the open issue: 1) “Autonomous triggering” and “Aperiodic triggering” are fully independent, or 2) “Autonomous triggering” method is conditioned to the “Aperiodic triggering” method. 4. In relation with the previous observation, a middle-ground solution could consist in letting the UE start with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its *GNSS-ValidityDuration* plus *ul-TransmissionExtensionValue*(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the GNSS-ValidityDuration. 5. For GNSS Enhancements and the comeback on “FG 2-4a” and “FG 2-4b,” adopt the following changes:  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  1.1 In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its *GNSS-ValidityDuration* plus *ul-TransmissionExtensionValue*(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the *GNSS-ValidityDuration*.  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | Rel. 18 2-3a Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | ~~WA:~~ Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | | 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  1.1 In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its *GNSS-ValidityDuration* plus *ul-TransmissionExtensionValue*(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the *GNSS-ValidityDuration*.  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | Rel. 18 2-3b, Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | ~~WA:~~ Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | |
| Qualcomm Incorporated [16] | In our view, it should be possible for a UE to implement autonomous reacquisition without supporting triggered gaps. Note that the implementation of triggered gaps is much more complex than autonomous gaps (requiring e.g. new MAC-CE support) and, therefore, it is likely that commercial deployments may only support autonomous reacquisition initially. Therefore, we make the following proposal:  **Proposal 4.1: 2-3a / 2-3b are not prerequisites of 2-4a / 2-4b.**  The proposal above is implemented in the following table:   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3a]~~ Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | | 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3b],~~ Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling | |

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| 2. IoT\_NTN\_enh | 2-2a | NGSO for HARQ disabling for eMTC | Support of NGSO for HARQ disabling for eMTC | At least one of 2-1a-1  2-1b-1  2-1c-1  2-1a-2  2-1b-2  2-1c-2  2-1d-1  2-1d-2  2-2 | Yes | N/A | NGSO is not supported for HARQ disabling for eMTC | Per UE | No | No |  | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-2b | NGSO for HARQ disabling for NB-IoT | Support of NGSO for HARQ disabling for NB-IoT | At least one of 2-1e-1  2-1f-1  2-1g-1  2-1e-2  2-1f-2  2-1g-2 | Yes | N/A | NGSO is not supported for HARQ disabling for NB-IoT | Per UE | No | No |  | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-6a | NGSO for GNSS enhancements for eMTC | Support of NGSO for GNSS enhancements for eMTC | At least one of 2-3a, 2-4a, 2-5a | Yes | N/A | NGSO for GNSS enhancements for eMTC is not supported | Per UE | No | No |  | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-6b | NGSO for GNSS enhancements for NB-IoT | Support of NGSO for GNSS enhancements for NB-IoT | At least one of 2-3b, 2-4b, 2-5b | Yes | N/A | NGSO for GNSS enhancements for NB-IoT is not supported | Per UE | No | No |  | Optional with capability signaling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | For FG 2-2a, FG 2-2b, 2-6a and FG 2-6b, to our understanding, the original intention to introduce FGs of 2-2a/2-2b/2-6a/2-6b is to allow UE reporting separate capability for GSO and NGSO scenarios because several companies think the benefit of HARQ disabling and GNSS operation is not obvious in NGSO scenario. According to the current CR for TS36.331, these FGs are captured as following table.   |  |  | | --- | --- | | ***ntn-GNSS-EnhNGSO-Support***  This field indicates whether the GNSS measurement enhancements in RRC\_CONNECTED that are indicated as supported are applicable in NGSO scenario for UE indicating support of GSO and NGSO scenarios. If this field is not included, the GNSS measurement enhancements in RRC\_CONNECTED that are indicated as supported are not applicable in NGSO scenario. | 2-2a  /2-2b | | ***ntn-HarqEnhNGSO-Support***  This field indicates whether the UL and DL HARQ process enhancements that are indicated as supported are applicable in NGSO scenarios for UE indicating support of GSO and NGSO scenarios. If this field is not included, the UL and DL HARQ process enhancements that are indicated as supported are not applicable in NGSO scenario. | 2-6a  /2-6b- |   Based on the RAN2 specification, the FG2-2a/2-2b/2-6a/2-6b are only used when the Rel-17 capability of *ntn-Connectivity-EPC-r17* is reported and *ntn-ScenarioSupport-r17* is not reported (implying UE support NTN features for both GSO and NGSO). It is not clear whether the *ntn-ScenarioSupport-r17* can be still applicable to Rel-18 FGs of HARQ disabling and GNSS when either GSO or NGSO is reported. For example, if a UE hope to report supporting Rel-17 and Rel-18 IoT NTN feature only in NGSO scenario, is it valid to report *ntn-ScenarioSupport-r17=ngso* only? So, we propose to update the definition of FG2-2a/2-2b/2-6a/2-6b as *ntn-ScenarioSupport-r17* that UE can report component value of {GSO, NGSO}. If the field is absent, the UE support R18 NTN features for both GSO and NGSO scenario. As the applicability of Rel-18 HARQ/GNSS FGs to GSO/NGSO is separately reported in FG2-2a/2-2b/2-6a/2-6b, the Rel-17 IoT NTN capability of *ntn-ScenarioSupport-r17* is not applied to R18 FGs.  **Proposal IoT NTN-2: Update the title of 2-2a/2-2b/2-6a/2-6b as “Scenario for HARQ disabling for eMTC”, “Scenario for HARQ disabling for NB-IoT”, “Scenario for GNSS enhancements for eMTC” and “Scenario for GNSS enhancements for NB-IoT”. The component value can be {gso, ngso}. If the field is absent, UE support HARQ disabling and/or GNSS enhancement for both GSO and NGSO scenario. Clarify in the column of note that ntn-ScenarioSupport-r17 is not applicable to R18 FGs**.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2. IoT\_NTN\_enh | 2-2a | ~~NGSO~~Scenario for HARQ disabling for eMTC | Support of NGSO or GSO for HARQ disabling for eMTC | At least one of 2-1a-1  2-1b-1  2-1c-1  2-1a-2  2-1b-2  2-1c-2  2-1d-1  2-1d-2  2-2 | Yes | N/A | NGSO is not supported for HARQ disabling for eMTC | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling | | 2. IoT\_NTN\_enh | 2-2b | ~~NGSO~~Scenario for HARQ disabling for NB-IoT | Support of NGSO or GSO for HARQ disabling for NB-IoT | At least one of 2-1e-1  2-1f-1  2-1g-1  2-1e-2  2-1f-2  2-1g-2 | Yes | N/A | NGSO is not supported for HARQ disabling for NB-IoT | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling | | 2. IoT\_NTN\_enh | 2-6a | ~~NGSO~~Scenario for GNSS enhancements for eMTC | Support of NGSO or GSO for GNSS enhancements for eMTC | At least one of 2-3a, 2-4a, 2-5a | Yes | N/A | NGSO for GNSS enhancements for eMTC is not supported | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling | | 2. IoT\_NTN\_enh | 2-6b | ~~NGSO~~Scenario for GNSS enhancements for NB-IoT | Support of NGSO or GSO for GNSS enhancements for NB-IoT | At least one of 2-3b, 2-4b, 2-5b | Yes | N/A | NGSO for GNSS enhancements for NB-IoT is not supported | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] |  |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] |  |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

## NR\_netcon\_repeater

Void

## NR\_BWP\_wor

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 53. NR\_BWP\_wor | 53-3 | Support RLM/BM/BFD measurements based on NCD-SSB within active BWP | 1. UE performs RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB, where the NCD-SSB is within the active DL BWP.  2. Bandwidth of UE-specific RRC configured BWP may not include bandwidth of the CORESET#0 (if CORESET#0 is present) and CD-SSB for PCell/PSCell (if configured) and bandwidth of the UE-specific RRC configured BWP may not include CD-SSB for Scell  3. NCD-SSB within the active DL BWP can be used as the QCL source for other reference signal.  4. UE performs L3 intra-frequency measurements without gaps based on NCD-SSB, where the NCD-SSB is within the active DL BWP. |  | Yes | n/a | UE cannot support RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB within active BWP | Per band | No | No | n/a | Note: This FG applies only to PCell  This FG is not applicable to RedCap or eRedCap UEs. | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Samsung [5] |  |
| Vivo [6] |  |
| Apple [7] |  |
| CATT [8] |  |
| Nokia [9] |  |
| OPPO [10] |  |
| LG Electronics [11] |  |
| Vodafone [12] | As RAN4 agreed to extend the applicability of the L1 and L3-intra frequency measurement requirements for the PSCell in EN-DC or NR-DC scenarios, the only update that is required from RAN1 point of view is to remove the note “Note: This FG applies only to PCell” on FG 53-3 from the latest update **Error! Reference source not found.**:  ***Proposal 1:*** *RAN1 to update note on FG 53-3 of the UE features list for NR\_BWP\_wor on the FG applicability to PCell and PSCell.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 53. NR\_BWP\_wor | 53-3 | Support RLM/BM/BFD measurements based on NCD-SSB within active BWP | 1. UE performs RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB, where the NCD-SSB is within the active DL BWP.  2. Bandwidth of UE-specific RRC configured BWP may not include bandwidth of the CORESET#0 (if CORESET#0 is present) and CD-SSB for PCell/PSCell (if configured) and bandwidth of the UE-specific RRC configured BWP may not include CD-SSB for Scell  3. NCD-SSB within the active DL BWP can be used as the QCL source for other reference signal.  4. UE performs L3 intra-frequency measurements without gaps based on NCD-SSB, where the NCD-SSB is within the active DL BWP. |  | Yes | n/a | UE cannot support RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB within active BWP | Per band | No | No | n/a | Note: This FG applies to PCell and PSCell.  This FG is not applicable to RedCap or eRedCap UEs. | Optional with capability signalling | |
| ZTE [13] |  |
| NTT DOCOMO, INC. [14] | RAN4 sent Reply LS to RAN2/1 in [5], and the LS is to inform following conclusion made by RAN4.   |  | | --- | | Regarding dual connectivity for UE supporting *ncd-SSB-BWP-Wor-r18*, the following scenario is supported from RAN4 requirement perspective   * For UE supporting option C and configured with EN-DC or NR-DC, NCD-SSB based L1 and L3 intra-frequency measurement requirements are also applicable for the PSCell. |   In component 2, “PCell/PSCell” is described, while in note, it is described that “this FG applies only to PCell”.  The current description of the note intends to reflect following RAN4 agreement, rather than precluding PSCell.   |  | | --- | | * The following scenario is supported from RAN4 requirement perspective:   + For UE supporting option C and configured with CA, NCD-SSB based L1 and L3 intra-frequency measurement requirements are only applicable for the PCell. |   Therefore, the note should be updated to be consistent with component 2 and RAN4 conclusion.  **Proposal 10: Update FG 53-3 as follows.**   |  |  |  |  | | --- | --- | --- | --- | | 44-3 | Support RLM/BM/BFD measurements based on NCD-SSB within active BWP | 1. UE performs RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB, where the NCD-SSB is within the active DL BWP.  2. Bandwidth of UE-specific RRC configured BWP may not include bandwidth of the CORESET#0 (if CORESET#0 is present) and CD-SSB for PCell/PSCell (if configured) and bandwidth of the UE-specific RRC configured BWP may not include CD-SSB for Scell  3. NCD-SSB within the active DL BWP can be used as the QCL source for other reference signal.  4. UE performs L3 intra-frequency measurements without gaps based on NCD-SSB, where the NCD-SSB is within the active DL BWP. | Note: This FG applies only to PCell/PSCell (if configured)  This FG is not applicable to RedCap or eRedCap UEs. | |
| Ericsson [15] |  |
| Qualcomm Incorporated [16] |  |

## NR\_ATG

Void

# Discussion Items during RAN1 #117

After review of contributions submitted to RAN1 #117 in this agenda item, the following topics were identified by the moderator for discussion during RAN1 #117.

**General comments**

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| --- | --- |
| Company | Comments/Questions/Suggestions |
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## NR\_MIMO\_evo\_DL\_UL

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 1-1: Across all CCs in a band

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-1 | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured joint TCI states per CC per BWP  2. Maximum number of activated joint TCI states across all CCs in a band | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate values: {2, 4, 6, 8, 16, 32}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2 | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC | 1. Maximum number of configured DL TCI states per CC per BWP  2. Maximum number of configured UL TCI states per CC per BWP  3. Maximum number of activated DL TCI states across all CCs in a band  4. Maximum number of activated UL TCI states across all CCs in a band | 40-1-1, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with single activated TCI codepoint per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {4,8,12,16,24,32,48,64,128}  Component 2 candidate values: {4,8,12,16,24,32,48,64}  Component 3 candidate values: {2,4,8,16}  Component 4 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-2a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC | 1. TCI state indication for update and activation  a) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) with DL assignment  b) MAC-CE+DCI-based TCI state indication (use of monitored DCI formats 1\_1 and if supported 1\_2) without DL assignment  2. Maximum number of activated DL TCI states across all CCs in a band  3. Maximum number of activated UL TCI states across all CCs in a band | 40-1-2 | yes | n/a | Unified TCI with separate DL/UL TCI update for single-DCI based intra-cell multi-TRP with multiple activated TCI codepoints per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {2,4,8,16}  Component 3 candidate values: {2,4,8,16}  Note: FG 16-2b-0 can be used to indicate support of two default beams | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-7 | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 1. Support of mTRP operation for M-DCI with joint TCI state  3. Maximum number of configured joint TCI states per BWP per CC  4. Maximum number of activated joint TCI states across all CCs in a band per ‘coresetPoolIndex’ value  5. One MAC-CE activates one joint TCI-states per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value | 23-1-1 | yes | n/a | Unified TCI with joint DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values {intra-cell, intra-cell and inter-cell}  Component 3 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {1, 2, 4, 8, 16}  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions  Note: FG 16-2a-6 can be used to indicate support of two default beams | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-9 | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC | 0. Support of mTRP operation for M-DCI with separate DL/UL TCI state  1. Maximum number of configured DL TCI states per BWP per CC  2. Maximum number of configured UL TCI states per BWP per CC  3. Maximum number of activated DL TCI states across all CC in a band  4. Maximum number of activated UL TCI states across all CC in a band  5. One MAC-CE activated DL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value.  6. One MAC-CE activated UL TCI-state per CC in a band for a TRP associated with a ‘coresetPoolIndex’ value. | 40-1-7, 23-10-1 | yes | n/a | Unified TCI with separate DL/UL TCI update for multi-DCI based multi-TRP with single activated TCI codepoint per CORESETPoolIndex per CC is not supported | Per band | n/a | n/a | n/a | Component 0 candidate values {intra-cell, intra-cell and inter-cell}  Component 1 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 3 candidate values: {1, 2, 4, 8, 16}  Component 4 candidate values: {1, 2, 4, 8, 16} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-2: FG 40-2-8

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-2-8 | Maximum number of TAGs across all CCs | Maximum number of TAGs across all CCs in a band combination | 40-2-1 or 40-2-2 | yes | n/a | Maximum number of TAGs across all CCs is unknown when UE supports two TAGs per CC | Per BC | n/a | n/a | n/a | Component candidate values: {2,3,4}  Note: UE only supports the configuration where all UL CCs of the same frequency band are configured with up to 2 Timing Advance Group ID  Note: The same description of “supportedNumberTAG” in 38.306 applies to this FG as well | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-3: Across all CCs for Per band and Per BC

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1 | Basic feature for Rel-16-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of mode 2 for Rel-16 eType-II codebook refinement for multi-TRP CJT  2. Support for PMI subband R=1.  3. Support of parameter combinations with L=2,4  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-16-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-16-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 5 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel. 16 based type-II CJT must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-1a | Support of mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with L=2,4  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT]  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-1 | Yes | N/A | Mode 1 for Rel-16-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-3 | Support R=2 for Rel-16-based CJT codebook | 1. Support of Rel-16 eType-II codebook refinement for multi-TRP CJT with PMI subbands R=2  2. {Max # of Tx ports in one resource set, Max # of resource sets, total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-1-1 | Yes | N/A | R=2 for Rel-16-based CJT codebook is not supported | Per band  Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4,8,12,16,24,32}  b) {2 to 64}  c) {4 to 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5 | Basic feature for Rel-17-based CJT type-II codebook | Support of N=N\_TRP only  Support of N\_L=1 only  1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT  2. Support of PMI subband R=1.  3. Support of parameter combinations with M=1  4. Support of rank 1,2  5. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  6. Supported frequency basis selection mode 2, i.e., common frequency basis selection among different TRPs  7. Scaling factor X for CPU occupation counting for Rel-17-based CJT type-II codebook  8. Maximum number of NZP CSI-RS resources in one NZP CSI-RS resource set associated with multi-TRP CJT | 2-35 | Yes | N/A | Mode 2 for Rel-17-based CJT type-II codebook is not supported | Per band and Per BC | No | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256}  Component 7 candidate values: {1, 1.5, 2}  Component 8 candidate values: {2,3,4}  Note:  When NTRP=1 TRP is configured, OCPU =1.  When NTRP>1 TRPS are configured, OCPU = ceil(X \* NTRP)  Note: A-CSI is supported, and whether UE supports SP-CSI on PUSCH is dependent on FG2-32b  Note: A UE that supports CSI enhancement for Rel 17 based type-II CJT must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-5a | Support of mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=1.  2. Support of parameter combinations with M=1  3. Support of rank 1,2  4. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource associated with multi-TRP CJT  b) Maximum total number of NZP CSI-RS resource associated with multi-TRP CJT  c) Maximum total number of Tx ports of NZP CSI-RS resources associated with multi-TRP CJT  5. Supported frequency basis selection mode 1, i.e., common frequency basis selection among different TRPs with FD basis selection integer frequency offset | 40-3-1-5 | Yes | N/A | Mode 1 for Rel-17-based CJT type-II codebook with FD basis selection integer frequency offset is not supported | Per band and per BC | N/A | N/A | N/A | Component 4 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-7 | Support of M=2 and R=1 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with M=2 and PMI subband R=1  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with M=2 and R=1 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | M=2 and R=1 for Rel-17-based CJT codebook are not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-8 | Support R=2 for Rel-17-based CJT codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for multi-TRP CJT with PMI subband R=2.  2. {Max # of Tx ports in one resource set, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-1-5 or 40-3-1-5a | Yes | N/A | R=2 for Rel-17-based CJT codebook is not supported | Per band and Per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1 | Support of Rel-16-based doppler CSI | 1. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  2. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  3. Support parameter combinations with L=2,4  4. Support for rank = 1,2  5. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band simultaneously  7. Value of Y for CPU occupation (OCPU = Y.N4), when P/SP-CSI-RS is configured for CMR  8. Value of Y for CPU occupation (OCPU = Y.K), when A-CSI-RS is configured for CMR  9. Support for the size of DD-basis, N4=1  10. Scaling factor for active resource counting Kp | 2-35 | Yes | N/A | Rel-16 based Type II doppler codebook is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 5 candidate values  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 7 candidate values: {1, 2, 3}  Component 8 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 4}  Note: When N4=1, OCPU =4  Note: OCPU ≥ 4 when P/SP-CSI-RS is configured for CMR  Note: when K=12, OCPU =8  Note: A UE that supports CSI enhancement for Rel. 16 based type-II doppler must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-1a | Support of Rel-16-based doppler measurement with N4>1 | 1. Support for the size of DD-basis, N4>1  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band simultaneously  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR | 40-3-2-1 | Yes | N/A | Rel-16 based Type II doppler codebook with N4>1 is not supported | Per band  and Per BC | N/A | N/A | N/A | Component 2 candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 3 Candidate values  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-2 | Support R=2 for Rel-16-based doppler codebook | A list of supported combinations {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports}, across all CCs in a band simultaneously, with R=2 | 40-3-2-1 | Yes | N/A | R=2 for Rel-16-based doppler codebook is not supported | Per band and per BC | N/A | 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 |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-5 | Support of M=2 and R=1 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with M=2 and PMI subband R=1  2. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | M=2 and R=1 for Rel-17-based doppler codebook is not supported | Per-band  and Per-BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-6 | Support R=2 for Rel-17-based doppler codebook | 1. Support of Rel-17 FeType-II port selection codebook refinement for predicted PMI with PMI subbands R=2  2. A list of supported combinations, up to 16, across all CCs in a band simultaneously, where each combination is  a) Maximum number of Tx ports in one NZP CSI-RS resource  b) Maximum total number of NZP CSI-RS resource  c) Maximum total number of Tx ports of NZP CSI-RS resources | 40-3-2-4 | Yes | N/A | R=2 for Rel-17-based doppler codebook is not supported | Per band and per BC | N/A | N/A | N/A | Component 2 candidate values:  a) {4, 8, 12, 16, 24, 32}  b) {2,3,4 … 64}  c) {4, …, 256} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-1 | TDCP (Time Domain Channel Properties) report | 1. Support of Y=1 delay value for TDCP report 2. Basic delay value, component candidate value <= D\_basic = 1 slot  3. Support of amplitude report  4. Value of X for CPU occupation (OCPU=(Y+1).X)  5. Support to configure KTRS = 1 TRS resource set  6. Maximum number of simultaneously active CSI-RS resources for TDCP across all CCs in a band | 2-35 | Yes | N/A | Time Domain Channel Properties report is not supported | Per band and Per BC | N/A | N/A | N/A | Component 4 candidate values: {1,2}  Component 6, candidate values {4, 6, 8, 10, 12, 14, 16, 18, 20, 22, …, 60, 62, 64}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-3-5 | Number of CSI-RS resources for TDCP | 1. Maximum number of configured CSI-RS resources for TDCP per CC  2. Maximum number of configured CSI-RS resources for TDCP across all CCs in a band  3. Maximum number of simultaneously active CSI-RS resources for TDCP per CC | 40-3-3-1 | Yes | N/A | Number of CSI-RS resources for TDCP is not reported | Per band and Per BC | N/A | N/A | N/A | Component 1 candidate values: {2, 4, 6, 8, 10, 12}  Component 2 candidate values: {2, 4, 6, 8, 12, … 64}  Component 3 candidate values: {2, 4, 6, 8, 12, 16, 20, 24, 28, 32}  Note: counting of simultaneously active CSI-RS resources follows existing specification TS38.214 | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-4: FG 40-5-5

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-5 | Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching | Support of maximum 2 SP SRS resource sets and maximum 1 periodic SRS resource set for 8T8R antenna switching | 40-5-4 | Yes | n/a | ~~Maximum 2 SP and 1 periodic SRS sets for 8T8R antenna switching is not supported~~ Maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS is supported | Per FS | n/a | n/a | n/a | ~~Note: If UE does NOT support this feature, support maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS~~  Note: The two SP-SRS resource sets are not activated at the same time | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| ZTE | Support. |

### Issue 1-5: FG 40-6-1a/2a

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1a | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—noncodebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—noncodebook  3. Support of two SRS resource sets with usage set to 'noncodebook'  4. Maximum number of SRS resources in one SRS resource set  5. Maximum number of layers of each panel for Single-DCI STx2P with SDM  8. Maximum number of simultaneous transmitted SRS resources from one or two SRS resource set(s) at one symbol | 2-15 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—noncodebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,3, 4}  Component 5 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-2a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook | 2.Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SFN and sTRP  3. 1 PTRS port for single-DCI based STx2P SFN scheme for PUSCH—noncodebook  4. Support of two SRS resource sets with usage set to 'noncodebook'  5. Maximum number of SRS resources in one SRS resource set  6. Maximum number of MIMO layers of each SRS resource set for NCB PUSCH with SFN scheme  8. Maximum number of simultaneous transmitted SRS resources from one or two SRS resource set(s) at one symbol | 2-15 | Yes | n/a | Single-DCI based STx2P SFN scheme for PUSCH—noncodebook is not supported | Per FSPC | n/a | FR2 only | n/a | Component 5 candidate values: {1, 2 ,3, 4}  Component 6 candidate values: {1, 2}  Component 8 candidate values: {1, 2, 3, 4} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-6: FG 40-6-5

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

* **Alt. 1**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-5 | Support grouped-based beam reporting for STx2P | 1. Support group based L1-RSRP reporting for STxMP based transmission  2. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  3. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  4. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs | 23-5-1 | Yes | n/a | Grouped-based beam reporting for STx2P is not supported | Per Band | n/a | FR2 only | n/a | Component 1 candidate values: {JointULandDL, ULOnly, both}  Component 2 candidate values: {1,2,3,4}  Component 3 candidate values: {2,3,4,8,16,32,64}  Component 4 candidate values: {8, 16, 32, 64, 128}  Note: components 3 and 4 are also counted in FG 16-1g, 16-1g-1, and 23-5-1  NOTE: If the UE sets a value other than *n0* in an FR1 band, it shall set that same value in all FR1 bands. If the UE sets a value other than *n0* in an FR2 band, it shall set that same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells | Optional with capability signaling |

* **Alt. 2**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-5 | Support grouped-based beam reporting for STx2P | 1. Support group based L1-RSRP reporting for STxMP based transmission  2. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  3. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs in a band  4. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs in a band | 23-5-1 | Yes | n/a | Grouped-based beam reporting for STx2P is not supported | Per Band | n/a | FR2 only | n/a | Component 1 candidate values: {JointULandDL, ULOnly, both}  Component 2 candidate values: {1,2,3,4}  Component 3 candidate values: {2,3,4,8,16,32,64}  Component 4 candidate values: {8, 16, 32, 64, 128}  Note: components 3 and 4 are also counted in FG 16-1g, 16-1g-1, and 23-5-1 | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-7: FG 40-7-1a/b/c/d

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-4 | SRS 8 Tx ports—antenna switching | 1. Support of 8T8R for antenna switching  2. Downgrade antenna switching configurations  3. Report the entry number of the first-listed band with UL in the band combination that affects this DL  4. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-53 | Yes | n/a | SRS with 8 Tx ports—antenna switching is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: {noTDM, TDM and noTDM}  Component 2 candidate value: combination (including empty) of {1T1R, 1T2R, 1T4R, 1T6R, 1T8R, 2T2R, 2T4R, 2T6R, 2T8R, 4T4R, 4T8R}  Component 3 candidate value: {1,2,…,32}  Component 4 candidate value: {1,2,…,32}  Note: UE reports support of SRS with 8 Tx ports and Comb8 mapping —antenna switching via FG 23-8-8  Note: UE reporting support of TDM SRS should be able to transmit at *P\_CMAX* per OFDM symbol with 4 ports | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1 | Basic features for Codebook-based 8Tx PUSCH | 1. Maximum number of PUSCH MIMO layers for codebook based PUSCH  2. Maximum number of 8 port SRS resources per SRS resource set with usage set to 'codebook’ for codebook-based 8Tx PUSCH  3. SRS 8 Tx ports—for codebook2/ codebook3/ codebook4 |  | Yes | n/a | Codebook-based 8Tx PUSCH is not supported | Per FSPC | No | No | No | Component 1 candidate values: {1,2 ,3,4 ,5,6,7,8}  Component 2 candidate values: {1,2}  ~~Component 3 candidate values: {noTDM, TDM and noTDM}~~  A UE that supports FG 40-7-1 must support at least one of FGs 40-7-1a/b/c/d  Note: UE reporting support of TDM SRS should be able to transmit at *P\_CMAX* per OFDM symbol with 4 ports | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1a | Codebook-based 8Tx PUSCH—codebook1 | 1. Support of codebook-based 8Tx PUSCH—codebook1  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1  3. SRS 8 Tx ports—codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | ~~2.~~ Component 2 candidate values: {~~(4,1)~~ng1n4n1, ~~(2,2)~~ng1n2n2, both}  Component 3 candidate values: {noTDM, TDM and noTDM} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1b | Codebook-based 8Tx PUSCH—codebook2 | 1. Support of codebook-based 8Tx PUSCH—codebook2  2. SRS 8 Tx ports—codebook2 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook2 is not supported | Per FSPC | No | No | No | Component 2 candidate values: {noTDM, TDM and noTDM} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1c | Codebook-based 8Tx PUSCH—codebook3 | 1. Support of codebook-based 8Tx PUSCH—codebook3  2. SRS 8 Tx ports—codebook3 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook3 is not supported | Per FSPC | No | No | No | Component 2 candidate values: {noTDM, TDM and noTDM} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1d | Codebook-based 8Tx PUSCH—codebook4 | 1. Support of codebook-based 8Tx PUSCH—codebook4  2. SRS 8 Tx ports—codebook4 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook4 is not supported | Per FSPC | No | No | No | Component 2 candidate values: {noTDM, TDM and noTDM} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| ZTE | For 40-7-1a, the component ‘SRS 8 Tx ports—codebook1’ is needed, and the correspondin candidate value should be ‘nonTDM’ and ‘TDM and nonTDM’, because whether the coherence between 8-port TDM SRS and 8-port fully-coherent PUSCH is up to UE capability.  For 40-7-1b/40-7-1c/40-7-1d, the component ‘SRS 8 Tx ports—codebook2’/‘SRS 8 Tx ports—codebook3’/‘SRS 8 Tx ports—codebook4’ is not needed, because the SRS ports belong to a same antenna port group are transmitted over same OFDM symbol, and the coherence between SRS ports belonging to a same coherent antenna group and PUSCH ports belonging to the same coherent antenna port group naturally holds. In other words, the coherence is not up to UE capability, and the corresponding component is not needed. |

### Issue 1-8: FG 40-7-1g-1

**Proposal:**

* **Alt. 1: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | yes | n/a | SRS resources for UL full power transmission mode 2 cannot be signaled | Per FSPC | n/a | n/a | n/a | Component 1 candidate values: ~~3~~2 bit bitmap {b0, b1~~, b2~~}  b0 indicates whether SRS resource can be configured with ~~1~~2 port  b1 indicates whether SRS resource can be configured with ~~2~~4 port  ~~b2 indicates whether SRS resource can be configured with 4 port~~ | Optional with capability signalling |

* **Alt. 2**
  + **Define two groups of 8 Tx full power Mode 2 precoders/TPMIs for FG 40-7-1g-2 according to the maximum rank supported by the UE for 8 Tx, where the full power precoders constitute a single non-zero submatrix in the intermediate precoder matrix from 38.211. The UE indicates support for only one of the groups**
    - **Note that the proposal above for 40-7-1g-2 should be captured directly in 38.306, as was done for Rel-16 UL FPTx Mode 2, since it is not straightforwardly included in the feature lists.**
  + **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-1g-1 | SRS resources for UL full power transmission mode 2 | 1. SRS configurations with different number of antenna ports per SRS resource for mode 2 | 40-7-1g | yes | n/a | SRS resources for UL full power transmission mode 2 cannot be signaled | Per FSPC | n/a | n/a | n/a | ~~Component 1 candidate values: 3 bit bitmap {b0, b1, b2}~~  ~~b0 indicates whether SRS resource can be configured with 1 port~~  ~~b1 indicates whether SRS resource can be configured with 2 port~~  ~~b2 indicates whether SRS resource can be configured with 4 port~~  Component 1 candidate values:{1\_8, 1\_2\_8, 1\_4\_8, 1\_2\_4\_8}  1st state (1\_8): each SRS resource can be configured with 1 port or 8 ports  2nd state (1\_2\_8): each SRS resource can be configured with 1 port or 2 ports or 8 ports  3rd state (1\_4\_8): each SRS resource can be configured with 1 port or 4 ports or 4 ports  4th state (1\_2\_4\_8): each SRS resource can be configured with 1 port or 2 ports or 4 ports or 8 ports  Note: Any of the above states can be used if 40-7-1g is reported as 2 or 4. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-9: FG 40-7-2a

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

* **Alt. 1**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} ~~across all CCs~~ simultaneously | 40-7-2 | yes | n/a | Association between CSI-RS and SRS for non-codebook case is not supported | Per FSPC | No | No | No | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256}  Note: Component 2 is reported per BC | Optional with capability signalling |

* **Alt. 2**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-7-2a | Association between CSI-RS and SRS for non-codebook case | 1. Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRS-ResourceSet" for noncodebook 8Tx PUSCH operation  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources, and total # of Tx ports} across all CCs in a band simultaneously | 40-7-2 | yes | n/a | Association between CSI-RS and SRS for non-codebook case is not supported | Per FS~~PC~~ | No | No | No | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {1 to 64}  The candidate value set of total # of ports is:  {2 to 256} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-10: New FG

**Proposal: Introduce the following new FG/row**

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| 40-1-14 | Two PHR reporting for STx2P | Support of PHR reporting related to STx2P | At least one of 40-6-1, 40-6-1a, 40-6-2, 40-6-2a, 40-6-3a, 40-6-3b | UE will report a PHR for an actual PUSCH transmission and PHR for the first indicated TCI state or PHR associated with coresetPoolIndex0 is reported if actual PUSCH transmission is based on STx2P schemes | Per Band | FR2 only | Note: If gNB does not configure corresponding RRC parameter for this FG, UE will report a PHR for an actual PUSCH transmission and PHR for the first indicated TCI state or PHR associated with coresetPoolIndex0 is reported if actual PUSCH transmission is based on STx2P schemes | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-11: New FGs

**Proposal: Introduce the following new FGs/rows**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40-6-3a-1 | UE STxMP processing capability for codebook | 1. Require additional timeline to process multiple TBs for codebook multi-DCI based STx2P PUSCH+PUSCH for DG+DG  Note. This FG can be applied for CG+DG also if UE can support those FG. | 40-6-3a | UE should process multiple TBs within legacy timeline | Per FSPC | FR2 only | candidate values:  UE reports candidate value independently for each SCS in unit of symbols  For 15kHz SCS: {1,2}  For 30kHz SCS: {1,2,4}  For 60kHz SCS: {2,4,8}  For 120kHz SCS: {4,8,16}  For 480kHz SCS: {16,32,64}  For 960kHz SCS: {32,64,128} | Optional with capability signalling |
| 40-6-3b-2 | UE STxMP processing capability for noncodebook | 1. Require additional timeline to process multiple TBs for noncodebook multi-DCI based STx2P PUSCH+PUSCH for DG+DG  Note. This FG can be applied for CG+DG also if UE can support those FG. | 40-6-3b | UE should process multiple TBs within legacy timeline | Per FSPC | FR2 only | candidate values:  UE reports candidate value independently for each SCS in unit of symbols  For 15kHz SCS: {1,2}  For 30kHz SCS: {1,2,4}  For 60kHz SCS: {2,4,8}  For 120kHz SCS: {4,8,16}  For 480kHz SCS: {16,32,64}  For 960kHz SCS: {32,64,128} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-12: New FG

**Proposal: Introduce the following new FG/row**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3r | multi-DCI STx2P PUSCH with different PHY priorities | Support of multi-DCI STx2P PUSCH with different PHY priorities | 12-1 | Yes | N/A | Multi-DCI STx2P PUSCH with different PHY priorities is not supported | Per FS | No | FR2 only | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-13: New FG

**Proposal: Introduce the following new FG/row**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3q | multi-DCI based STx2P for PUSCH+PUSCH and repetition in time for at least one of the PUSCHs | 1. Support of multi-DCI based STx2P for PUSCH+PUSCH and semi-static indication of PUSCH repetitions over multiple slots  2. Support of multi-DCI based STx2P for PUSCH+PUSCH and dynamic indication of repetition Type-A  3. Support of multi-DCI based STx2P for PUSCH+PUSCH and dynamic indication of repetition Type-B | 40-6-3a, or 40-6-3b | Yes | N/A | UE cannot be indicated to perform multi-DCI based STx2P PUSCH over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-14: New FG

**Proposal: Introduce the following new FG/row**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a2 | Additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP | Support of additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP | 40-4-5 | Yes | n/a | Additional row(s) for antenna ports (0,2,3) for Rel.18 UL DMRS ports for single-DCI based M-TRP are not supported | Per FS | No | No | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-15: New FGs

**Proposal: Introduce the following new FGs/rows**

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1c | Single-DCI based STx2P SDM scheme for PUSCH and repetition in time | 1. Support of single-DCI based STx2P SDM scheme and semi-static indication of PUSCH repetitions over multiple slots  2. Support of single-DCI based STx2P SDM scheme and dynamic indication of repetition Type-A  3. Support of single-DCI based STx2P SDM scheme and dynamic indication of repetition Type-B | 40-6-1 or 40-6-1a | Yes | N/A | UE cannot be indicated to perform single-DCI based STx2P SDM scheme over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-2c | Single-DCI based STx2P SFN scheme for PUSCH and repetition in time | 1. Support of single-DCI based STx2P SFN scheme and semi-static indication of PUSCH repetitions over multiple slots  2. Support of single-DCI based STx2P SFN scheme and dynamic indication of repetition Type-A  3. Support of single-DCI based STx2P SFN scheme and dynamic indication of repetition Type-B | 40-6-2 or 40-6-2a | Yes | N/A | UE cannot be indicated to perform single-DCI based STx2P SFN scheme over R15/16 PUSCH repetitions in time | Per FSPC | No | FR2 only | n/a | Notes:  For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14.  For component 2, UE also reports FG11-6.  For component 3, UE also reports FG11-5. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-16: Rel-17 UE capabilities

* **For mTRP-CSI-EnhancementPerBC-r17, “across all CCs” means “across all CCs in the band combination”**
* **For mTRP-CSI-EnhancementPerBand-r17, “across all CCs” means “across all CCs within the reported band”**

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| Company | Comments/Questions/Suggestions |
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| 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1  Note: If the UE includes values for component 4 in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes values for component 4 in an FR2 band, it shall set the same value in all FR2 bands. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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| 23-2-1d | PDCCH repetition for Case 2 PDCCH monitoring with a span gap | 1. Support of PDCCH repetition for PDCCH monitoring of any occasions with span gap as defined in FG 3-5b.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs in a [band/BC] | 3-5b, 23-2-1 | Yes |  | PDCCH repetition for Case 2 PDCCH monitoring with a span gap is not supported | Per FS | n/a | n/a | n/a | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 44, 64, no limit}  Component 4 candidate values: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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## NR\_pos\_enh2

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 2-1: Typos/Corrections

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 41. NR\_pos\_enh2 | 41-1-7a | SL PRS measurement for SL-RSTD | 1. Support SL RSTD measurement based on SL-PRS  2. Support SL RSTD measurement reporting  3. Maximum number of SL RSTD measurement reporting for different SL-PRS reception for the same pair of UEs | 41-1-1 | No | No | UE does not support SL PRS measurement for SL-RSTD | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Comp~~o~~onent 3 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-7c | SL PRS measurement for UE Rx – Tx time difference without Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting without Tx time stamp  3. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs~~]~~ | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for Rx – Tx time difference without Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-7d | SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | 1. Support UE Rx – Tx time difference measurement based on SL PRS  2. Support UE Rx – Tx time difference measurement reporting with Tx time stamp  3. Reporting M Rx-Tx measurements for the same SL-PRS transmission (or reception) and different SL-PRS reception (or transmission) for the same pair of UEs  4. Maximum number of Rx-Tx measurement reporting for different SL-PRS reception for the same pair of UEs~~]~~ | 41-1-1, at least one of 41-1-4a/b/c | No | No | UE does not support SL PRS measurement for UE Rx – Tx time difference with Tx time stamp | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values of M={1,2,3,4}  Component 4 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-2-11 | Finer timing reporting granularity for PRS measurement | Supported ReportingGranularityfactors ~~-1 >=~~ X |  | No | N.A. | Reporting Granularity cannot be signalled | Per band | N.A. | N.A. | N.A. | Component 1 candidate values for X: {-6, -5, -4, -3, -2, -1}  Need for location server to know if the feature is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | OK |

### Issue 2-2: FG 41-1-3

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {~~[~~floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)~~]~~}  Component 4 candidate values: ~~CP length:~~ {NCP,NCP and ECP}  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 | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | OK |

### Issue 2-3: FGs 41-1-2/3/4a/b/c

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-1-2 | Receiving SL-PRS in a shared resource pool | 1. Support SL-PRS in shared resource pool  2. Support receiving SCI format 2D | 15-1 41-1-1 | Yes | No | Receiving SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Note: UE shall also support receiving SL PRS transmission request included SCI format 2D | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-3 | Receiving SL-PRS in a dedicated resource pool | 1. Support SL-PRS in dedicated resource pool  2. Support receiving SCI format 1B  3. UE can receive X PSCCH in a slot  4. Supported CP type for 60 kHz SCS | 41-1-1 | Yes | No | Receiving SL-PRS in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Component 3 candidate values: {[floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)]}  Component 4 candidate values: ~~CP length:~~ {NCP,NCP and ECP}  Note: UE shall also support receiving SL PRS transmission request included SCI format 1B | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D | 15-2 or 15-3, 41-1-2 | Yes | No | Transmitting SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | The supported resource allocation modes are the same as for communication and signaled in FGs 15-2 and 15-3  Need for location server/UE to know if the feature is supported  Note: UE shall also support sending SL PRS transmission request included SCI format 2D | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4b | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated SL PRS resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  4. Support receiving DCI format 3\_2  5. Support downlink pathloss based open loop power control of SL-PRS | 41-1-3 | Yes | No | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/UE to know if the feature is supported  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: UE shall also support sending SL PRS transmission request included SCI format 1B | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4c | Transmitting SL-PRS mode 2 in a dedicated resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B | at least one of {41-1-8, 41-1-10} | Yes | No | Transmitting SL-PRS mode 2 in a dedicated resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/ UE to know if the feature is supported  Note: UE shall also support sending SL PRS transmission request included SCI format 1B | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Whether these FGs also mean that the UE shall support the physical layer SL PRS request, is also related to the new FG issue 2-9. At the same time, note that there are ongoing discussions in RAN2 to add a higher layer request; in which case, the physical layer request doesn’t need to be mandated. |

### Issue 2-4: p0-OLPC-Sidelink-r17

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-1-4a | Transmitting SL-PRS in a shared resource pool | 1. Support of transmitting SL-PRS in a shared resource pool  2. Support transmitting SCI format 2D | 15-2 or 15-3, 41-1-2 | Yes | No | Transmitting SL-PRS in a shared resource pool is not supported | Per band | n/a | n/a | n/a | The supported resource allocation modes are the same as for communication and signaled in FGs 15-2 and 15-3  Need for location server/UE to know if the feature is supported  Note: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-4b | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool | 1. UE can transmit SL-PRS and PSCCH within a slot without PSSCH in dedicated SL PRS resource pool  2. UE can transmit SL-PRS according to the mapping rule between PSCCH and SL-PRS  3. Support transmitting SCI format 1B  4. Support receiving DCI format 3\_2  5. Support downlink pathloss based open loop power control of SL-PRS | 41-1-3 | Yes | No | Transmitting SL-PRS mode 1 in a dedicated SL PRS resource pool is not supported | Per band | n/a | n/a | n/a | Need for location server/UE to know if the feature is supported  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: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-17 | Open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool | Support of open loop SL pathloss based power control for SL-PRS and associated PSCCH and SL RSRP report for dedicated resource pool for unicast transmissions | at least one of 41-1-4b or 41-1-4c | Yes | Yes | Open loop SL power control and SL RSRP report for dedicated resource pool is not supported for unicast transmissions | Per band | n/a | n/a | n/a | Note: If UE indicates support of *p0-OLPC-Sidelink-r17*, the range of P0 values associated with p0-OLPC-Sidelink-r17 is used for SL PRS transmission | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | We are OK with the note for 41-1-4a and 41-1-4b, but for 41-1-17 is it really needed? 41-1-17 is for SL pathloss; I thought the *p0-OLPC-Sidelink-r17* is about DL pathloss, but I am open for further dsicsusion for 41-1-17. |

### Issue 2-5: FG 41-1-10

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-1-10 | Support of full sensing in a dedicated resource pool | 1. UE can transmit SL-PRS and associated PSCCH using full sensing  2. Support DL pathloss based open loop power control when configured by NR Uu  3. UE can receive X PSCCH in a slot |  | Yes | No | UE cannot transmit SL-PRS using full sensing in a dedicated resource pool | Per band | n/a | n/a | n/a | Component 3 candidate values: {4,8}  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 2 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: UE supporting this FG also support receiving SCI format 1B | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | OK |

### Issue 2-6: FGs 41-2-8/9/10

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-2-8 | Support to perform ~~legacy~~ DL PRS-RSRP, DL PRSR-RSRPP, DL RSTD measurements inside the indicated time window only for DL TDoA | Support to perform ~~legacy~~ measurements inside the indicated time window only for DL TDoA | 13-3a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for ~~legacy~~ PRS measurements for DL TDoA in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-2-9 | Support to perform ~~legacy~~ DL PRS-RSRP, DL PRSR-RSRPP, UE Rx-Tx measurements inside the indicated time window only for multi-RTT | Support to perform ~~legacy~~ measurements inside the indicated time window only for multi-RTT | 13-4a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for ~~legacy~~ PRS measurements for multi-RTT in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-2-10 | Support to perform ~~legacy~~ DL PRS-RSRP, DL PRSR-RSRPP measurements inside the indicated time window only for DL AoD | Support to perform ~~legacy~~ measurements inside the indicated time window only for DL AoD | 13-2a | No | N/A | The UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for ~~legacy~~ PRS measurements for DL AoD in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window | Per band | No | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | OK |

### Issue 2-7: FG 41-3-3

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 41. NR\_pos\_enh2 | 41-3-3 | Support of PRS measurement in RRC\_IDLE | Support of DL PRS measurement in RRC\_IDLE for DL-TDOA and/or DL-AoD ~~Rel. 17 methods~~ the UE supports in RRC\_INACTIVE | 13-1, at least one of {27-18a, 27-18b}, 27-6~~}~~ | No | n/a | PRS measurements in RRC\_IDLE not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling. |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | OK |

### Issue 2-8: New FGs

**Proposal: Introduce the following new rows/FGs**

* **Alt. 1**

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| 41. NR\_pos\_enh2 | 41-1-20a | Supports SL PRS reception for a band configured with SL CA | 1. Support of SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-2 or 41-1-3}, 47-v1 | Yes | No | UE does not support SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-20b | Supports SL PRS tranmsission for a band configured with SL CA | 1. Support of SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-4a, 41-1-4b or 41-1-4c}, 47-v1 | Yes | No | UE does not support SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling |

* **Alt. 2**

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| 41. NR\_pos\_enh2 | 41-1-20a | SL PRS transmission for a band configured with SL CA | Support SL PRS transmission for a band configured with SL CA | 47-v1 | Yes | Yes | SL PRS transmission for a band configured with SL CA is not supported | Per band | N.A. | N.A. | N.A. | Need for location server/UE to know if the feature is supported.  Note: In a shared SL PRS resource pool in a single SL carrier: Tx power control follows the rule defined for SL CA in NR Rel-18.  Note: In a dedicated SL PRS resource pool in a single SL carrier when the slots (pre)configured for the dedicated SL PRS resource pool do not collide with the slots (pre)configured for any other resource pool or S-SSB resource(s) in other carriers. | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-20b | SL PRS reception for a band configured with SL CA | Support SL PRS reception for a band configured with SL CA | 47-v1 | Yes | Yes | SL PRS reception for a band configured with SL CA is not supported | Per band | N.A. | N.A. | N.A. | Need for location server/UE to know if the feature is supported.  Note: In a shared SL PRS resource pool in a single SL carrier: Tx power control follows the rule defined for SL CA in NR Rel-18.  Note: In a dedicated SL PRS resource pool in a single SL carrier when the slots (pre)configured for the dedicated SL PRS resource pool do not collide with the slots (pre)configured for any other resource pool or S-SSB resource(s) in other carriers. | Optional with capability signaling |

* **Alt. 3**

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| 41. NR\_pos\_enh2 | 41-1-xx | Supports SL PRS Rx for a band configured with SL CA | 1. Support of SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-2 or 41-1-3}  47-v1 | Yes | No | UE does not support SL PRS reception for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-xx | Supports SL PRS Tx for a band configured with SL CA | 1. Support of SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | One of {41-1-4a, 41-1-4b or 41-1-4c}  47-v1 | Yes | No | UE does not support SL PRS transmission for a shared SL PRS resource pool and/or a dedicated SL PRS resource pool for a band configured with SL CA | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported | Optional with capability signaling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | OK to support Alt. 2. If we go with Alt 1/3, we need to add the Notes that appear in Alt. 2 |

### Issue 2-9: New FG

**Proposal:**

* **Introduce the following new row/FG**
* **Send an LS to RAN2 to inquire on the specification support of higher layer mechanism for a UE to request the SL PRS transmission from another UE**

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| 41. NR\_pos\_enh2 | 41-1-21 | SL-PRS transmission request in physical layer | 1. Support transmitting SL-PRS transmission request via SCI  2. Support receiving SL-PRS transmission request via SCI |  | No | Yes | SL-PRS transmission request in physical layer cannot be signalled | Per band | No | No | No |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Qualcomm | Support |

### Issue 2-10: LTE FGs

**Proposal: Capture the following FGs in the LTE UE feature list: 41-1-1, 41-1-1a, 41-1-2, 41-1-3, 41-1-4c, 41-1-4d, 41-1-5, 41-1-7x, 41-1-8, 41-1-10, 41-1-11, 41-1-12, 41-1-12, 41-1-13, 41-1-13b, 41-1-14, 41-1-18, 41-1-19, 41-1-20a, 41-1-20b**

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | Support |

### Issue 2-11: LS to RAN2

**Proposal: Send an LS to RAN2 that for positioning UE feature**

* **A component in a FG without candidate values means that UE shall support it without any additional signalling**
  + **For example, component 8 of FG 41-4-6/7/8 does not need any signaling**
* **Components in a FG with candidate values (i.e. requires capability signaling) should be mandatory**

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Qualcomm | Not needed |

## Netw\_Energy\_NR

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 3-1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 42. Netw\_Energy\_NR | 42-1 | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for periodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP | ~~FFS~~ | Yes |  | UE does not support spatial domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to all sub-configurations contain~~s~~ one port subset  Note: SD-type2 refers to all sub-configurations contain~~s~~ list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values: SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values: SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUSCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | ~~FFS~~ One of {42-1, 42-1b} | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to all sub-configurations contain~~s~~ one port subset  Note: SD-type2 refers to all sub-configurations contain~~s~~ list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: A UE shall declare the same value for component 9 to indicate the combined total limit for PUCCH and PUSCH  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for semi-persistent CSI reporting on PUCCH  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | ~~FFS~~ One of {42-1, 42-1b} | Yes |  | UE does not support spatial domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to all sub-configurations contain~~s~~ one port subset  Note: SD-type2 refers to all sub-configurations contain~~s~~ list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128}  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4}  Note: Components 6 and 7 are signaled per BC  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Notes: The value reported for Components 2 and 3 is no larger than the value reported for Components 2 and 3 in FG 42-1a (if supported), respectively  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: A UE shall declare the same value for component 9 to indicate the combined total limit for PUCCH and PUSCH  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one port subset configuration/list of CSI-RS resource IDs for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across aperiodic CSI report settings with sub-configurations per BWP | ~~FFS~~ | Yes |  | UE does not support spatial domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 1 candidate values: {SD-type1, SD-type2, SD-type1and2}  Note: SD-type1 refers to all sub-configurations contain~~s~~ one port subset  Note: SD-type2 refers to all sub-configurations contain~~s~~ list of CSI-RS resource IDs  Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4}  Component 4 candidate values: SD Type 1: {1, 2, 3 … 32} SD Type 2: {1, 2, 3 … 32}  Component 5 candidate values:  SD Type 1: {8, 16, 24, … 128 } SD Type 2: {8, 16, 24, … 128 }  Component 6 candidate values:  SD Type 1: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} SD Type 2: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values:  SD Type 1: {8, 16, 24, …, 248, 256} SD Type 2: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11,12}  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2 | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for periodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of periodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across periodic CSI report settings with sub-configurations per BWP | ~~FFS~~ | Yes |  | UE does not support power domain adaptation for periodicCSI reporting | Per band | No | No | N/A | Component 2 candidate value: {2,3,4}  Component 4 candidate value: {1, 2, 3 … 32}  Component 5 candidate value: {8, 16, 24, … 128 }  Component 6 candidate value: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate value: {8, 16, 24, …, 248, 256}  Note: Components 6 and 7 are signaled per BC  Component 9 candidate values: {2, 3, 4}  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting  1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | ~~FFS~~ One of {42-2, 42-2b} | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUSCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128 }  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4,5,6,7,8,9,10,11,12}  Note: Components 5 and 6 are signaled per BC  Note: The value reported in component 3 or 4 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 5 or 6 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 8 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: A UE shall declare the same value for component 8 to indicate the combined total limit for PUCCH and PUSCH  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for semi-persistent CSI reporting on PUCCH  1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration.  3. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  4. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  6. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Support of single-panel type 1 codebook  8. Supported total number of semi-persistent CSI reporting settings without sub-configurations plus the total number of sub-configurations across semi-persistent CSI report settings with sub-configurations per BWP | ~~FFS~~ One of {42-2, 42-2b} | Yes |  | UE does not support power domain adaptation for semi-persistent CSI reporting on PUCCH | Per band | No | No | N/A | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4}  Component 3 candidate values: {1, 2, 3 … 32}  Component 4 candidate values: {8, 16, 24, … 128}  Component 5 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 6 candidate values: {8, 16, 24, …, 248, 256}  Component 8 candidate values: {2, 3, 4}  Note: Components 5 and 6 are signaled per BC  Note: The value reported in component 3 or 4 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 5 or 6 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations.  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Notes: The value reported for Components 2 and 3 is no larger than the value reported for Components 2 and 3 in FG 42-2a (if supported), respectively  Note: the value reported in component 8 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: A UE shall declare the same value for component 8 to indicate the combined total limit for PUCCH and PUSCH  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 1. Support of CSI feedback based on CSI report sub-configuration(s), each containing one power offset for aperiodic CSI reporting  2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration  4. Supported maximum number of simultaneous NZP-CSI-RS resources per CC  5. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC  6. Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  7. Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs in a band combination  8. Support of single-panel type 1 codebook  9. Supported total number of aperiodic CSI reporting settings without sub-configurations plus the total number of sub-configurations across aperiodic CSI report settings with sub-configurations per BWP | ~~FFS~~ | Yes |  | UE does not support power domain adaptation for aperiodic CSI reporting | Per band | No | No | N/A | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3 … 32}  Component 5 candidate values: {8, 16, 24, … 128 }  Component 6 candidate values: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}  Component 7 candidate values: {8, 16, 24, …, 248, 256}  Component 9 candidate values: {2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}  Note: Components 6 and 7 are signaled per BC  Note: The value reported in component 4 or 5 is used for a CC when a CSI report configuration in the active BWP of the CC includes report setting(s) with sub-configurations.  Note: The value reported in component 6 or 7 is used when a CSI report configuration in the active BWP of any CC includes report setting(s) with sub-configurations  Note: For components 4/5/6/7, the same value should be reported in FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b regardless of P/SP/AP-CSI report or SD/PD or PUCCH/PUSCH as in legacy FG 2-33. For components 4/5, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CCs only configured with legacy CSI-report(s). And for components 6/7, the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b are applied for CC sets in which at least one CC is configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 are used for CC sets in which all CCs are only configured with legacy CSI-report(s).  Note: the value reported in component 9 is used instead of the values in FG2-35 for BWP when CSI report configuration in the BWP includes report setting(s) with sub-configurations  Note: For components 4~7 in FG42-1, 42-1a/b/c, 42-2, 42-2b and components 3~6 in FG42-2a/c, NZP-CSI-RS resource and CSI-RS ports are counted for legacy reporting settings, Rel-18 reporting settings across all reporting types and all types of adaptation. The UE shall declare the same value in all of FG42-1, 42-1a/b/c, 42-2, 42-2a/b/c to indicate the combined total limit across legacy reporting settings plus all Rel-18 reporting types and adaptation methods the UE supports | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-8 | simultaneousCSI-SubReportsPerCC-r18 | Indicates the number of CSI report(s) for which the UE can measure and process reference signals simultaneously in a CC of the band for which this capability is provided. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsPerCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports | ~~FFS~~ | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per Band | No | No | N/A | Component 1 candidate values: {1, 2, 3, 4, 5, 6, 7, 8}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsPerCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling |
| 42. Netw\_Energy\_NR | 42-9 | simultaneousCSI-SubReportsAllCC-r18 | Indicates whether the UE supports CSI report framework and the number of CSI report(s) which the UE can simultaneously process across all CCs, and across MCG and SCG in case of NR-DC. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-SubReportsAllCC-r18* includes the beam report, and CSI report without sub-configurations plus CSI sub-report across CSI reports. This parameter may further limit *simultaneousCSI-SubReportsPerCC-r18* in MIMO-ParametersPerBand and Phy-ParametersFRX-Diff for each band in a given band combination | ~~FFS~~ | Yes |  | UE does not support spatial or power domain adaptation for CSI reporting | Per BC | No | No | N/A | Component 1 candidate values: {5, 6, 7, ..., 32}  Note: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsAllCC*  Note: UE supporting at least one of FG 42-1/1a/1b/1c/2/2a/2b/2c shall report this FG | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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## NR\_Mob\_enh2

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 4-1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 45. NR\_Mob\_enh2 | 45-1 | Intra-frequency L1 measurement and reports for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on SSB(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement  ~~4. Support of up to L candidate cells and M beams in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement~~  3. Maximum number of candidate cells in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  4. Maximum number of beams per candidate cell in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  5. Maximum total number of beams per in one report where a SSBRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  ~~5~~6. Maximum number of periodic LTM CSI report configs per BWP  7. Maximum number of aperiodic LTM CSI report configs per BWP  8. Maximum number of semi-persistent LTM CSI report configs per BWP | 2-21 or 2-22 or 2-23 or 2-23a | Yes | No | UE does not support intra-frequency L1 measurement and reports for Rel-18 LTM operation | Per BC | No | No | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component ~~4~~3 candidate values: ~~L:~~ {1, 2,3,4}  Component 4 candidate values: ~~M:~~ {1, 2,3,4}  Component 5 candidate values:  {1,2,3,4, 6, 8, 9, 12, 16}  ~~M × L: {1,2,3,4, 6, 8, 9, 12, 16}~~  Component ~~5~~6 candidate values: ~~Aperiodic:~~ {~~0,~~1,2,3,4}  Component 4 candidate values ~~Periodic~~: {0,1,2,3,4}  Component 4 candidate values ~~Semi-persistent~~: {0,1,2,3,4} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 4-2: Prerequisites

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 45. NR\_Mob\_enh2 | 45-3 | Beam indication with joint DL/UL LTM TCI states | 1. Support of unified TCI with joint DL/UL LTM TCI-state indication for LTM procedure.  2. Maximum number of configured joint LTM TCI state(s) per candidate cell  3. Support of indicating and activating a single joint LTM TCI state in a cell switch command.  4. Supported QCL source RS in the LTM TCI-stateconfiguration  5. Maximum number of configured joint LTM TCI state(s) across candidate cells  6. Maximum number of configured cells for joint LTM TCI states | ~~23-1-1,~~ RAN2 FG for LTM | Yes | No | UE does not support Beam indication with joint DL/UL LTM TCI states | Per band | No | No | n/a | Component 2 candidate values: {8, 12, 16, 24, 32, 48, 64, 128}  Component 4 candidate values: {SSB, TRS, both}  Component 5 candidate values: {8, 16, 24, 32, …, 1024}  Component 6 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |
| 45. NR\_Mob\_enh2 | 45-4 | Beam indication with separate DL/UL LTM TCI states | 1. Support of unified TCI with separate DL/UL TCI-state indication for LTM procedure.  2. Maximum number of configured DL TCI state(s) per candidate cell  3. Maximum number of configured UL TCI state(s) per candidate cell  4. Support of indicating and activating a pair of UL/DL TCI-state in a cell switch command.  5. Supported QCL source RS in the LTM TCI-state configuration  7. Maximum number of configured separate DL LTM TCI state(s) across candidate cells  8. Maximum number of configured separate UL LTM TCI state(s) across candidate cells  9. Maximum number of configured cells for separate DL/UL LTM TCI states | ~~23-10-1,~~ RAN2 FG for LTM | Yes | No | UE does not support Rel-18 LTM operation with separate DL/UL TCI states | Per band | No | No | n/a | Component 2 candidate values: {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate values: {4, 8, 12, 16, 24, 32, 48, 64}  Component 5 candidate values: {SSB, TRS, both}  Component 7 candidate values: {8, 16, 24, 32, …, 1024}  Component 8 candidate values: {4, 8, 12, 16, …, 512}  Component 9 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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## NR\_NTN\_enh

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 5-1: FG 44-1

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 44. NR\_NTN\_enh | 44-1 | PUCCH repetition on common PUCCH resource | 1. Support repetition transmission of PUCCH for Msg4 HARQ-ACK on common PUCCH resource (i.e., PUCCH resource before dedicated configuration is provided)  2. Support receiving repetition factor in system information  3. Support receiving repetition factor in DCI format 1\_0 with CRC scrambled by TC-RNTI scheduling Msg4 PDSCH  4. Support Msg3 to report capability for PUCCH Msg4 HARQ-ACK repetition  5. Extension of the repetition transmission of PUCCH before dedicated PUCCH resource configuration  6. Support of RSRP threshold for Msg4 HARQ-ACK repetition on common PUCCH resources |  | Yes | No | UE does not support PUCCH repetition for common PUCCH resources | Per Band | N/A | N/A | N/A | A UE that includes LCID codepoint = one of {2, 3, 4, 5, 6, 7} for UL CCCH when the LX field is set to 1 must support FG 44-1  ~~[~~Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and 5.2.3-1 ~~[TBD for FR2-NTN bands]~~  in TS 38.101-5 ~~[~~and HAPS operation bands in Clause 5.2 of TS 38.104~~]~~ | Optional without capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 5-2: FG 44-3

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 44. NR\_NTN\_enh | 44-3 | UE Rx-Tx Measurement and Report for Multi-RTT with single satellite in NTN | 1. Support UE Rx-Tx time difference and UE Rx-Tx time difference offset measurement based on single sample and report for Multi-RTT positioning with single satellite in NTN  2. Support of reporting DL timing drift due to Doppler over the service link associated with the UE Rx-Tx time difference measurement period | 13-4, 13-8 | No | No | UE does not support Multi-RTT positioning with single satellite in NTN | Per Band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 and 5.2.3-1 ~~[TBD for FR2-NTN bands]~~ in TS 38.101-5  Need for location server to know if the feature is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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## IoT\_NTN\_enh

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 6-1: Prerequisites

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3a]~~ Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |
| 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | ~~[Rel. 18 2-3b],~~ Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | This issue is directly connected with “Issue 6-3”.  During several meetings in a row , there have been discussions on whether the “Aperiodic triggering” method should be captured or not as a pre-requisite of the “Autonomous triggering” method. Nonetheless, it has not been possible to reach consensus mainly due to different interpretations of a conclusion touching upon the “pre-requisite” aspect.  Aiming at moving things forward, we propose the following middle-ground solution:  In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its *GNSS-ValidityDuration* plus *ul-TransmissionExtensionValue*(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the GNSS-ValidityDuration. Under the above premises, the “Aperiodic triggering” feature group is a pre-requisite of the “Autonomous triggering” feature group.  The above is captured in “Issue 6-3”. |
| Qualcomm | OK with the change |

### Issue 6-2: FG GSO/NGSO Differentiation

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 2. IoT\_NTN\_enh | 2-2a | ~~NGSO~~Scenario for HARQ disabling for eMTC | Support of NGSO or GSO for HARQ disabling for eMTC | At least one of 2-1a-1  2-1b-1  2-1c-1  2-1a-2  2-1b-2  2-1c-2  2-1d-1  2-1d-2  2-2 | Yes | N/A | NGSO is not supported for HARQ disabling for eMTC | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-2b | ~~NGSO~~Scenario for HARQ disabling for NB-IoT | Support of NGSO or GSO for HARQ disabling for NB-IoT | At least one of 2-1e-1  2-1f-1  2-1g-1  2-1e-2  2-1f-2  2-1g-2 | Yes | N/A | NGSO is not supported for HARQ disabling for NB-IoT | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-6a | ~~NGSO~~Scenario for GNSS enhancements for eMTC | Support of NGSO or GSO for GNSS enhancements for eMTC | At least one of 2-3a, 2-4a, 2-5a | Yes | N/A | NGSO for GNSS enhancements for eMTC is not supported | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling |
| 2. IoT\_NTN\_enh | 2-6b | ~~NGSO~~Scenario for GNSS enhancements for NB-IoT | Support of NGSO or GSO for GNSS enhancements for NB-IoT | At least one of 2-3b, 2-4b, 2-5b | Yes | N/A | NGSO for GNSS enhancements for NB-IoT is not supported | Per UE | No | No | Component value: {gso, ngso}  Note: if the field is absent, both GSO and NGSO are supported  Note: ntn-ScenarioSupport-r17 is not applicable. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | Not ok, what is being proposed was already discussed in RAN1#116 and was not agreed.  The proposed changes basically revert the WA, which took several meetings of discussion and that was finally agreed recently in RAN1#116.  The proponent claims that the motivation comes from RAN2, but the wording in TS 36.331 comes from the situation that RAN2 drafted an update on 36.331 before receiving the UE feature list from RAN1 with the WA agreed. RAN2 is having a discussion about that. |
| Qualcomm | OK with the change |

### Issue 6-3: FG 2-4a/b

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 2. IoT\_NTN\_enh | 2-4a | GNSS position fix in RRC Connected state for eMTC—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  1.1 In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its GNSS-ValidityDuration plus ul-TransmissionExtensionValue(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the GNSS-ValidityDuration  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete and RRCConnectionReconfigurationComplete for HO case  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | [Rel. 18 2-3a] Rel. 17 2-1 | Yes | N/A | Release 18 eMTC UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |
| 2. IoT\_NTN\_enh | 2-4b | GNSS position fix in RRC Connected state for NB-IoT—autonomous | 1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger  1.1 In RRC connected-mode, the UE starts with an ‘Autonomous’ GNSS timer-based acquisition starting the autonomous timer-based GNSS measurement gap upon the expiry of its GNSS-ValidityDuration plus ul-TransmissionExtensionValue(if configured), unless an 'Aperiodic GNSS trigger command' is received after at least 5 seconds have elapsed since the UE reported the GNSS-ValidityDuration  2. UE reports GNSS position fix time duration for measurement at least during the initial access stage and in connected mode via RRCConnectionReestablishmentComplete-NB  3. UE reports the remaining GNSS validity duration with MAC CE in connected mode | [Rel. 18 2-3b], Rel. 17 2-1b |  |  | Release 18 NB-IoT UE cannot get autonomous GNSS position fix in RRC Connected state | Per UE | No | No | Note: This applies to non-DRX | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | Ok with the proposal. Given the deadlock situation, the above approach can be seen as a middle-ground solution aiming at moving things forward. |
| Qualcomm | We do not understand what is the purpose of this proposal. Feature 1 already clarifies that the UE acquires GNSS autonomously if it doesn’t receive a trigger. |

### Issue 6-4: FG 2-1g-2

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 2. IoT\_NTN\_enh | 2-1g-2 | Dynamic HARQ feedback disabling by DCI-based overridden indication for NB-IoT in multi TB case | 1. UE receives DCI indication to override RRC configuration for disabling HARQ feedback  2. For ~~single~~ multi TB ~~scheduled~~ scheduling a single transport block by single DCI, UE follows NPDCCH monitoring behavior for a HARQ process configured as HARQ feedback disabled by per-HARQ process bitmap signaling and further reversed to HARQ feedback enabled by DCI | At least one of {Rel-16 2-6, 2-7},  Rel. 17 2-1b,  Rel-18 2-1e-2, 2-1f-2 | Yes | N/A | Release 18 NB-IoT UE cannot disable HARQ feedback in multi TB case | Per UE | No | No | Note: this applies to multi-TB case | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | Ok with the proposal. It reflects what was agreed in RAN1#116. |

## NR\_netcon\_repeater

Void

## NR\_BWP\_wor

After review of contributions submitted to RAN1 #117 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 8-1: FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 53. NR\_BWP\_wor | 53-3 | Support RLM/BM/BFD measurements based on NCD-SSB within active BWP | 1. UE performs RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB, where the NCD-SSB is within the active DL BWP.  2. Bandwidth of UE-specific RRC configured BWP may not include bandwidth of the CORESET#0 (if CORESET#0 is present) and CD-SSB for PCell/PSCell (if configured) and bandwidth of the UE-specific RRC configured BWP may not include CD-SSB for Scell  3. NCD-SSB within the active DL BWP can be used as the QCL source for other reference signal.  4. UE performs L3 intra-frequency measurements without gaps based on NCD-SSB, where the NCD-SSB is within the active DL BWP. |  | Yes | n/a | UE cannot support RLM/BM/BFD and gapless L3 intra-frequency measurements based on NCD-SSB within active BWP | Per band | No | No | n/a | Note: This FG applies only to PCell and SPCell (if configured)  This FG is not applicable to RedCap or eRedCap UEs. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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## NR\_ATG

Void

# Conclusion

Agreements reached during RAN1 #117 as part of this agenda item are summarized in [ ].

# References

1. R1-2403705, LS on Rel-18 RAN1 UE features list for NR after RAN1#116bis, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2401822, Updated RAN1 UE features list for Rel-18 LTE after RAN1#116, Moderators (AT&T, NTT DOCOMO, INC.)
3. R1-2403919, UE features for other Rel-18 work items (Topics B), Huawei/HiSilicon
4. R1-2403972, UE features for Rel-18 Work Items (Topics B), Intel Corporation
5. R1-2404102, UE features for other Rel-18 work items (Topics B), Samsung
6. R1-2404164, Discussion on Rel-18 UE features topics B (Positioning), vivo
7. R1-2404271, Discussion on UE Feature Topics B, Apple
8. R1-2404383, Remaining issues on UE features for expanded and improved NR positioning, CATT
9. R1-2404485, UE Features for Other Topics B (MIMO, Pos, NES, MobEnh, IoT-NTN, NR-NTN), Nokia
10. R1-2404824, UE features for other Rel-18 work items (Topics B), OPPO
11. R1-2404887, Discussion on UE features for NES, LG Electronics
12. R1-2404910, Discussion on BWP Without Restriction maintenance, Vodafone
13. R1-2405004, UE features for other Rel-18 work items (Topics B), ZTE
14. R1-2405029, Discussion on UE features for other Rel-18 work items (Topics B), NTT DOCOMO, INC.
15. R1-2405104, Rel-18 UE features topics set B, Ericsson
16. R1-2405142, UE features for other Rel-18 work items (Topics B), Qualcomm Incorporated