**3GPP TSG RAN WG1 #116bis R1-24nnnnn**

**Changsha, Hunan Province, China, April 15th – 19th, 2024**

**Agenda Item: 8.5.3**

**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 [116bis-R18-UE\_features] during RAN1 #116bis. According to the Chair’s Notes:

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| [116bis-R18-UE\_features] Email discussion on Rel-18 UE features – Hiroki (DOCOMO)   * 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 #116bis within the scope of [116bis-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 #116bis

The following is the moderator’s summary of contributions submitted to RAN1 #116bis in this agenda item.

## NR\_MIMO\_evo\_DL\_UL

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| 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. M aximum 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-3 | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP | Support of per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP | 40-1-1 | yes | n/a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP is not supported | Per band | n/a | n/a | n/a | Component candidate values: {per resource, per resource set, both} | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | The issue of UE ambiguity when UE is configured to follow unified TCI state with capability of per resource set for a configured aperiodic CSI-RS resource set with two Resource Groups for NCJT CSI measurement/reporting was discussed in RAN1 #114 meeting and below agreement was made:  **Agreement @RAN1 #114**  On unified TCI framework extension, if the UE supports NCJT CSI, the UE should support resource-level RRC configuration for informing that the UE shall apply the first or the second indicated joint/DL TCI state to AP CSI-RS resource  Above agreement has not been captured in spec and can be mentioned in the note column of FG 40-1-3. Similarly, for a configured aperiodic CSI-RS resource set for CJT CSI measurement/reporting with K NZP CSI-RS resources each corresponding to one TRP/TRP-group, there would be ambiguity on UE behavior when UE is configured to follow unified TCI state with capability of per resource set in FG 40-1-3 and two TCI states for CJT Tx scheme for PDSCH in FG 40-1-4. Following the same rule as agreed for NCJT in RAN1 #114 meeting, we may condition the support of CJT CSI in UTCI framework on the support of resource-level RRC configuration for informing that the UE shall apply the first or the second indicated joint/DL TCI state to AP CSI-RS resource. This can also be mentioned in the note column of FG 40-1-3.  **Proposal 2:** The note column of FG 40-1-3 can be updated to mention condition on support of operation of NCJT/CJT CSI as below:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-3 | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP | Support ofPer aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP |  | yes | n/a |  | Per band | n/a | n/a | n/a | Component candidate values: {per resource, per resource set, both}  Note: when the UE supports NCJT CSI under 23-7-1 or CJT under 40-1-4, component value {per resource} is declared. | Optional with capability signalling | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-12 | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP | 1. Support of common multi-CC TCI state ID update and activation for single-DCI based multi-TRP  2. Maximum number of CC list(s) | 40-1-1 or 40-1-2 | yes | n/a | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4} | Optional with capability signaling |

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| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | Minor comment to remove FG40-1-2 from pre-requisite of FG40-1-12, as FG40-1-1 is already pre-requisite of FG40-1-2, to align that FG40-1-9 is not pre-requisite of FG40-1-13   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-12 | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP | 1. Support of common multi-CC TCI state ID update and activation for single-DCI based multi-TRP  2. Maximum number of CC list(s) | 40-1-1 | yes | n/a | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4} | Optional with capability signaling | |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-2-2 | Basic feature for multi-DCI based inter-cell Multi-TRP operation with two TA enhancement | 1. Support of two TA enhancement for multi-DCI based inter-cell Multi-TRP operation  2. Maximum number of n-TimingAdvanceOffset value per serving cell |  | yes | n/a | Two TA enhancement for multi-DCI based inter-cell Multi-TRP operation is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1,2} | Optional with capability signalling |

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| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | We have the following analysis for updated UE features list from RAN1#116 meeting on Rel-18 two TAs for multi-DCI MTRP:  For FG 40-2-7, the prerequisite FG should include 23-4, which is specified for Rel-17 inter-cell MDCI MTRP operation.  ***Proposal 1-2:*** *For FGs family 40-2 of ‘Rel-18 two TAs for multi-DCI MTRP’, the following modification is proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-2-2 | Basic feature for multi-DCI based inter-cell Multi-TRP operation with two TA enhancement | 1. Support of two TA enhancement for multi-DCI based inter-cell Multi-TRP operation  2. Maximum number of n-TimingAdvanceOffset value per serving cell | 23-4 | yes | n/a | Two TA enhancement for multi-DCI based inter-cell Multi-TRP operation is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1,2} | Optional with capability signalling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-2-7 | Two TAs for multi-DCI STxMP PUSCH+PUSCH | Support of two TAs for multi-DCI STxMP PUSCH+PUSCH | 40-2-1 or 40-2-2, 40-6-3a or 40-6-3b | yes | n/a | Two TAs for multi-DCI STxMP PUSCH+PUSCH is not supported | Per FSPC | n/a | n/a | n/a |  | Optional with capability signalling |

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| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | For a UE that supports simultaneous multiple UL transmissions via FG 40-2-7 with pre-requisite of FG 40-2-1 or FG 40-2-2, it can be assumed that UE can well handle any overlap duration with no reduction of any of UL transmissions in multi-DCI based multi-TRP operation with two TA enhancement. This can be mentioned in FG 40-2-6 note column.  **Proposal 3:** The note column of FG 40-2-7 can be updated to mention support of any overlap duration for two UL transmissions in multi-DCI based Multi-TRP with 2 TA as below:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-2-7 | Two TAs for multi-DCI STxMP PUSCH+PUSCH | Support of two TAs for multi-DCI STxMP PUSCH+PUSCH | 40-2-1 or 40-2-2, 40-6-3a or 40-6-3b | yes | n/a | Two TAs for multi-DCI STxMP PUSCH+PUSCH is not supported | Per FSPC | n/a | n/a | n/a | Note: support of any overlap duration with no reduction of any of UL transmissions for two UL transmissions in multi-DCI based Multi-TRP with 2 TA | Optional with capability signalling | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-24 | Timeline for regular eType-II-CJT CSI, or for port selection FeType-II-CJT CSI | Timeline relaxation parameter | 40-3-1-1, or 40-3-1-5 | Yes | N/A | Relaxed timeline is not supported | Per band and Per-BC | No | N/A | N/A | Component candidate value: {0, Z2’} | Optional with capability signaling |

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| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | For CSI timeline relaxation, a common understanding is, the relaxed timeline should be the basic UE capability, while the more ambiguous non-relaxed timeline has higher requirements for UE – this is also confirmed by companies during RAN1#116 online discussion.  Therefore, following the same concept of UE feature 40-3-2-11 (for Type-II-Doppler), we think 40-3-1-24 (for Type-II-CJT) should also let UE to have the freedom to report its basic timeline feature.  **Proposal 2.1: Adopt the following note (copied from 40-3-2-11) to UE feature 40-3-1-24.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-24 | Timeline for regular eType-II-CJT CSI, or for port selection FeType-II-CJT CSI | Timeline relaxation parameter | 40-3-1-1, or 40-3-1-5 | Yes | N/A | Relaxed timeline is not supported | Per band and Per-BC | No | N/A | N/A | Component candidate value: {0, Z2’}  Note: A UE that supports FG 40-3-1-1 or FG 40-3-1-5 must signal this FG | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w, independently for each SCS in unit of symbols  For 15kHz SCS: {0, 4, 8, 16, 32}  For 30kHz SCS: {0, 8, 16, 32, 64}  For 60kHz SCS: {0, 16, 32, 64, 128}  For 120kHz SCS: {0, 16, 32, 64, 128}  For 480kHz SCS: {0, 64, 128, 256, 512}  For 960kHz SCS: {0, 128, 256, 512, 1024}  Component 2 candidate values: [{CAP1, CAP2}]  For N4 = 1  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP1 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP2 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m + Z'2, 2Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w + Z'2, 2Z'2)  Z2/Z'2 are defined in Table 5.4-2 in TS38.214  K = {4,8,12}, is the number of AP CSI-RS resources for the CMR in a CSI report setting  M = {1,2}, is the offset between two adjacent AP CSI-RS resources for the CMR in slots  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling |

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| Company | Summary |
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| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w, independently for each SCS in unit of symbols  For 15kHz SCS: {0, 4, 8, 16, 32}  For 30kHz SCS: {0, 8, 16, 32, 64}  For 60kHz SCS: {0, 16, 32, 64, 128}  For 120kHz SCS: {0, 16, 32, 64, 128}  For 480kHz SCS: {0, 64, 128, 256, 512}  For 960kHz SCS: {0, 128, 256, 512, 1024}  Component 2 candidate values: {CAP1, CAP2}  For N4 = 1  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP1 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP2 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m + Z'2, 2Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w + Z'2, 2Z'2)  Z2/Z'2 are defined in Table 5.4-2 in TS38.214  K = {4,8,12}, is the number of AP CSI-RS resources for the CMR in a CSI report setting  M = {1,2}, is the offset between two adjacent AP CSI-RS resources for the CMR in slots  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling | |
| Xiaomi [11] | Acorrding to the following agreement, the supported value of *w* is a UE feature and needs to be discussed in this part.  ***Agreement***  *For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z for Capability 2 associated with P/SP-CSI-RS, decide, in RAN1#114, based on the following alternatives:*   * *Alt1: w=14.(KP–1).d or 14. KP.d, where d denotes the CSI-RS periodicity* * *Alt2: w=14 or 28 (fixed)*   ***Agreement***  *For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z associated with P/SP-CSI-RS,*   * *w (unit of symbols) is reported by UE*   + *To be finalized as part of Rel-18 UE feature discussions*   However, according to discussion in RAN1#116 meeting, *w* is provided as independently for each SCS in unit of symbols, and the candidate value is given as  For 15kHz SCS: {0, 4, 8, 16, 32}  For 30kHz SCS: {0, 8, 16, 32, 64}  For 60kHz SCS: {0, 16, 32, 64, 128}  For 120kHz SCS: {0, 16, 32, 64, 128}  For 480kHz SCS: {0, 64, 128, 256, 512}  For 960kHz SCS: {0, 128, 256, 512, 1024}  This is not consistent with above agreement. In our view, the value of *w* should be assocated with the number of periodic active CSI-RS resources and periodic of CSI-RS, since the CSI processing time needs to increase with the periodic increases. Therefore, Alt1, i.e.,*w*=14.(KP–1).d or 14. KP.d is preferred.  ***Proposal 4-3: Regarding aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook, the value of w should be as defined as w=14.(KP–1).d or 14. KP.d and given in the following table.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w =14.(KP–1).d or 14. KP.d, independently ~~for each SCS in unit of symbols~~  ~~For 15kHz SCS: {0, 4, 8, 16, 32}~~  ~~For 30kHz SCS: {0, 8, 16, 32, 64}~~  ~~For 60kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 120kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 480kHz SCS: {0, 64, 128, 256, 512}~~  ~~For 960kHz SCS: {0, 128, 256, 512, 1024}~~  Component 2 candidate values: ~~[~~{CAP1, CAP2}~~]~~  For N4 = 1  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP1 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP2 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m + Z'2, 2Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w + Z'2, 2Z'2)  Z2/Z'2 are defined in Table 5.4-2 in TS38.214  K = {4,8,12}, is the number of AP CSI-RS resources for the CMR in a CSI report setting  M = {1,2}, is the offset between two adjacent AP CSI-RS resources for the CMR in slots  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling | |
| ZTE Corporation [12] | Regarding one pending issue for CAP of FG 40-3-2-11, we do not think that a default CAP is needed while having the note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG.  ***Proposal 1-3:*** *For FG 40-3-1, the following modification is proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w, independently for each SCS in unit of symbols  For 15kHz SCS: {0, 4, 8, 16, 32}  For 30kHz SCS: {0, 8, 16, 32, 64}  For 60kHz SCS: {0, 16, 32, 64, 128}  For 120kHz SCS: {0, 16, 32, 64, 128}  For 480kHz SCS: {0, 64, 128, 256, 512}  For 960kHz SCS: {0, 128, 256, 512, 1024}  Component 2 candidate values: ~~[~~{CAP1, CAP2}~~]~~  <unchanged is omitted>  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | Then for the detail of Type-II-Doppler CSI timeline, according to our understanding, the “measurement window” size for periodic CSI-RS (denoted as w) is not captured appropriately.  There were 2 agreements according to RAN1#114 (2023-08, Toulouse) regarding this “w”:   |  | | --- | | **Agreement (RAN114, 2023-08)**  For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z for Capability 2 associated with P/SP-CSI-RS, decide, in RAN1#114, based on the following alternatives:   * Alt1: w=14.(KP–1).d or 14. KP.d, where d denotes the CSI-RS periodicity * Alt2: w=14 or 28 (fixed)   **Agreement (RAN114, 2023-08)**  For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z associated with P/SP-CSI-RS,   * w (unit of symbols) is reported by UE   + To be finalized as part of Rel-18 UE feature discussions |   More background: The motivation for UE to have longer “w” is, to accommodate enough CSI-RS occasions after PDCCH and before the report PUSCH – to avoid pre-buffering of CSI-RS receiving data before PDCCH.   * For aperiodic CSI-RS, this is no issue, and the “measurement window” size is agreed as 14.(K–1).m in RAN1#113 (2023-05, Incheon).   + Here K denotes number of CSI-RS occasions, while m denotes the time interval (in slots) between two consecutive CSI-RS occasions – thus 14\*(K-1)\*m is the “measurement window” size (in symbols). * For periodic CSI-RS, “w” issue is left over to UE capability decision.  |  | | --- | | **Agreement (RAN1#113, 2023-05)**  For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z   * Based on the two UE capabilities agreed for Z’:   + Capability 1:     - For AP CSI-RS: Z=legacy Z+14.(K–1).m     - For P/SP CSI-RS: Z= legacy Z+w where w>0       * TBD: Value of w   + Capability 2:     - For AP CSI-RS: Z= legacy Z+14.(K–1).m + r     - For P/SP CSI-RS: Z= legacy Z+w+r     - Note: r corresponds to the agreed value for Z’ relaxation in previous agreement.   Note: Since this pertains Type-II, the relevant values are Z2/Z2’ |   Therefore, to better align with previous agreements, we think this UE capability should capture the above Alt1 and Alt2 according to RAN1#114:   * Alt1: w=14.(KP–1).d or 14. KP.d, where d denotes the CSI-RS periodicity * Alt2: w=14 or 28 (fixed)   **Proposal 2.2: Adopt the following changes to FG 40-3-2-11.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w, independently for each SCS in unit of symbols: {14\*(KP–1)\*d, 14\*KP\*d, 14, 28}  Note1: Kp is according to Component 10 of FG 40-3-2-1, or according to Component 9 of FG 40-3-2-4;  Note2: d=4 (minimum periodicity of periodic CSI-RS)  ~~For 15kHz SCS: {0, 4, 8, 16, 32}~~  ~~For 30kHz SCS: {0, 8, 16, 32, 64}~~  ~~For 60kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 120kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 480kHz SCS: {0, 64, 128, 256, 512}~~  ~~For 960kHz SCS: {0, 128, 256, 512, 1024}~~  Component 2 candidate values: ~~[~~{CAP1, CAP2}~~]~~  For N4 = 1  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP1 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP2 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m + Z'2, 2Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w + Z'2, 2Z'2)  Z2/Z'2 are defined in Table 5.4-2 in TS38.214  K = {4,8,12}, is the number of AP CSI-RS resources for the CMR in a CSI report setting  M = {1,2}, is the offset between two adjacent AP CSI-RS resources for the CMR in slots  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling | |
| NTT DOCOMO, INC. [16] | For the yellow-highlighted part, if we strictly follow the text in the corresponding agreement, it should be Capability 1 and Capability 2, respectively. Meanwhile, as it is just a notation, we think just to use CAP1/CAP2 is also fine.  **Proposal 1: For FG 40-3-2-11, either of the following works without any issue**   * **Replace {CAP1, CAP2} with {Capability 1, Capability 2}, just to align the wording with the agreement, or;** * **Keep {CAP1, CAP}** |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1 | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for mapping type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-5 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for mapping type A is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1a | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for mapping type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-6 | Yes | n/a | UE does not support basic feature of Rel.18 enhanced DMRS ports for PDSCH for mapping type B | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1b | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1c | Alternative additional DMRS position for co-existence with LTE CRS for Rel.18 enhanced DMRS ports for PDSCH | Support of alternative additional DMRS position for co-existence with LTE CRS for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1, 5-28 | Yes | n/a | UE does not support alternative additional DMRS position for co-existence with LTE CRS for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1d | 2 symbols FL-DMRS for Rel.18 enhanced DMRS ports for PDSCH | Support of 2 symbols FL-DMRS for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support 2 symbols FL-DMRS for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1e | 2-symbol FL DMRS + one additional 2-symbols DMRS for Rel.18 enhanced DMRS ports for PDSCH | Support of 2-symbol FL DMRS + one additional 2-symbols DMRS for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support 2-symbol FL DMRS + one additional 2-symbols DMRS for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1f | 1 symbol FL DMRS and 3 additional DMRS symbols for Rel.18 enhanced DMRS ports for PDSCH | Support of 1 symbol FL DMRS and 3 additional DMRS symbols for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support 1 symbol FL DMRS and 3 additional DMRS symbols for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1g | DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a | Component 1 candidate values: {etype 1, both etype 1 and etype 2} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1h | 1 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 | Support of 1 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 | 40-4-1 | Yes | n/a | 1 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1i | 2 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 | Support of 2 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 | 40-4-1 or 40-4-1a | Yes | n/a | 2 port DL PTRS for Rel.18 enhanced DMRS ports for PDSCH with rank 1-8 is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for mapping type A | Support of Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for mapping type A | 40-4-1 | Yes | n/a | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port is not supported for mapping type A | Per FS | No | No | n/a |  | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For Rel-15 DMRS, the perquisite of FG 2-6a (supporting 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port) is FG 2-5 which includes supporting 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port.. This rule has been destroyed in Rel-18. Thus, we have the following proposal:  **Proposal MIMO-1:**   * **Similar to Rel-15, the prerequisite of FG 40-4-1b should be FG 40-4-1 and FG 40-4-1j.**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1b | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1, FG 40-4-1j | Yes | n/a | UE does not support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |   In Rel-15, it is mandatory to support DMRS type 1. Similarly, For FG 40-4-1g and FG 40-4-6c in Rel-18, eType1 should be mandatory supported.  **Proposal MIMO-3:**   * **For FG 40-4-1g and FG 40-4-6c, support to add the note “Note: A UE supporting one of FG 40-4-1 or FG 40-4-1a must support this FG”.**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1g | DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a | Component 1 candidate values: {etype 1, both etype 1 and etype 2}  Note: A UE supporting one of FG 40-4-1 or FG 40-4-1a must support this FG | Optional with capability signaling |   In addition, the description of FG 40-4-1b (more than one port) and FG 40-4-1j (for at least one port) are overlapped, where FG 40-4-1b is included in FG 40-401j. The original intention of FG 40-4-1j and FG 2-5 is to support 1 symbol FL DMRS and 2 additional DMRS symbols for one port, so we have the following proposal:  **Proposal MIMO-2:**   * **Delete all description of “at least” in FG 40-4-1j.**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port for mapping type A | Support of Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port for mapping type A | 40-4-1 | Yes | n/a | Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port is not supported for mapping type A | Per FS | No | No | n/a |  | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] | A few typos on 40-4-1x for PDSCH need to be corrected. Table below shows the original UE feature list defined for legacy DMRS, where in 2-5 and 2-6 the feature supports “Scheduling type A” and “Scheduling type B”. To align same terminology as legacy, we propose to change the description text in 40-4-1, 40-4-1a and 40-4-1j from “mapping type” to “scheduling of type”. Note that mapping type A and mapping type B have their own UE feature group which is feature group 5-x in 38.822.   1. For NR MIMO, correct the feature group description in 40-4-1, 40-4-1a, 40-4-1j to change from “mapping Type” to “scheduling of Type” to align with legacy description and avoid ambiguity.  |  |  |  |  |  | | --- | --- | --- | --- | --- | | 40-4-1 | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-5 | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type A is not supported | | 40-4-1a | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-6 | UE does not support basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type B | | … |  |  |  |  | | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for ~~mapping~~ scheduling of type A | Support of Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for ~~mapping~~ scheduling type A | 40-4-1 | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port is not supported for ~~mapping~~ scheduling of type A | |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a | Additional row(s) for antenna ports (0,2,3) for Rel.18 DMRS ports for single-DCI based M-TRP | Support of additional row(s) for antenna ports (0,2,3) for Rel.18 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 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 | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | Issue 2: 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” has ambiguity that the feature group is for DL, UL, or both DL and UL DMRS. It is better to break this UE feature groups into two groups, one for DL DMRS and one for UL DMRS.    **Proposal 2.6: Break 40-4-5a “Additional row(s) for antenna ports (0,2,3) for Rel.18 DMRS ports for single-DCI based M-TRP” into two separate UE feature groups, one for DL DMRS, the other for UL DMRS.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a1 | 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 ports for single-DCI based M-TRP are not supported | Per FS | No | No | n/a |  | Optional with capability signaling | | 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 | |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6c | DMRS type for Rel.18 enhanced DMRS ports for PUSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PUSCH | 40-4-6 | Yes | n/a | DMRS type for Rel.18 enhanced DMRS ports for PUSCH is not supported | Per FS | No | No | n/a | Component candidate values: {eType 1, both eType 1 and eType 2}  Note: A UE supporting one of FG 40-4-6 or FG 40-4-6a must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-10 | DMRS port configuration for PUSCH with 8Tx | DMRS port configuration for PUSCH with 8Tx for Rel 15 and Rel. 18 | 40-4-6 | Yes | n/a | Port configuration for PUSCH with 8Tx is not supported | Per FS | No | No | n/a | Candidate values: {Rel. 15 DMRS, Rel. 15 DMRS and Rel. 18 DMRS}  Note: A UE supporting 8 Tx must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-11 | Joint configuration of Rel.18 DMRS ports and Rel.18 dynamic switching between DFT-S-OFDM and CP-OFDM for PUSCH | Support of joint configuration of Rel.18 DMRS ports and Rel.18 dynamic switching between DFT-S-OFDM and CP-OFDM for PUSCH | 40-4-6 or 40-4-6a, 54-3 | Yes |  | Joint configuration of Rel.18 DMRS ports and Rel.18 dynamic switching between DFT-S-OFDM and CP-OFDM for PUSCH is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In Rel-15, it is mandatory to support DMRS type 1. Similarly, For FG 40-4-1g and FG 40-4-6c in Rel-18, eType1 should be mandatory supported.  **Proposal MIMO-3:**   * **For FG 40-4-1g and FG 40-4-6c, support to add the note “Note: A UE supporting one of FG 40-4-1 or FG 40-4-1a must support this FG”.**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6c | DMRS type for Rel.18 enhanced DMRS ports for PUSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PUSCH | 40-4-6 | Yes | n/a | DMRS type for Rel.18 enhanced DMRS ports for PUSCH is not supported | Per FS | No | No | n/a | Component candidate values: {eType 1, both eType 1 and eType 2}  ~~[~~Note: A UE supporting one of FG 40-4-6 or FG 40-4-6a must support this FG~~]~~ | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] | Based on the updated UE features after RAN1#116 meeting, we observe the following issues:   * Based on current FG 40-4-10, a UE supporting Rel-15 DMRS only for 8Tx must support Rel-18 DMRS with OCC4 (FG 40-4-6) since FG 40-4-6 is prerequisite of FG 40-4-10. That is not reasonable since Rel-15 DMRS is not relied on Rel-18 DMRS. UE should be able to support 8Tx based on only Rel-15 DMRS. * According to the note of FG 40-4-10, a UE supporting 8 Tx must support FG 40-4-10, so it needs to also support FG 40-4-6 (Rel-18 DMRS with OCC4). However, 8Tx and Rel-18 DMRS are two independent features and not need to be tied together.   Hence, we have the following proposals for FG 40-4-10:   * FG 40-4-6 is not needed to be prerequisite for Rel-15 DMRS with rank 5-8. A UE only supporting Rel-15 DMRS can also support rank 5-8 for 8Tx. * Rel-15 DMRS with rank 5-8 and Rel-18 DMRS can be prerequisite for Rel-18 DMRS with 8Tx. * Two FGs are used to support Rel-15 DMRS with 8Tx and Rel-18 DMRS with 8Tx.   ***Proposal 1: The following can be applied to UE feature for Rel-18 DMRS and 8Tx:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling | | ~~40. NR\_MIMO\_evo\_DL\_UL~~ | ~~40-4-10~~ | ~~DMRS port configuration for PUSCH with 8Tx~~ | ~~DMRS port configuration for PUSCH with 8Tx for Rel 15 and Rel. 18~~ | ~~40-4-6~~ | ~~Yes~~ | ~~n/a~~ | ~~Port configuration for PUSCH with 8Tx is not supported~~ | ~~Per FS~~ | ~~No~~ | ~~No~~ | ~~n/a~~ | ~~Candidate values: {Rel. 15 DMRS, Rel. 15 DMRS and Rel. 18 DMRS}~~  ~~Note: A UE supporting 8 Tx must support this FG~~ | ~~Optional with capability signaling~~ | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-10 | DMRS port configuration for PUSCH with rank 5-8 and Rel-15 DMRS for 8Tx | DMRS port configuration for PUSCH with rank 5-8 and 8Tx for Rel 15 DMRS | 2-16 | Yes | n/a | DMRS port configuration for PUSCH with rank 5-8 and Rel-15 DMRS is not supported for 8Tx | Per FS | No | No | n/a | Note: A UE supporting 8 Tx must support this FG | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-11 | DMRS port configuration for PUSCH with for 8Tx | DMRS port configuration for PUSCH with 8Tx for Rel18 DMRS | 40-4-6, 40-4-10 | Yes | n/a | DMRS port configuration for PUSCH with Rel-18 DMRS is not supported for 8Tx | Per FS | No | No | n/a |  | Optional with capability signaling | |
| CATT [7] |  |
| Samsung [8] | In Rel-15, we have the following two FGs supporting PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2-16 | Basic uplink DMRS (uplink) for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols |  | n/a | n/a | n/a | n/a | Conditioned to whether PUSCH scheduling type A is supported | Mandatory without capability signalling | | 2-16b | Support 1+2 DMRS (uplink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port |  | *oneFL-DMRS-TwoAdditionalDMRS-UL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |   The difference between FG 2-16 and FG 2-16b above is that PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for one port is supported by Component 3 of FG 2-16, and PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for more than one port is supported by FG 2-16b.  In Rel-18, for enhanced DMRS types, similar structure of FGs with Rel-15 are agreed to use, but for PUSCH DMRS, we have only the following FG supporting 1 symbol FL DMRS and 2 additional DMRS symbols.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |   Similar with Rel-15 UE capability signaling structure, we would like to distinguish between supporting one port and more than one port. Hence we would like to modify the description of Component 3 of FG 40-4-6, and introduce a new FG supporting Rel-18 enhanced DMRS for PUSCH with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for more than one port.  **Proposal 6:** *Revise a description (as red text below) in Component 3 in FG 40-4-6 to support Rel-18 enhanced DMRS for PUSCH with 1 symbol FL DMRS and 2 additional DMRS symbols for one port.*   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for one port | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | For UL DMRS, missing UE feature group “1 symbol FL DMRS and 2 additional DMRS symbols for more than one port”. This UE feature was defined in legacy Rel-15 as 2-16b. However, for Rel-18 DMRS, this UE feature was missed.   |  |  |  | | --- | --- | --- | | 2-16 | Basic uplink DMRS (uplink) for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols | | 2-16b | Support 1+2 DMRS (uplink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for **more than one** port |   While for Rel-18 UL DMRS UE feature 40-4-6, we only have the following component 3 and missing a similar UE feature like 2-16b.   |  |  |  | | --- | --- | --- | | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols |   By the way, please notice that for Rel-18 DL DMRS, we also have separate capability for “**more than one port** ” port and “**at least one port** ” with 1 symbol FL DMRS and 2 additional DMRS symbols. But we don’t have such separate capability for Rel-18 UL DMRS.   |  |  | | --- | --- | | 40-4-1b | 1 symbol FL DMRS and 2 additional DMRS symbols for **more than one port** for Rel.18 enhanced DMRS ports for PDSCH | | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for **at least one port** for mapping type A |   **Proposal 2.4: In 40-4 family of UE feature groups for Rel-18 DMRS, add a UE feature group 40-4-6k for “1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH”.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6k | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | 40-4-1 | Yes | n/a | UE does not support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Per FS | No | No | n/a |  | Optional with capability signaling |   Furthermore, with the above UE feature added, the component 3 of 40-4-6 should be clarified for “at least one port ” to match with DL DMRS UE features description, i.e., 40-4-1j (Rel-18) and 2-5 (Rel-15).   |  |  |  | | --- | --- | --- | | 2-5 | Basic downlink DMRS  for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port. | | 2-6a | Support 1+2 DMRS (downlink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port |   Strictly speaking, 2-16 (Rel-15) component 3 has the same editorial issue. But it is too late to change Rel-15 specification. Therefore, we don’t propose the change for Rel-15 but only for Rel-18.  With the above analysis, we also propose the following editorial change to 40-4-6.  **Proposal 2.5: Update component 3 of 40-4-6 as the following.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling | |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-1a | Comb offset hopping time-domain behavior when repetition factor R>1 | Supported comb offset hopping granularity in time when repetition factor R>1 is configured | 40-5-1 | Yes | n/a | Comb offset hopping time-domain behavior when repetition factor R>1 is not supported | Per band | n/a | n/a | n/a | Component candidate values: {‘per SRS symbol’,’per R SRS symbols’, ‘both’} | Optional with capability signaling |
| 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 | 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | We have the following analysis for UE-feature outcome from RAN1#116 meeting on SRS enhancement targeting TDD CJT and 8 TX operation:   * For FG 40-5-1a, the consequence if the feature is not supported by the UE should be ‘Comb offset hopping is not supported when repetition factor R>1’; * 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 1-4:*** *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 | 40-5-1a | Comb offset hopping time-domain behavior when repetition factor R>1 | Supported comb offset hopping granularity in time when repetition factor R>1 is configured | 40-5-1 | Yes | n/a | ~~Comb offset hopping time-domain behavior when repetition factor R>1 is not supported~~  Comb offset hopping is not supported when repetition factor R>1 | Per band | n/a | n/a | n/a | Component candidate values: {‘per SRS symbol’,’per R SRS symbols’, ‘both’} | Optional with capability signaling | | 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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | One minor editorial   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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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| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-1b | SRS comb offset hopping combined with legacy group/sequence hopping | Support of SRS comb offset hopping combined with legacy group/sequence hopping | 40-5-1 | Yes | n/a | SRS comb offset hopping combined with legacy group/sequence hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-2b | SRS cyclic shift hopping combined with legacy group/sequence hopping | Support of SRS cyclic shift hopping combined with legacy group/sequence hopping | 40-5-2 | Yes | n/a | SRS cyclic shift hopping combined with legacy group/sequence hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | The RAN2 LS also asked RAN1 to replace the term “legacy” in UE features list by more meaningful description, and there are some FGs having the term “legacy” as below.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 40-5-1b | SRS comb offset hopping combined with legacy group/sequence hopping | Support of SRS comb offset hopping combined with legacy group/sequence hopping | 40-5-1 | Yes | n/a | SRS comb offset hopping combined with legacy group/sequence hopping is not supported | | 40-5-2b | SRS cyclic shift hopping combined with legacy group/sequence hopping | Support of SRS cyclic shift hopping combined with legacy group/sequence hopping | 40-5-2 | Yes | n/a | SRS cyclic shift hopping combined with legacy group/sequence hopping is not supported |   If a clarification for the wording “legacy” is necessary, potential alternative wording can be “Rel-15” and/or “supported in NR SRS basic feature (FG 2-52)” since group/sequence hopping for SRS described here is Rel-15 features. Or even just to remove “legacy” could work without issues since there is only one SRS group/sequence hopping in NR.  **Proposal 4: For FG 40-5-1b and 40-5-2b, inform RAN2 that “legacy” means “supported in NR SRS basic feature, i.e., FG 2-52”**   * **The following revisions for the two FGs can be considered as well**  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 40-5-1b | SRS comb offset hopping combined with ~~legacy~~ group/sequence hopping | Support of SRS comb offset hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) | 40-5-1 | Yes | n/a | SRS comb offset hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) is not supported | | 40-5-2b | SRS cyclic shift hopping combined with ~~legacy~~ group/sequence hopping | Support of SRS cyclic shift hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) | 40-5-2 | Yes | n/a | SRS cyclic shift hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) is not supported | |
| Ericsson [17] |  |
| Apple [18] |  |

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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 | 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] | 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 2: A UE supporting TDMed 8 ports SRS should be able to transmit at per OFDM symbol with 4 ports and applied the following note:***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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—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  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 |   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, and the current FG 40-7-1b/c/d can be applied regardless of SRS configuration. A UE cannot report capability of TDMed SRS if it doesn’t support any codebook type for TDMed SRS.  ***Proposal 4: 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 separate FG 40-7-1b/c/d.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | Component 1 candidate values: {noTDM SRS, TDM and noTDM SRS}  Component 2 candidate values: {(4,1), (2,2), both} | Optional with capability signaling | |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] | According to the description of component 2 of FG 40-5-4, the following revision is proposed that empty combination set for antenna switching configuration should not be allowed, at least one candidate value should be supported by the UE.  Proposal 4-1: Adopt the following for FG40-5-4 to allow at least one candidate value for the antenna switching configurations.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | There is another RAN4 LS reply [3] 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: to add component on support of TDM and/or nonTDM 8TX ports SRS for FGs of each codebook type. * Option 2: to 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 5: For FG 40-7-1/1a/1b/1c/1d, support the following updates:**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 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 [17] | **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}  } |   However, 40-7-1a is described as follows:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **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} |   There is no description of what (N1,N2) is for an 8 Tx UL MIMO codebook in the RAN1 specs, and so 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 suggest making changes based on the 38.306 description, given 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=ng1n4n1, 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.  … | | --- |  1. Correct the description of codebook1 support in the description of *codebookParameter8TxPUSCH-r18* in 38.306 as follows: “Value n4-1 corresponds to (4,1) codebook1=ng1n4n1, value n2-2 corresponds to (2,2) codebook1=ng1n4n1, value both corresponds to both codebooks.” |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1 | Single-DCI based STx2P SDM scheme for PUSCH—codebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—codebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—codebook  3. Support of two SRS resource sets with usage set to 'codebook'  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  7. Max number of NZP PUSCH ports associated with one SRS resource set  8. Maximum number of SRS antenna ports for each SRS resource in each SRS resource set | 2-14 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—codebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,4}  Component 5 candidate values: {1, 2}  Component 7 candidate values: {1, 2 ,4}  Component 8 candidate values: {1, 2 ,4}  Note: For component 7, if a row of the TPMI consists of all 0’s, the corresponding PUSCH port is not counted  Note: If value 4 is reported for component 4, UE also reports value 4 in FG 16-5c | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | In RAN1 #116 meeting, the following agreement was achieved on the power control of PUSCH/PUCCH for UL STxMP[1].   |  |  |  | | --- | --- | --- | | **Agreement**  Adopt the following text proposal to TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1:   * Reason for change: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions is defined in the latest version of TS 38.101-2 Clause 6.2K.4, and this would impact the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Summary of change: Reflec the “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 to the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Consequences if not approved: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 is not reflected in RAN1 specifications for PUCCH/PUSCH Tx power determination  |  | | --- | | * + 1. UE behaviour   If a UE transmits a PUSCH on active UL BWP of carrier of serving cell using parameter set configuration with index and PUSCH power control adjustment state with index ~~, the UE determines the PUSCH transmission power in PUSCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelScheme,* and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUSCH transmission occasion , the UE determines the PUSCH transmission power for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUSCH transmission power in PUSCH transmission occasion as   [dBm]  where,  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of serving cell in PUSCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of serving cell in PUSCH transmission occasion .  -------------------------------------------Unchanged parts are omitted------------------------------------------- | | 7.2.1 UE behaviour  If a UE transmits a PUCCH on active UL BWP of carrier in the primary cell using PUCCH power control adjustment state with index ~~, the UE determines the PUCCH transmission power in PUCCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelSfnScheme*, and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUCCH transmission occasion , the UE determines the PUCCH transmission power in PUCCH transmission occasion for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUCCH transmission power in PUCCH transmission occasion as   [dBm]  where  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of primary cell in PUCCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of primary cell in PUCCH transmission occasion  -------------------------------------------Unchanged parts are omitted------------------------------------------- | |   According to the agreement, if a UE supports single-DCI based STx2P, “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission should be supported. Based on this, we propose to add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4 as a basic UE feature for single-DCI based UL simultaneous transmission: Support of separate configured maximum output power for each of indicated joint/UL TCI states  **Proposal 1: Add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4: Support of separate configured maximum output power for each of indicated joint/UL TCI states.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-1 | Single-DCI based STx2P SDM scheme for PUSCH—codebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—codebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—codebook  3. Support of two SRS resource sets with usage set to 'codebook'  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  7. Max number of NZP PUSCH ports associated with one SRS resource set  8. Maximum number of SRS antenna ports for each SRS resource in each SRS resource set  9. Support of separate configured maximum output power for each of indicated joint/UL TCI states | 2-14 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—codebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,4}  Component 5 candidate values: {1, 2}  Component 7 candidate values: {1, 2 ,4}  Component 8 candidate values: {1, 2 ,4}  Note: For component 7, if a row of the TPMI consists of all 0’s, the corresponding PUSCH port is not counted  Note: If value 4 is reported for component 4, UE also reports value 4 in FG 16-5c | Optional with capability signaling | |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | In RAN1 #116 meeting, the following agreement was achieved on the power control of PUSCH/PUCCH for UL STxMP[1].   |  |  |  | | --- | --- | --- | | **Agreement**  Adopt the following text proposal to TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1:   * Reason for change: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions is defined in the latest version of TS 38.101-2 Clause 6.2K.4, and this would impact the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Summary of change: Reflec the “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 to the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Consequences if not approved: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 is not reflected in RAN1 specifications for PUCCH/PUSCH Tx power determination  |  | | --- | | * + 1. UE behaviour   If a UE transmits a PUSCH on active UL BWP of carrier of serving cell using parameter set configuration with index and PUSCH power control adjustment state with index ~~, the UE determines the PUSCH transmission power in PUSCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelScheme,* and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUSCH transmission occasion , the UE determines the PUSCH transmission power for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUSCH transmission power in PUSCH transmission occasion as   [dBm]  where,  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of serving cell in PUSCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of serving cell in PUSCH transmission occasion .  -------------------------------------------Unchanged parts are omitted------------------------------------------- | | 7.2.1 UE behaviour  If a UE transmits a PUCCH on active UL BWP of carrier in the primary cell using PUCCH power control adjustment state with index ~~, the UE determines the PUCCH transmission power in PUCCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelSfnScheme*, and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUCCH transmission occasion , the UE determines the PUCCH transmission power in PUCCH transmission occasion for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUCCH transmission power in PUCCH transmission occasion as   [dBm]  where  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of primary cell in PUCCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of primary cell in PUCCH transmission occasion  -------------------------------------------Unchanged parts are omitted------------------------------------------- | |   According to the agreement, if a UE supports single-DCI based STx2P, “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission should be supported. Based on this, we propose to add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4 as a basic UE feature for single-DCI based UL simultaneous transmission: Support of separate configured maximum output power for each of indicated joint/UL TCI states  **Proposal 1: Add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4: Support of separate configured maximum output power for each of indicated joint/UL TCI states.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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  9. Support of separate configured maximum output power for each of indicated joint/UL TCI states | 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} | |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | 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 1-5:*** *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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3g | Codebook multi-DCI based STx2P PUSCH+PUSCH – Partially =overlapping PUSCHs in time, non- overlapping in frequency | Support of partially overlapping PUSCHs in time, non-overlapping in frequency | 40-6-3a | Yes | N/A | Partially overlapping PUSCHs in time, non-overlapping in frequencyfor codebook multi-DCI based STx2P PUSCH+PUSCH is not supported | Per Band | n/a | FR2 only | n/a |  | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | One minor editorial   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3g | Codebook multi-DCI based STx2P PUSCH+PUSCH – Partially overlapping PUSCHs in time, non- overlapping in frequency | Support of partially overlapping PUSCHs in time, non-overlapping in frequency | 40-6-3a | Yes | N/A | Partially overlapping PUSCHs in time, non-overlapping in frequency for codebook multi-DCI based STx2P PUSCH+PUSCH is not supported | Per Band | n/a | FR2 only | n/a |  | Optional with capability signaling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-4 | Single-DCI based STx2P SFN scheme for PUCCH | 1. Support of single-DCI based STx2P SFN scheme for PUCCH  2. Supported PUCCH formats for STxMP SFN scheme |  | Yes | n/a | Single-DCI based STx2P SFN scheme for PUCCH is not supported | Per FS | n/a | FR2 only | n/a | Component 2 candidate values: {PF0/2, PF1/3/4, PF0-4) | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | In RAN1 #116 meeting, the following agreement was achieved on the power control of PUSCH/PUCCH for UL STxMP[1].   |  |  |  | | --- | --- | --- | | **Agreement**  Adopt the following text proposal to TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1:   * Reason for change: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions is defined in the latest version of TS 38.101-2 Clause 6.2K.4, and this would impact the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Summary of change: Reflec the “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 to the RAN1 specifications for PUCCH/PUSCH Tx power determination in TS 38.213 V18.1.0 Section 7.1.1 and Section 7.2.1, respectively. * Consequences if not approved: “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission to multiple directions defined in the latest version of TS 38.101-2 Clause 6.2K.4 is not reflected in RAN1 specifications for PUCCH/PUSCH Tx power determination  |  | | --- | | * + 1. UE behaviour   If a UE transmits a PUSCH on active UL BWP of carrier of serving cell using parameter set configuration with index and PUSCH power control adjustment state with index ~~, the UE determines the PUSCH transmission power in PUSCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelScheme,* and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUSCH transmission occasion , the UE determines the PUSCH transmission power for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUSCH transmission power in PUSCH transmission occasion as   [dBm]  where,  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of serving cell in PUSCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of serving cell in PUSCH transmission occasion .  -------------------------------------------Unchanged parts are omitted------------------------------------------- | | 7.2.1 UE behaviour  If a UE transmits a PUCCH on active UL BWP of carrier in the primary cell using PUCCH power control adjustment state with index ~~, the UE determines the PUCCH transmission power in PUCCH transmission occasion as~~   * if the UE is indicated with a first *TCI-State* or *TCI-UL-State* and a second *TCI-State* or *TCI-UL-State*, and is configured with *multipanelSfnScheme*, and the UE determines to apply both the first *TCI-State* or *TCI-UL-State* and the second *TCI-State* or *TCI-UL-S*tate to PUCCH transmission occasion , the UE determines the PUCCH transmission power in PUCCH transmission occasion for the k-th indicated *TCI-State* or *TCI-UL-State* as   [dBm]   * otherwise, the UE determines the PUCCH transmission power in PUCCH transmission occasion as   [dBm]  where  - is the UE configured maximum output power for the k-th indicated *TCI-State* or *TCI-UL-State* defined in [8-2, TS 38.101-2] for carrier of primary cell in PUCCH transmission occasion .  - is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3] for carrier of primary cell in PUCCH transmission occasion  -------------------------------------------Unchanged parts are omitted------------------------------------------- | |   According to the agreement, if a UE supports single-DCI based STx2P, “Per-indicated-TCI-state” configured maximum output power for simultaneous transmission should be supported. Based on this, we propose to add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4 as a basic UE feature for single-DCI based UL simultaneous transmission: Support of separate configured maximum output power for each of indicated joint/UL TCI states  **Proposal 1: Add the following component in FG 40-6-1, FG 40-6-1a and FG 40-6-4: Support of separate configured maximum output power for each of indicated joint/UL TCI states.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-4 | Single-DCI based STx2P SFN scheme for PUCCH | 1. Support of single-DCI based STx2P SFN scheme for PUCCH  2. Supported PUCCH formats for STxMP SFN scheme  3. Support of separate configured maximum output power for each of indicated joint/UL TCI states |  | Yes | n/a | Single-DCI based STx2P SFN scheme for PUCCH is not supported | Per FS | n/a | FR2 only | n/a | Component 2 candidate values: {PF0/2, PF1/3/4, PF0-4) | Optional with capability signaling | |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-6 | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | Support of out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | 40-6-3a or 40-6-3b | Yes | N/A | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH is not supported | Per FSPC | N/A | N/A | N/A |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | To clarify STxMP is only for FR2   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-6-6 | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | Support of out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | 40-6-3a or 40-6-3b | Yes | N/A | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH is not supported | Per FSPC | N/A | FR2 only | N/A |  | Optional with capability signalling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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} | 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] | The FG 40-7-1g-1 was agreed in RAN1#116 [1], where the candidate values for component 1 is 3 bit bitmap, 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. However, the prerequite of FG 40-7-1g-1 is FG 40-7-1g and the prerequite of FG 40-7-1g is FG 40-7-1, which is for “Codebook-based 8Tx PUSCH” with component 3 as “SRS 8 Tx ports—codebook”. The current FG 40-7-1g-1 does not support UE to report 8 port SRS capability, which is incorrect.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 |   We proposed following description for component 1 which is similar to Rel-16 UE feature for full power mode 2. It is proposed to revise the description of component 1 as below.   1. ***Support to revise the description of component 1 of FG 40-7-1g-1 as below.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 respource 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 8 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: The first, second, third or fourth state can be used if 40-7-1g is reported as 2 or 4. | Optional with capability signalling | |
| OPPO [6] | 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. However, for 2/4Tx, a UE that supports FG 16-5c should support at least full power operation with single port, and single port is included in each candidate for 16-5c-2. For 8Tx, whether SRS resource can be configured with one port (whether UE supports full power mode 2 with single port) is reported via one bit b0. That is, full power operation with single port is mandatory for UE with 2/4Tx, but optional for UE with 8Tx. That is not reasonable considering UE can always transmit with full power via antenna virtualization of all antennae to single port.  ***Proposal 3: 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}  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 | |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] | It was agreed in RAN1#114 to support full power mode 2 as follows, and furthermore in RAN1#116 to use a bitmap to indicate whether any or all of 1, 2, and 4 port SRS resources can be in an SRS resource set for full power mode 2.   |  | | --- | | **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. |   However, as can be seen below, while an 8 port SRS resource must be supported for 8 Tx UEs, 8 ports is not listed as an SRS port size that can be indicated by the UE in 40-7-1g-1.  38.214 describes full power mode 2 with the following, which identifies that it is possible to have an 8 port resource with 8 Tx mode 2 and is consistent with the agreement above. Since it is possible, and since 8 port resource capability is not indicated, 40-7-g1-1 implies the UE must support 8 port for the FG. However, it should also be possible to configure an 8 Tx UE with fewer than 8 ports in each resource in mode 2. This makes it somewhat confusing whether 40-7-1g-1 implies that an 8 Tx UE could support full power mode 2 with only 1, 2, or 4 ports.   |  | | --- | | 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'. |   We therefore would like to clarify any confusion on the requitement to support 8 ports for FG 40-7-1g-1 with a note 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  Note: At least an 8 port SRS resource is supported for component 1. |  1. Clarify that UEs support at least an 8 port SRS resource in FG 40-7-1g-1 by adding: “Note: At least an 8 port SRS resource is supported for component 1.” to the Note column.  |  | | --- | | **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 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.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | | 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. |
| Apple [18] |  |

**Other**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | 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~~ |   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 | 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 |   On the table of UE feature list for CSI, we propose the following modifications to maintain consistency across MIMO FGs:   * 40-3-1-1: move “Support of mode 2 …” to the top of the 4th column * 40-3-1-5: move “Support of mode 2 …” to the top of the 4th column * 40-3-2-1: replace “Support of Rel-16-based doppler CSI” by “Basic feature for Rel-16-based doppler CSI” * 40-3-2-4: replace “Support of Rel-17-based doppler CSI” by “Basic feature for Rel-17-based doppler measurement” * 40-3-3-1: replace “TDCP (Time Domain Channel Properties) report” by “Basic feature for TDCP (Time Domain Channel Properties) report”   In RAN1#114bis, it is concluded as follows that all DCI formats except fallback DCIs (i.e., DCI format 0\_0 and 1\_0) can indicate Rel-18 DMRS ports.   |  | | --- | | **Conclusion in RAN1#114b**  DCI formats 1\_1/1\_2/0\_1/0\_2 and other DCI formats (except for DCI format 0\_0/1\_0), which are specified as equally applied as at least one of DCI formats 1\_1/1\_2/0\_1/0\_2, can indicate Rel.18 DMRS ports. |   Based on the above conclusion, in Clause 5.1.6.2 in TS38.214, the reception procedure for DMRS indicated by different DCI format has been specified as follows. Here, considering UE’s receiving operation, we would like to focus on DL DCI format and corresponding DL DMRS types.   |  | | --- | | 5.1.6.2 DM-RS reception procedure  The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB*. The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 1\_3.  The DM-RS reception procedures for PDSCH scheduled by PDCCH with DCI format 1\_1 described in this clause equally apply to PDSCH scheduled by PDCCH with DCI format 4\_2, by applying the parameters of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* in *pdsch-ConfigMulticast* instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB in PDSCH-Config*. |   In the Clause 5.1.6.2, DMRS reception procedure has been specified based on DCI format 1\_1, and by using the above specification text, it can be equally applied for DMRS reception procedure which is driven by DCI format 1\_2, 1\_3, and 4\_2. Each DCI format (except DCI format 1\_3) has its own RRC parameters for DMRS indication.   * For DCI format 1\_2, *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* can be used to indicate DMRS, instead of *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* which are utilized for DCI format 1\_1. * For DCI format 1\_3, same RRC parameters for DCI format 1\_1 are utilized. * For DCI format 4\_2, instead of RRC parameters for DCI format 1\_1, *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* in *pdsch-ConfigMulticast* can be used to indicate DMRS.   **Observation 1**: Different DCI formats can indicate different DMRS types, based on different RRC parameters.  In order to inform the supported DMRS types from UE to gNB, two UE capabilities are defined in Rel-15 (FG 2-10) and Rel-18 (FG 40-4-1g) as follows:   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2-10 | Support DMRS type (downlink) | Support DMRS {type 1, both type 1 and type 2} |  | supportedDMRS-TypeDL | Phy-ParametersFRX-Diff | No | Yes |  | Type 1 is mandatory with capability signalling.    Type 2 is optional with capability signalling |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-1g | DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a | Component 1 candidate values: {etype 1, both etype 1 and etype 2} | Optional with capability signaling |   By reporting FG 2-10, UE can report either “type 1” or “both type1 and type 2” where type 1 and type 2 here stand for Rel-15 DMRS type 1, and Rel-15 DMRS type 2, respectively.  By reporting FG 40-4-1g, UE can report either “etype 1” or “both etype 1 and etype 2” where etype 1 and etype 2 here stand for Rel-18 enhanced DMRS type 1, and Rel-18 enhanced DMRS type 2, respectively.  **Observation 2**: Current UE capabilities FG 2-10 and FG 40-4-1g can report the DMRS types UE can support which can be up to 4 different DMRS types.  Given possibly supported DCI formats and DMRS types from a certain UE, gNB can configure appropriate RRC parameters for DCI format and corresponding RRC parameters for DMRS types. As a consequence, when a UE reports up to 4 different DMRS types are supported, the UE can be configured with up to 4 different DMRS types from across all DCI formats which the UE can monitor. In this case, the UE shall prepare reception procedure for 4 different DMRS types, which means 4 different MMSE coefficient filters are ready to be used for channel estimation in advance, which could be burden to UE from memory and processing point of view. Hence, it is informative to gNB if a UE can report a new UE capability including the information of the maximum number of configured DMRS types for across all DL DCI formats per cell so that the UE can indicate to gNB the processing limit considering DMRS channel estimation.  **Proposal 5:**Introduce a UE capability introducing the maximum number of configured DMRS types for across all DL DCI formats per cell (except DCI format 1\_0) as with the following FG structure:   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-XX | Capability on the maximum number of configured DMRS types for across all DL DCI formats (except DCI format 1\_0) | The maximum number of configured DMRS types for across all DL DCI formats (except DCI format 1\_0) | 2-10, 40-4-1 | Yes | n/a | Capability on the maximum number of configured DMRS types for across all DL DCI formats is not supported (except DCI format 1\_0) | Per FS | No | No | n/a | Component candidate values: {2, 3, 4} | Optional with capability signaling |   In Rel-15, we have the following two FGs supporting PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2-16 | Basic uplink DMRS (uplink) for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols |  | n/a | n/a | n/a | n/a | Conditioned to whether PUSCH scheduling type A is supported | Mandatory without capability signalling | | 2-16b | Support 1+2 DMRS (uplink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port |  | *oneFL-DMRS-TwoAdditionalDMRS-UL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |   The difference between FG 2-16 and FG 2-16b above is that PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for one port is supported by Component 3 of FG 2-16, and PUSCH DMRS with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for more than one port is supported by FG 2-16b.  In Rel-18, for enhanced DMRS types, similar structure of FGs with Rel-15 are agreed to use, but for PUSCH DMRS, we have only the following FG supporting 1 symbol FL DMRS and 2 additional DMRS symbols.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |   Similar with Rel-15 UE capability signaling structure, we would like to distinguish between supporting one port and more than one port. Hence we would like to modify the description of Component 3 of FG 40-4-6, and introduce a new FG supporting Rel-18 enhanced DMRS for PUSCH with 1 symbol FL (front-loaded) DMRS and 2 additional DMRS symbols for more than one port.  **Proposal 7:** *Introduce a new FG to support Rel-18 enhanced DMRS for PUSCH with 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port.*   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-4-XX | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port by Rel-18 enhanced DMRS ports for PUSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port by Rel-18 enhanced DMRS ports for PUSCH | 40-4-6 | Yes | n/a | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port by Rel-18 enhanced DMRS ports for PUSCH is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |   In [2], 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), the corresponding supported codebook type for non-TDM and TDM based 8-port SRS could be different even from the same UE. Hence, we would like to introduce an UE capability signalling to report one more combination of supported codebook types which can be applied to TDM based 8-port SRS, while the current UE capability FG 40-7-1a, FG 40-7-1b, FG 40-7-1c, and FG 40-7-1d can be applied to non-TDM based 8-port SRS since non-TDM is basically supported by the structure of Component 3 in FG 40-7-1.  **Proposal 8:** Introduce an UE capability to indicate supported codebook types corresponding to TDM based 8-port SRS with the following FG structure (Current UE capability FG 40-7-1a, FG 40-7-1b, FG 40-7-1c, and FG 40-7-1d can be applied to non-TDM based 8-port SRS).   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40-7-XX | Codebook-based 8Tx PUSCH—codebook type(s) for TDMed 8TX SRS | 1. Supported codebook type(s) for TDMed 8TX SRS  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | Yes | n/a | Supported codebook type(s) of codebook-based 8Tx PUSCH for TDMed 8TX SRS is not supported | Per  FSPC | No | No | No | Component 1 candidate value: Combination (including empty) of {codebook1, codebook2, codebook3, codebook4}  Component 2 candidate value: {N/A, (4,1), (2,2), both}  A UE that supports Component 3 of FG 40-7-1 as “TDM and noTDM” must support this FG. | Optional with capability signaling |   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 9:** *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 | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] | According to the agreement in RAN1-116 meeting [1], the following FGs/rows are agreed as baseline for further discussions on unified TCI framework extension for multi-TRP:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-14a | Dynamic switching - scheme A | Support of dynamic switching between single-TRP and PDSCH SFN scheme A by TCI selection field in DCI formats 1\_1, 1\_2 | 40-1-4, 23-6-1a | Yes | n/a | dynamic switching between single-TRP and PDSCH SFN scheme A by TCI selection field in DCI formats 1\_1, 1\_2 is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-14b | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI selection field in DCI formats 1\_1, 1\_2 | 40-1-4, 23-6-2a | Yes | n/a | dynamic switching between single-TRP and PDSCH SFN scheme B by TCI selection field in DCI formats 1\_1, 1\_2 is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signaling |   Refer to TS 38.306[2], the following two UE feature were defined that UE need to indicate whether the UE supports dynamic switching between single-TRP and PDSCH SFN scheme A/B by TCI state field in DCI formats 1\_1 and 1\_2. But in Rel-18, a new DCI field, i.e., TCI selection field will be introduced into DCI formats 1\_1 and 1\_2 to indicate the TCI state for PDSCH. Thus it is necessary to define a new UE capability to indicate whether the UE supports dynamic switching between single-TRP and PDSCH SFN scheme A/B by TCI selection field in DCI formats 1\_1 and 1\_2.   | ***sfn-SchemeA-DynamicSwitching-r17***  Indicates whether the UE supports dynamic switching between single-TRP and PDSCH SFN scheme A by TCI state field in DCI formats 1\_1 and 1\_2. The UE supporting this feature shall indicate *sfn-SchemeA-r17* or *sfn-SchemeA-PDSCH-only-r17*. | FS | No | N/A | N/A | | --- | --- | --- | --- | --- | | ***sfn-SchemeB-DynamicSwitching-r17***  Indicates whether the UE supports dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1 and 1\_2.  The UE supporting this feature shall indicate *sfn-schemeB-r17* or *sfn-schemeB-PDSCH-only-r17.* | FS | No | N/A | N/A |   ***Proposal 2-1: Define a new UE capability to indicate whether the UE supports dynamic switching between single-TRP and PDSCH SFN scheme A/B by TCI selection field in DCI formats 1\_1 and 1\_2.***  According to the agreement in RAN1-116 meeting [1], the following FGs/rows are agreed as baseline for further discussions on CSI for CJT:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-24 | The maxmum total number of supported SD basis for M-TRP CJT | The maxmum total number of supported SD basis for M-TRP CJT |  | Yes | n/a | SD basis selection for M-TRP CJT is not supported. | Per band and per BC | n/a | n/a | n/a | Candidate values for component 1:  {2, 4, 6, 8, 10, 12, 16} | Optional with capability signaling | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-25 | The supported subset of linkages | The supported subset of linkages |  | Yes | n/a | The linkages of the parameter combination is not supported. | Per band and per BC | n/a | n/a | n/a |  | Optional with capability signaling |   According to the following agreement, the number of supported SD basis combination can be reported based on UE capability.  **Agreement (RAN1-112b e-meeting)**  On the Parameter Combination of Type-II codebook refinement for CJT mTRP, only the following linkages are supported (marked ‘x’), for Rel-16 eType-II based   * For *NTRP* =1,   + fully reuse seven out of the eight Parameter Combinations from Rel-16 eType-II as indicated in the table below     - FFS (by RAN1#112bis-e): whether to add one more Parameter Combination for L=4 based on the legacy Rel-16 eType-II FD combo {½, ½, ¼, ¼; ½} or the agreed FD combo {½, ½, ½, ½; ½}, or not to add from the indicated seven below * For *NTRP* >1, only the following linkages are supported (marked ‘x’) * Note: Configured linkage(s) are associated with the configured value of *NTRP*, regardless whether the dynamic TRP selection (the dynamic change of *N* given *NTRP*) is configured. Also, the configured linkage(s) are valid for any dynamically selected SD basis and/or any dynamically selected CSI-RS resource (TRP). * FFS: UE feature/capability to support only a subset of linkages  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **NTRP** | **SD combo** | **FD combo {pv},** | | | | | | | {1/8, 1/8, 1/16, 1/16}, ¼ | {1/8, 1/8, 1/16, 1/16}, ½ | {1/4, ¼, 1/8, 1/8}, ¼ | {1/4, ¼, 1/8, 1/8}, ½ | {1/4, ¼, ¼, ¼}, ¾ | {1/2, ½, ½, ½}, ½ | | 1 | 2 |  |  | x | x |  |  | | 4 |  |  | x | x | x |  | | 6 w/ restriction |  |  |  | x | x |  | | 2 | {2,2} | x |  |  |  |  |  | | {2,4}  {4,2} | x |  |  |  |  |  | | {4,4} |  | x |  | x |  | x | | 3 | {2,2,2} | x | x |  |  |  |  | | {2,2,4}  {2,4,2}  {4,2,2} | x | x |  |  |  |  | | {4,4,4} | x | x | x | x | x | x | | 4 | {2,2,2,2} | x |  |  |  |  | N/A | | {2,2,2,4} | x |  |  |  |  | N/A | | {2,2,4,4} |  |  |  | x | x | N/A | | {4,4,4,4} |  | x |  | x | x | N/A |   **Agreement (RAN1-112 meeting)**  On the Type-II codebook refinement for CJT mTRP, for Rel-16-based refinement, support *at least* the following combinations of {*Ln*} for the higher-layer-configured value of NTRP (FFS by RAN1#112: whether the bracketed permutations are also supported):   * FFS by RAN1#112: whether other combinations can be supported   FFS (by RAN1#112bis-e): Whether/how the supported combinations of {*n*} for Rel-17-based refinement are derived from the supported combinations of {*Ln*} for Rel-16-based refinement  FFS: Whether the total number of Ln is a UE capability   |  |  | | --- | --- | | **NTRP** | **{Ln} combination** | | 1 | {2} | | {4} | | {6} (analogous to legacy, only for total # ports =32, rank 1-2, R=1 | | 2 | {2,2} | | {2,4}, [{4,2}] | | {4,4} | | 3 | {2,2,2} | | {2,2,4} [and its other permutations] | | {4,4,4} | | 4 | {2,2,2,2} | | {2,2,2,4} [and its other permutations] | | {2,2,4,4} [and its other permutations] | | {4,4,4,4} |   ***Proposal 4-1: Define a UE capability to indicate the total number of supported SD basis combinations.***  According to the following agreement, the supported subset of linkages can be reported based on UE capability.  ***Proposal 4-2: Define a UE capability to indicate the supported subset of linkages.*** |
| ZTE Corporation [12] | A list of UE features (40-1-1 ~ 40-1-13) are developed in [1] for Rel-18 unified TCI extension for multi-TRP. Then, for the left-over UE feature issue(s) for unified TCI framework extension for MTRP operation, we identify, besides for FG 40-1-3, that additional FG for indicating UE supporting M-DCI based MTRP CSI-RS configuration is also needed. Then, some FG related pre-requisite FGs should be clarified.  ***Proposal 1-1:*** *For FG 40-1-3, the following modification for introducing a new FG is proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-1-3a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP | Support of per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP | 40-1-7 | yes | n/a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP is not supported | Per band | n/a | n/a | n/a | Component candidate values: {per resource, per resource set, both} | Optional with capability signalling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | Another issue, periodicity restriction of periodic CSI-RS was discussed for Type-II-Doppler CSI (since long periodicity makes no sense to high the mobility scenario that this CSI targeted), but unfortunately got no consensus due to limited TU of Rel-18.   |  | | --- | | **Conclusion (RAN1#114, 2023-08):**  For the Type-II codebook refinement for high/medium velocities, there is no consensus on supporting the following proposals:   * … (Other non-relevant bullets omitted) * when P/SP-CSI-RS is configured as the CMR, any restriction in CSI-RS periodicity |   A fair comparison can refer to the case of aperiodic CSI-RS, where the largest “time interval” between two consecutive CSI-RS occasions is only 2 slots.   |  | | --- | | **TS 38.214 v18.2.0 (2024-03)** |   From UE implementation perspective, longer CSI-RS periodicity requires longer buffer and receiving continuity, therefore, we propose  **Proposal 2.3: Adopt the following additional Feature Group to FG 40-3-2-x**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-3-2-[12] | Supported maximum periodicity of CMR when configured as periodic CSI-RS | Maximum periodicity of periodic CSI-RS (in slots) UE can handle for Type-II-Doppler CSI report | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | UE cannot handle a long periodicity CSI-RS configured by gNB | Per-band  Per-BC | No | N/A | N/A | Component candidate values (in slots): {4,5,8,10} | 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 diffenrentiate 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 2.7: 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** |
| NTT DOCOMO, INC. [16] | In addition, according to RAN2 LS in [2], the granularity of “across all CCs” for some MIMO capabilities should be clarified.   |  | | --- | | * **Topic 3: UE capabilities with "across all CCs”**   In R1-2312705, some features (i.e. 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, FG 40-7-2a, FG 42-1/1a/1b/2/2a/2b, FG 55-6h) indicating capability “across all CCs” have different granularity, i.e. either per band, per BC or per FS.  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.  Therefore, RAN2 would like to ask RAN1 to further clarify the granularity of “across all CCs” for the above listed feature groups if their granularity are per band/per FS in Rel-18 RAN1 NR UE features list.  Additionally, RAN2 also would like to ask RAN1 to clarify the granularity of “across all CCs” for the below Rel-17 capabilities for correction:   * *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* |   As indicated by RAN2 above, the definition of “across all CCs” for a per-BC capability is rather clear; we believe it just means “across all CCs in all bands in the band combination”. Also, given that there may be more than a CC even in a single band (e.g., intra-band CA), it is clear for a per-band capability as well – “across all CCs” indicated in a per-band capability means “across all CCs in the band”. Taking FG 40-1-1 component 2 (maximum number of activated joint TCI states across all CCs) as an example, if “32” is reported for a band, say Band#A, 32 shall always be the maximum number of activated joint TCI states across all CCs in Band#A. This should apply to any operation in which Band#A is involved (including inter-band CA, DC, etc).  For per-FS (i.e., per band per band combination) capability, however, it may not be so clear as the above. 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.  We strongly hope to see no ambiguity for interpretation of any UE capability information for the sake of work efficiency at our commercial side, and thus suggest discussing the issue at least for per-FG capability. For per-band and per-BC capability, we think the interpretation is rather clear, which should be informed to RAN2 considering that they asked our feedback on the LS.  **Proposal 2: Clarify the meaning of “across all CCs” for per-band capability and per-BC capability as follows in a LS reply to RAN2:**   * **When it is described for a per-band capability, it means “across all CCs within the band”** * **When it is described for a per-BC capability, it means “across all CCs in all bands within the band combination”**   **Proposal 3: For the meaning of “across all CCs” for per-FS (i.e. per band per band combination) capability, discuss which of the following interpretations is correct:**   * **Interpretation#1 (aligned with our understanding): “across all CCs” implies “across all CCs in a band in a band combination”.** * **Interpretation#2: “across all CCs” implies “across all CCs in a band combination”.** |
| Ericsson [17] |  |
| Apple [18] | We propose to add the following FG to mirror the legacy FG2-16b quoted below. We acknowledge that the current FG definition, i.e., FG40-4-6, FG40-4-6a and the newly proposed FG40-4-4b following the legacy way can be ambiguous especially regarding 1 port and more than 1 port, we are open to clarify since this ambiguity exists in legacy as well.  A white background with black text  Description automatically generated   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6b | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | 40-4-6 | Yes | n/a | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH is not supported | Per FS | No | No | n/a |  | Optional with capability signalling |   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 | |

## NR\_pos\_enh2

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| 41. NR\_pos\_enh2 | 41-1-1 | Common SL PRS Processing Capability in a SL BWP | 1. Maximum SL PRS bandwidth in MHz in a resource pool for positioning, which is supported and reported by UE for SL-PRS measurement  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  3. Maximum number of slots with active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  4. Minimum time after the end of a slot carrying the active SL-PRS resource(s) assuming maximum number of symbols and maximum bandwidth for a UE to finish the SL-PRS resource and the associated PSCCH processing which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | WA: Per Band | n/a | n/a | n/a | Component 1 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  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  Component 3 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Component 4 candidate values: {20ms, 30ms, 40ms, 50ms, 80ms, 100ms, 160ms}  Note: a 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  Need for location server/ UE to know if the feature is supported | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *Confirm WA that Reporting type is* ***per band****.* |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | For FG 41-1-1, “per Band” was agreed as WA. It needs to be confirmed in this meeting.  Proposal 2: For FG 41-1-1, confirm the “per Band” WA. |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-1 | Common SL PRS Processing Capability in a SL BWP | 1. Maximum SL PRS bandwidth in MHz in a resource pool for positioning, which is supported and reported by UE for SL-PRS measurement  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  3. Maximum number of slots with active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  4. Minimum time after the end of a slot carrying the active SL-PRS resource(s) assuming maximum number of symbols and maximum bandwidth for a UE to finish the SL-PRS resource and the associated PSCCH processing which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | Per Band | n/a | n/a | n/a | Component 1 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  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  Component 3 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Component 4 candidate values: {20ms, 30ms, 40ms, 50ms, 80ms, 100ms, 160ms}  Note: a 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  Need for location server/ UE to know if the feature is supported | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-1 | Common SL PRS Processing Capability in a SL BWP | 1. Maximum SL PRS bandwidth in MHz in a resource pool for positioning, which is supported and reported by UE for SL-PRS measurement  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  3. Maximum number of slots with active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  4. Minimum time after the end of a slot carrying the active SL-PRS resource(s) assuming maximum number of symbols and maximum bandwidth for a UE to finish the SL-PRS resource and the associated PSCCH processing which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | Per Band | n/a | n/a | n/a | Component 1 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  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  Component 3 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Component 4 candidate values: {20ms, 30ms, 40ms, 50ms, 80ms, 100ms, 160ms}  Note: a 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  Need for location server/ UE to know if the feature is supported | Optional with capability signaling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.1: With regards to the FGs on Common SL PRS Processing capability (FGs 41-1-1 and FG 41-1-1a) and 41-1-10, confirm the Working assumptions.** |
| NTT DOCOMO, INC. [16] | For FG 41-1-1, RAN1 made the working assumption for reporting type. We support this working assumption, and FG 41-1-1 can be reported per band.  **Proposal 6: For FG 41-1-1, confirm the working assumption.** |
| Ericsson [17] |  |
| Apple [18] | * ***Proposal 1: For FG 41-1-1***   + ***Agree on Working Assumption Per band*** |

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| 41. NR\_pos\_enh2 | 41-1-1a | Common SL PRS Processing Capability | 1. Maximum number of active SL PRS resources across all configured RPs across all bands in a slot assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum number of slots with active SL PRS resources across all configured RPsacross all bands assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | Per UE | No | No | No | Component 1 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  Component 2 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Need for location server/ UE to know if the feature is supported  This row/FG is a WA | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *Confirm WA for this row.* |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | FG 41-1-1a was added in RAN1#116 as WA due to FG 41-1-1 was “per Band” WA. It includes two components for the UE’s processing capability across all bands. If “per Band” WA is agreed for FG 41-1-1, then there is a need to include FG 41-1-1a.  **Proposal 3: For FG 41-1-1a, confirm the WA to introduce FG 41-1-1a.** |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-1a | Common SL PRS Processing Capability | 1. Maximum number of active SL PRS resources across all configured RPs across all bands in a slot assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum number of slots with active SL PRS resources across all configured RPsacross all bands assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | Per UE | No | No | No | Component 1 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  Component 2 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Need for location server/ UE to know if the feature is supported | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-1a | Common SL PRS Processing Capability | 1. Maximum number of active SL PRS resources across all configured RPs across all bands in a slot assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum number of slots with active SL PRS resources across all configured RPsacross all bands assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | Per UE | No | No | No | Component 1 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  Component 2 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Need for location server/ UE to know if the feature is supported | Optional with capability signaling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.1: With regards to the FGs on Common SL PRS Processing capability (FGs 41-1-1 and FG 41-1-1a) and 41-1-10, confirm the Working assumptions.**  **Proposal 3.2: FGs 41-1-1 is a prerequisite for FG 41-1-1a.** |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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, 15-4, 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  [UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported] | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | * + - *Remove brackets for prerequisites.*     - *It is not necessary to list FG 15-4 as prerequisite since FG 15-4 is mandatory for a UE indicating support of NR sidelink.*     - *Remove brackets in the Note column.*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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, ~~15-4,~~ 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  ~~[~~UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported~~]~~ | Optional with capability signaling | |
| Vivo [5] | ***Add FG 41-1-1a as the Prerequisite feature of 41-1-2, 41-1-3, 41-1-7a/b/c/d/e/f/g*** |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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, 15-4, 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  UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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  UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported | Optional with capability signaling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.3: With regards to the FG 41-1-2 and 41-1-4,**   * **have only 41-1-1 and 41-1-1a as prerequisites.** * **Remove the Notes that are in brackets.** |
| NTT DOCOMO, INC. [16] | For FG 41-1-2/3, the candidate prerequisite FGs are FG 15-1, 15-4, 41-1-1. In our understanding, FG 15-1 and 15-4 are basic FGs for sidelink reception, and FG 41-1-1 is a basic FG for SL PRS. Thus, we think the bracket can be removed. Regarding the note, UEs supporting FG 41-1-1 should support receiving SL-PRS in a shared resource pool and/or in a dedicated resource pool. Thus, the bracket can be removed.  **Proposal 7: For FG 41-1-2/3, remove the brackets for prerequisites and note.** |
| Ericsson [17] |  |
| Apple [18] | * ***Proposal 2: For FG 41-1-2 and FG 41-1-3***   + ***Remove brackets on the following: UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported.*** |

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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 | [15-1, 15-4 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  [UE support of FG 41-1-1 must indicate either this feature group or feature group 41-1-2 is supported or both are supported] | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | * + - *Remove brackets for prerequisites.*     - *It is not necessary to list FG 15-4 as prerequisite since FG 15-4 is mandatory for a UE indicating support of NR sidelink.*     - *Remove brackets in the Note column.*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | ~~[~~15-1, ~~15-4,~~ 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  ~~[~~UE support of FG 41-1-1 must indicate either this feature group or feature group 41-1-2 is supported or both are supported~~]~~ | Optional with capability signaling | |
| Vivo [5] | ***Add FG 41-1-1a as the Prerequisite feature of 41-1-2, 41-1-3, 41-1-7a/b/c/d/e/f/g*** |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | 15-1, 15-4 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  UE support of FG 41-1-1 must indicate either this feature group or feature group 41-1-2 is supported or both are supported | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | 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  UE support of FG 41-1-1 must indicate either this feature group or feature group 41-1-2 is supported or both are supported | Optional with capability signaling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | For FG 41-1-2/3, the candidate prerequisite FGs are FG 15-1, 15-4, 41-1-1. In our understanding, FG 15-1 and 15-4 are basic FGs for sidelink reception, and FG 41-1-1 is a basic FG for SL PRS. Thus, we think the bracket can be removed. Regarding the note, UEs supporting FG 41-1-1 should support receiving SL-PRS in a shared resource pool and/or in a dedicated resource pool. Thus, the bracket can be removed.  **Proposal 7: For FG 41-1-2/3, remove the brackets for prerequisites and note.** |
| Ericsson [17] |  |
| Apple [18] | * ***Proposal 2: For FG 41-1-2 and FG 41-1-3***   + ***Remove brackets on the following: UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported.*** |

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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 | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *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 [2] 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 [3].*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.3: With regards to the FG 41-1-2 and 41-1-4,**   * **have only 41-1-1 and 41-1-1a as prerequisites.** * **Remove the Notes that are in brackets.** |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *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 [2] 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 [3].*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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, *p0-OLPC-Sidelink-r17* | 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 | |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.3: With regards to the FG 41-1-2 and 41-1-4,**   * **have only 41-1-1 and 41-1-1a as prerequisites.** * **Remove the Notes that are in brackets.** |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 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 | [15-[x], 41-1-3], 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *Remove brackets for prerequisites. For FG 41-1-4c, change prerequisite FG 15-[x] to FG 15-3.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | ~~[~~15-~~[x]~~3, 41-1-3~~]~~, 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 | |
| Vivo [5] | Considering the support of random selection in scheme 2, we think the UE can transmit SL PRS even if receiving SL PRS is not supported. So, in this case, the Prerequisite feature 41-1-3 can be removed from the Prerequisite feature for 41-1-4c.   |  | | --- | | **Agreement**  Sensing based or random selection in Scheme 2 is allowed by (pre-)configured per resource pool (similar to Rel-17 NR sidelink communication).   * + Working assumption: Sensing-based and random selection can be allowed in the same resource pool   + FFS: whether any enhancements are needed for coexistence of random selection and sensing-based resource selection in a resource pool * FFS: Details on the sensing-based resource selection and random selection, whether it will be similar to NR Rel-16 or NR Rel-17. |   In addition, based on the 15-3 and 15-5 UE features, we can find that the 15-3 is the Prerequisite feature of 15-5, not the other way around. In this case, the 15-[X] can also be removed.   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 15-3 | Transmitting NR sidelink mode 2 | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.  2) UE can transmit PSSCH according to the normal 64QAM MCS table.  3) UE supports PT-RS transmission in FR2.  4) UE can perform mode 2 sensing and resource allocation operations  6) UE can transmit using the subcarrier spacing and CP length it reports for FG 15-1  8) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  10) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR2  11) DL pathloss based open loop power control when mode 2 is configured by NR Uu | 15-1 | Yes | No |  | Per band | N.A. | N.A. | N.A. | Note: Random selection in the exceptional pool is supported.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  This is the basic FG for NR sidelink  Candidate values for B are {8,16}  Note: Component 6 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 10 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. | | 15-5 | Sidelink congestion control | 1) UE can report CBR measurement to gNB when operating in Mode 1 and mode 2  2) UE can adjust its radio parameters based on CBR measurement and CRlimit.  3) UE can process CBR and CR within the time it indicates | 15-1 and at least one of 15-2 and 15-3 | Yes | No |  | Per band | N.A. | N.A. | N.A. | This is the basic FG for NR sidelink  Note: component 1 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-3 candidate value set  {Congestion process time 1, Congestion process time 2} where  Congestion process time 1: 2, 2, 4, 8 slots for 15, 30, 60, 120 kHz subcarrier spacing.  Congestion process time 2: 2, 4, 8, 16 slots for 15, 30, 60, 120 kHz subcarrier spacing | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |  * ***Update FG 41-1-4c as follows***   + ***Remove 15-[X] and 41-1-3 from the Prerequisite feature in 41-1-4c***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | **Proposal 3.3: With regards to the FG 41-1-2 and 41-1-4,**   * **have only 41-1-1 and 41-1-1a as prerequisites.** * **Remove the Notes that are in brackets.**   c | 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 | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.3: With regards to the FG 41-1-2 and 41-1-4,**   * **have only 41-1-1 and 41-1-1a as prerequisites.** * **Remove the Notes that are in brackets.**   **Proposal 3.4: With regards to the FG 41-1-4c, do not introduce additional prerequisites.** |
| NTT DOCOMO, INC. [16] | For FG 41-1-4c, we think the prerequisite of FG 41-1-4b can be referred. Some companies proposed to add FG 15-3 as the prerequisite of FG 41-1-4c at the last meeting. Since RAN1 agreed to remove FG 15-2 from the prerequisite of FG 41-1-4b, 15-[x] can be removed from the prerequisite of FG 41-1-4c.  **Proposal 8: For FG 41-1-4c, remove 15-[x] from the prerequisite.** |
| Ericsson [17] |  |
| Apple [18] |  |

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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 | 41-1-7b | SL PRS measurement for SL RTOA | 1. Support SL RTOA measurement based on SL-PRS  2. Support SL RTOA measurement reporting  3. Maximum number of SL RTOA measurementreporting 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 RTOA | 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 | 41-1-7c | 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 | 41-1-7e | SL PRS measurement for SL PRS-RSRP | 1. Support SL PRS-RSRP measurement based on SL-PRS  2. Support SL PRS-RSRP measurement reporting | 41-1-1 | No | No | SL PRS measurement for SL PRS-RSRP 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 | 41-1-7f | SL PRS measurement for SL PRS-RSRPP | 1. Support SL PRS-RSRPP measurement based on SL-PRS  2. Support SL PRS-RSRPP measurement reporting | 41-1-1 | No | No | SL PRS measurement for SL PRS-RSRPP 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 | 41-1-7g | SL PRS measurement for SL AoA | 1. Support SL AoA measurement based on SL-PRS  2. Support SL AoA measurement reporting types. Candidate values: bitmap {GCS, LCS with translation, LCS without translation}. | 41-1-1 | No | No | SL PRS measurement for SL AoA 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *Correct typo:* Compo~~o~~nent 3 candidate values: {1,2,3,4}*.* |
| Vivo [5] | ***Add FG 41-1-1a as the Prerequisite feature of 41-1-2, 41-1-3, 41-1-7a/b/c/d/e/f/g*** |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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 | FFS | 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | * *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 [2] 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 [3].*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| Vivo [5] | For full sensing-based SL PRS transmission, the SL-PRS congestion control needs to be supported, so, we propose   * ***Add 41-1-5 as the Prerequisite feature in FG 41-1-10***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | 41-1-5 | 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 | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | 41-1-3 | 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 | Optional with capability signaling | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | **Proposal 3.1: With regards to the FGs on Common SL PRS Processing capability (FGs 41-1-1 and FG 41-1-1a) and 41-1-10, confirm the Working assumptions.**  **Proposal 3.5: With regards to the FG 41-1-10, do not introduce any prerequisites.** |
| NTT DOCOMO, INC. [16] | For FG 41-1-10, regarding FFS, we think receiving SL-PRS is necessary for sensing. Thus, FG 41-1-3 can be added to prerequisite. In addition, working assumption for reporting type can be confirmed.  **Proposal 9: For FG 41-1-10, prerequisite can be FG 41-1-3, and confirm the working assumption.** |
| Ericsson [17] |  |
| Apple [18] | * ***Proposal 8: FG 41-1-10***   + ***Agree on Working Assumption Per band*** |

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| 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 |

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| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] | *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 [2] 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 [3].*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 41. NR\_pos\_enh2 | 41-2-5 | Reporting timestamp with OFDM symbol index associated with RSCP measurement and RSCPD measurement | Support of Reporting timestamp with OFDM symbol index associated with RSCP measurement and RSCPD measurement | At least one of {41-2-1, 41-2-1a, 41-2-2,41-2-2a} | No | N.A. | Reporting timestamp with OFDM symbol index associated with RSCP measurement and RSCPD measurement is 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | For FG 41-2-5, there is a remaining issue on the prerequisite feature groups: “At least one of {[41-2-1, or 41-2-1a, or 41-2-2, 41-2-2a]”. We suggest removing the brackets. Clearly, for a UE that support FG 41-2-5, it needs to support at least one of 41-2-1, 41-2-1a, 41-2-2 and 41-2-2a.  **Proposal 4: For FG 41-2-5, make the following changes:**   * **At least one of {~~[~~41-2-1, ~~or~~ 41-2-1a, ~~or~~ 41-2-2, 41-2-2a~~]~~}** |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | For FG 41-2-6, there is a remaining issue 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 and the brackets. Clearly, 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 5: For FG 41-2-6, make the following changes:**   * **~~FFS~~ At least one of {~~[~~41-2-1, ~~or~~ 41-2-1a, ~~or~~ 41-2-2, 41-2-2a~~]~~}** |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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] |  |
| Vivo [5] | 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 | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | According to TS 37.355 which shows the association between positioning method and measurement metric, the legacy measurements can be considered as DL PRS-RSRP/DL RSTD of DL-TDOA, DL PRS-RSRP/UE Rx-Tx time difference of Multi-RTT method and DL PRS-RSRP/DL PRS-RSRPP of DL-AoD method. The measurement definitions are specified in TS 38.215. Hence, we propose the following changes.  **Proposal 10: For FG 41-2-8, “legacy measurements” should be change as “DL PRS-RSRP and DL RSTD measurements”.**  **Proposal 11: For FG 41-2-9, “legacy measurements” should be change as “DL PRS-RSRP and UE Rx-Tx time difference measurements”.**  **Proposal 12: For FG 41-2-10, “legacy measurements” should be change as “DL PRS-RSRP and DL PRS-RSRPP measurements”.** |
| Ericsson [17] |  |
| Apple [18] |  |

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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-7: 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] |  |
| Vivo [5] | |  | | --- | | 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 | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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] |  |
| Vivo [5] | |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 methods’ stated in 41-3-3 should be replaced with ‘DL-TDOA and/or 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. | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 41. NR\_pos\_enh2 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {80, 100, 160, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 300}  FR2 bands: {50, 100, 200, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Note: A UE that support FG 13-8a must signal a non-zero value for components 6 and 7 for aperiodic  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Based on RAN4 LS, we prefer to make the following changes to FG 41-4-6, 41-4-7, and 41-4-8.  In addition, there was a typo on the guard period, and “ms” should be changed “us”.  **Proposal Pos-5: Update FG 41-4-6, 41-4-7, and 41-4-8 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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.  Note: For component 2, it shall be less than or equal to the maximum aggregated transmission bandwidth associated with IE ca-BandwidthClassUL-NR. Additionally, it shall be less than or equal to the maximum aggregated bandwidth for the supported CA configuration in Table 5.5A.1-1 in TS 38.101-1 for FR1 bands or Table 5.5A.1-1 in TS 38.101-2 for FR2 bands for the band where aggregated SRS CCs is configured.  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Note: A UE that support FG 13-8a must signal a non-zero value for components 6 and 7 for aperiodic  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling | |
| Intel Corporation [4] | * + - *For Note column, update Component 2 candidate values as below to implement request from RAN4 in [4]:*       * Component 2 candidate values:       * For 2 in Component 1:       * FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~}       * FR2 bands: {50, 100, 200, 400, 600, 800}       * For 3 in Component 1:       * FR1 bands: {80, 100, 160, 200, 240, 300}       * FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Note: A UE that support FG 13-8a must signal a non-zero value for components 6 and 7 for aperiodic  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling | |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] | In RAN4 LS [2], RAN4 proposes the following changes related FG 41-4-6 and FG 41-4-7:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | *the UL CA capability shall be the pre-requisite for a UE support RAN1 feature 41-4-6 and parameter defined in feature 41-4-6 needs to be in line with parameters reported in UL CA capability. For example, the first two components defined in feature 41-4-6 are quoted as below*   1. *The number of supported aggregated carriers in intra band contiguous carriers* 2. *Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE*   *For the first component parameter, it shall be less than or equal to the maximum number of the component carrier associated with IE ca-BandwidthClassUL-NR.*  *For the second component parameter, it shall be less than or equal to the maximum aggregated transmission bandwidth associated with IE ca-BandwidthClassUL-NR. Additionally, it shall be less than or equal to the maximum aggregated bandwidth for the supported CA configuration in Table 5.5A.1-1 in TS 38.101-1 for FR1 bands or Table 5.5A.1-1 in TS 38.101-2 for FR2 bands for the band where aggregated SRS CCs is configured.*  *IE ca-BandwidthClassUL-NR in 38.306 is quoted as below.*   | ***ca-BandwidthClassUL-NR***  *Defines for UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. When all FeatureSetUplinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. For FR1, the value 'F' shall not be used as it is invalidated in TS 38.101-1 [2].* | *Band* | *No* | *N/A* | *N/A* | | --- | --- | --- | --- | --- |   *Based on above RAN4 agreement, For the second component parameter, the following modifications for the values in component 2 in feature 41-4-6 are suggested,*  *For 2 in Component 1:*  *FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190,200}*  *FR2 bands: {50, 100,200, 400, 600, 800}*  *For 3 in Component 1:*  *FR1 bands: {80, 100, 160,200, 240, 300}*  *FR2 bands: {50, 100, 200,300,400, 600,800, 1000, 1200}*  *For RAN1 feature 41-4-7, RAN4 agreed that the capability on UE power class to transmit the SRS aggregated CCs needs to be reported to the network. The reported power class can be PC2 or PC3 and applicable to FR1 only. For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network.* |   In our view, RAN1 should make the changes for FG 41-4-6 and FG 41-4-7 with the consideration of the suggestions from RAN4.  **Proposal 6: For FG 41-4-6, make the following changes:**   * **For 2 in Component 1:** * **FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200}** * **FR2 bands: {50, 100,200, 400, 600, 800}** * **For 3 in Component 1:** * **FR1 bands: {80, 100, 160, 200, 240, 300}** * **FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}** |
| Samsung [8] | According to the progress in RAN4 and the LS, the candidate values for the maximum aggregated UL SRS bandwidth in MHz has been suggested from RAN4’s perspective. For FGs 41-4-6, RAN1 shall add the candidate values.  **Proposal 10:** update FGs 41-4-6 related to SRS bandwidth aggregation as follow (changes in red):   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Note: A UE that support FG 13-8a must signal a non-zero value for components 6 and 7 for aperiodic  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period | 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {80, 100, 160, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 300}  FR2 bands: {50, 100, 200, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0ms, 30ms, 100ms, 140ms, 200ms}  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | Based on RAN4 LS, we prefer to make the following changes to FG 41-4-6, 41-4-7, and 41-4-8.  In addition, there was a typo on the guard period, and “ms” should be changed “us”.  **Proposal Pos-5: Update FG 41-4-6, 41-4-7, and 41-4-8 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period  10. Power class | 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0us, 30us, 100us, 140us, 200us}  Component 10 candidate values:  For 2 in component 1:  {PC2, PC3}  For 3 in component 1:  {PC2, PC3}  Note: Component 10 is only applicable for FR1 bands.  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling | |
| Intel Corporation [4] | * + - *Add component 10 to report UE power class with corresponding candidate values and note as recommended by RAN4 in [4]:*       * Component 10 candidate values: {PC2, PC3} for FR1 only. For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period  10. UE power class | 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {80, 100, 160, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 300}  FR2 bands: {50, 100, 200, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0ms, 30ms, 100ms, 140ms, 200ms}  Component 10 candidate values: {PC2, PC3} for FR1 only. For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network.  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource.  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling | |
| Vivo [5] | Based on the LS from RAN4(R4-2403654), the following are suggested   |  | | --- | | Based on above RAN4 agreement, For the second component parameter, the following modifications for the values in component 2 in feature 41-4-6 are suggested,  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190,200}  FR2 bands: {50, 100,200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160,200, 240, 300}  FR2 bands: {50, 100, 200,300,400, 600,800, 1000, 1200}  For RAN1 feature 41-4-7, RAN4 agreed that the capability on UE power class to transmit the SRS aggregated CCs needs to be reported to the network. The reported power class can be PC2 or PC3 and applicable to FR1 only. For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network. |   In addition, considering the UE feature about power class, we propose:   |  | | --- | | **TS 38.331**  ue-PowerClassPerBandPerBC-r17 ENUMERATED {pc1dot5, pc2, pc3} OPTIONAL,  -- R4 17-8 UL transmission in FR2 bands within an UL gap when the UL gap is activated |   So, we propose   * ***Update FG 41-4-7 as follows***    + ***Add a new component of power class for SRS aggregation***   + ***Add candidate values of bandwidth for SRS aggregation***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period  10. The power class of supported aggregated carriers in intra band contiguous 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180,190, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0ms, 30ms, 100ms, 140ms, 200ms}  Component 10 candidate values:  For 2 in Component 1:  FR1 bands: {PC2, PC3}  FR2 bands: {PC 1.5, PC2, PC3, PC5}  For 3 in Component 1:  FR1 bands: { PC2, PC3}  FR2 bands: {PC 1, PC2, PC3, PC5 }  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling | |
| OPPO [6] |  |
| CATT [7] | In RAN4 LS [2], RAN4 proposes the following changes related FG 41-4-6 and FG 41-4-7:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | *the UL CA capability shall be the pre-requisite for a UE support RAN1 feature 41-4-6 and parameter defined in feature 41-4-6 needs to be in line with parameters reported in UL CA capability. For example, the first two components defined in feature 41-4-6 are quoted as below*   1. *The number of supported aggregated carriers in intra band contiguous carriers* 2. *Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE*   *For the first component parameter, it shall be less than or equal to the maximum number of the component carrier associated with IE ca-BandwidthClassUL-NR.*  *For the second component parameter, it shall be less than or equal to the maximum aggregated transmission bandwidth associated with IE ca-BandwidthClassUL-NR. Additionally, it shall be less than or equal to the maximum aggregated bandwidth for the supported CA configuration in Table 5.5A.1-1 in TS 38.101-1 for FR1 bands or Table 5.5A.1-1 in TS 38.101-2 for FR2 bands for the band where aggregated SRS CCs is configured.*  *IE ca-BandwidthClassUL-NR in 38.306 is quoted as below.*   | ***ca-BandwidthClassUL-NR***  *Defines for UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. When all FeatureSetUplinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. For FR1, the value 'F' shall not be used as it is invalidated in TS 38.101-1 [2].* | *Band* | *No* | *N/A* | *N/A* | | --- | --- | --- | --- | --- |   *Based on above RAN4 agreement, For the second component parameter, the following modifications for the values in component 2 in feature 41-4-6 are suggested,*  *For 2 in Component 1:*  *FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190,200}*  *FR2 bands: {50, 100,200, 400, 600, 800}*  *For 3 in Component 1:*  *FR1 bands: {80, 100, 160,200, 240, 300}*  *FR2 bands: {50, 100, 200,300,400, 600,800, 1000, 1200}*  *For RAN1 feature 41-4-7, RAN4 agreed that the capability on UE power class to transmit the SRS aggregated CCs needs to be reported to the network. The reported power class can be PC2 or PC3 and applicable to FR1 only. For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network.* |   In our view, RAN1 should make the changes for FG 41-4-6 and FG 41-4-7 with the consideration of the suggestions from RAN4.  **Proposal 7: For FG 41-4-7, add the following:**   * **UE power class to transmit the SRS aggregated CCs needs to be reported to the network. The reported power class can be PC2 or PC3 and applicable to FR1 only.** * **For the case when UE can support aggregation of 2 and 3 SRS CCs, and if the power class for 2 aggregated CCs is different with power class for 3 aggregated CCs, both power class should be indicated to the network.** |
| Samsung [8] | According to the progress in RAN4 and the LS, the capability on UE power class has been agreed and suggest to added as a UE capability from RAN4’s perspective. For FGs 41-4-7, RAN1 shall add a sub-component on the UE power class.  **Proposal 11:** update FGs 41-4-7 related to SRS bandwidth aggregation as follow (changes in red):   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period  10. UE power class | 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {80, 100, 160, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 300}  FR2 bands: {50, 100, 200, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0ms, 30ms, 100ms, 140ms, 200ms}  Component 10 candidate values:  For 2 in Component 1:  FR1 bands: {PC2, PC3}  For 3 in Component 1:  FR1 bands: {PC2, PC3}  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling | |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 41. NR\_pos\_enh2 | 41-4-8 | Positioning SRS bandwidth aggregation in RRC\_INACTIVE | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period | 27-15b | Yes | n/a | Positioning SRS bandwidth aggregation in RRC\_INACTIVE is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {80, 100, 160, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 300}  FR2 bands: {50, 100, 200, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0ms, 30ms, 100ms, 140ms, 200ms}  Need for location server to know if the feature is supported. | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Based on RAN4 LS, we prefer to make the following changes to FG 41-4-6, 41-4-7, and 41-4-8.  In addition, there was a typo on the guard period, and “ms” should be changed “us”.  **Proposal Pos-5: Update FG 41-4-6, 41-4-7, and 41-4-8 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-8 | Positioning SRS bandwidth aggregation in RRC\_INACTIVE | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period  10. Power class | 27-15b | Yes | n/a | Positioning SRS bandwidth aggregation in RRC\_INACTIVE is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 200M}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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: {0us, 30us, 100us, 140us, 200us}  Component 10 candidate values:  For 2 in component 1:  {PC2, PC3}  For 3 in component 1:  {PC2, PC3}  Note: Component 10 is only applicable for FR1 bands.  Need for location server to know if the feature is supported. | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 41. NR\_pos\_enh2 | 41-4-9 | Affected bands if guard period is needed in SRS bandwidth aggregation | Indicate which other bands in the band combination are affected due to the need of a guard period | 41-4-7 or 41-4-8 | Yes | n/a | If not reported, all the bands of the UE are affected when a guard period is needed in SRS bandwidth aggregation | Per FS | n/a | n/a | n/a | For each band in the band combination, the UE can indicate which other bands in the band combination are affected by the SRS switch.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1#116, FG 41-4-9 was introduced to refine the impacted bands for the SRS transmission decoupled from communication CA. However, it is possible that the impacted bands only contain the target band, but the FG itself is not quite clear that an empty list of other bands could be indicated.  **Proposal Pos-4: Update FG 41-4-9 as follows.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-4-9 | Affected bands if guard period is needed in SRS bandwidth aggregation | Indicate which other bands in the band combination are affected due to the need of a guard period | 41-4-7 or 41-4-8 | Yes | n/a | If not reported, all the bands of the UE are affected when a guard period is needed in SRS bandwidth aggregation | Per FS | n/a | n/a | n/a | For each band in the band combination, the UE can indicate which other bands in the band combination are affected by the SRS switch.  Note: UE may indicate no other bands in the band combination are affected by the SRS switch.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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| 41. NR\_pos\_enh2 | 41-5-1 | PRS measurement with Rx frequency hopping within a MG and measurement reporting RRC\_CONNECTED for RedCap UEs | 1. Maximum DL PRS bandwidth across all hops  3. Maximum number of hops  4. Duration of DL PRS symbols N3 in units of ms a UE can process every T3 ms  5. RF Rx retune times between consecutive hops  6. Overlapping PRB(s) between adjacent hops | 13-1, one of 28-1 48-1 | Yes | n/a | PRS measurement with Rx frequency hopping within a MG and measurement report in RRC\_CONNECTED for RedCap UEs is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 3 candidate values: {2,3,4,5,6}  Component 4 candidate values:  T3: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N3: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 5 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 6 candidate values: {0, 1, 2, 4}  Note 1: The maximum DL PRS bandwidth per hop follows component 1 of FG 13-1  Note 2: DL PRS buffering capability follows component 2 of FG 13-1  Need for location server to know if the feature is supported. | Optional with capability signalling |
| 41. NR\_pos\_enh2 | 41-5-2 | Support of positioning SRS with Tx frequency hopping in RRC\_CONNECTED for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 13-8, one of {28-1,48-1} | Yes | n/a | Positioning SRS with Tx hopping in RRC\_CONNECTED is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 2 candidate values: {2,3,4,5,6}  Component 3 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 4 candidate values:  {100us, 140us, 200us, 300us, 500us}  Component 7 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  Note: No additional UE requirements shall be specified for the case of Tx hopping with non-overlapping hops compared to the case of Tx hopping with overlapping hops, e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops  Need for location server to know if the feature is supported | Optional with capability signalling |
| 41. NR\_pos\_enh2 | 41-5-2a | Support of positioning SRS with Tx frequency hopping in RRC\_INACTIVE for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 27-15b, one of {28-1,48-1} | Yes | n/a | Positioning SRS with Tx hopping in RRC\_INACTIVE is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 2 candidate values: {2,3,4,5,6}  Component 3 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 4 candidate values:  {100us, 140us, 200us, 300us, 500us}  Component 7 candidate values:  Periodic: {1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  Note: No additional UE requirements shall be specified for the case of Tx hopping with non-overlapping hops compared to the case of Tx hopping with overlapping hops, e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops  Need for location server to know if the feature is supported | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | It was discussed whether the frequency hopping feature can be applicable to non-RedCap UEs, and we believe there is no technical issue to extend that, and thus have the following proposal.  **Proposal Pos-6: Update FG 41-5-1, 41-5-2, and 41-5-2a as follows.**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-5-1 | PRS measurement with Rx frequency hopping within a MG and measurement reporting RRC\_CONNECTED for RedCap UEs | 1. Maximum DL PRS bandwidth across all hops  3. Maximum number of hops  4. Duration of DL PRS symbols N3 in units of ms a UE can process every T3 ms  5. RF Rx retune times between consecutive hops  6. Overlapping PRB(s) between adjacent hops | 13-1 | | 41. NR\_pos\_enh2 | 41-5-2 | Support of positioning SRS with Tx frequency hopping in RRC\_CONNECTED for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 13-8 | | 41. NR\_pos\_enh2 | 41-5-2a | Support of positioning SRS with Tx frequency hopping in RRC\_INACTIVE for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 27-15b | |
| Intel Corporation [4] | * + - *Editorial update for pre-requisite:* 13-1, one of {28-1, 48-1}*.*  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-5-1 | PRS measurement with Rx frequency hopping within a MG and measurement reporting RRC\_CONNECTED for RedCap UEs | 1. Maximum DL PRS bandwidth across all hops  3. Maximum number of hops  4. Duration of DL PRS symbols N3 in units of ms a UE can process every T3 ms  5. RF Rx retune times between consecutive hops  6. Overlapping PRB(s) between adjacent hops | 13-1, one of {28-1, 48-1} | Yes | n/a | PRS measurement with Rx frequency hopping within a MG and measurement report in RRC\_CONNECTED for RedCap UEs is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 3 candidate values: {2,3,4,5,6}  Component 4 candidate values:  T3: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N3: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 5 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 6 candidate values: {0, 1, 2, 4}  Note 1: The maximum DL PRS bandwidth per hop follows component 1 of FG 13-1  Note 2: DL PRS buffering capability follows component 2 of FG 13-1  Need for location server to know if the feature is supported. | Optional with capability signalling | |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

**Other**

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1#116, the following agreement was reached during the maintenance phase of SL positioning. The whole feature is waiting for the decision on whether/how to introduce the UE capability.   |  | | --- | | Working assumption  In NR Rel-18, in a band (pre)configured with SL CA, SL PRS transmission /reception can be supported:   * 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 * 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. * FFS: new UE capability(ies) are defined for this combination of features   Note: whether this combination of features is supported in Rel-18 requires a conclusion on whether to introduce new UE capability(ies). No specification work until the FFS is resolved. |   In our view, we prefer to define a new UE feature to individually indicate whether UE supports this combination of features. The reason is that from FG 47-v1 description, it does not consider the positioning feature, especially on the dedicated resource pool aspects.  **Proposal Pos-1: Define a new capability for combination of SL CA and SL positioning.**  **Proposal Pos-2: Introduce the following FGs.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 41. NR\_pos\_enh2 | 41-1-20a | 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 | 41-1-20b | 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 |   There was not much discussion whether the physical layer SL-PRS transmission request should be introduced as UE capability.  There could be multiple choice to include this functionality in the overall UE feature list.   * Option 1: include this in the existing SL-PRS transmission/SL-PRS reception capabilities, meaning that if UE supports SL-PRS transmission, it should also support transmitting the request, and if UE supports SL-PRS reception, it should also support receiving the request. * Option 2: define a new FG for this functionality.   **Proposal Pos-3: Discuss which option is adopted to include the physical layer SL PRS transmission request.**   * **Option 1: 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 |  * ***Option 2: Introduce a new 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 | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | An LTE or LTE V2X device might support NR SL Positioning without having to do NR SL communications. We propose to capture a subset of the sidelink positioning features as LTE features as was done for sidelink communications in previous releases.  **Proposal 3.6: 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.** |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | ***Create capability for the following WA in RAN1 #116:***  Working assumption  In NR Rel-18, in a band (pre)configured with SL CA, SL PRS transmission /reception can be supported:   * 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 * 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. * FFS: new UE capability(ies) are defined for this combination of features   Note: whether this combination of features is supported in Rel-18 requires a conclusion on whether to introduce new UE capability(ies). No specification work until the FFS is resolved. |

## Netw\_Energy\_NR

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| 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 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 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}  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 |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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 periodic 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}  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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.* |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-1 (SD and P-CSI reporting): NO prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: 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)** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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 periodic CSI report settings with sub-configurations per BWP | FG 2-33, FG 2-35 | 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}  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 | |

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| 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 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}  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 |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 15:**  **- 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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}  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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.*  Some modifications are proposed shown as below to avoid ambiguity. For example, the wording “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” does not clearly say whether “total number of sub-configurations across CSI report settings with sub-configuration” refers to CSI report setting for all time domain behaviors or solely to CSI report setting for semi-persistent CSI report setting. Hence, the update Table 3-1 is proposed.  ***Proposal 3-3:*** *For FG 42-1a/1b/1c and FG 43-2a/2c, the proposed modifications are shown in red in* *Table 3-1.*   |  |  |  |  | | --- | --- | --- | --- | | 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 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 semi-persistent CSI report settings with sub-configurations per BWP | |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-1a (SD and SP-CSI reporting on PUSCH): FG 42-1 or 42-1b as prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-1a: One of {42-1, 42-1b}** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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 semi-persistent CSI report settings with sub-configurations per BWP, which is transmitted on PUSCH | FG 2-33, FG 2-35 | 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}  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 | |

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| 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 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}  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 |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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}  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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.*  Some modifications are proposed shown as below to avoid ambiguity. For example, the wording “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” does not clearly say whether “total number of sub-configurations across CSI report settings with sub-configuration” refers to CSI report setting for all time domain behaviors or solely to CSI report setting for semi-persistent CSI report setting. Hence, the update Table 3-1 is proposed.  ***Proposal 3-3:*** *For FG 42-1a/1b/1c and FG 43-2a/2c, the proposed modifications are shown in red in Table 3-1.*   |  |  |  |  | | --- | --- | --- | --- | | 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 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 aperiodic CSI report settings with sub-configurations per BWP | |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-1b (SD and AP-CSI reporting): NO prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-1b: None (i.e., no prerequisite FG)** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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 aperiodic CSI report settings with sub-configurations per BWP | FG 2-33, FG 2-35 | 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}  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 | |

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| 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 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}  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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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** |  1. For FGs 42-1c/2c, the candidate value set for Lmax was agreed to be {2, 3, 4}. The note “Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH” may lead to confusion that whether the Lmax in the note means the maximum sub-configuration value per CSI report (already agreed to be 4) or the maximum sub-configuration value across all CSI reports (which we don’t think is the intention of the note). So we propose to delete the note. And the note “Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH” can also be deleted. 2. For FGs 42-1a/2a/1c/2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. For example, if a UE report Lmax =8 for 42-1a and Lmax =4 for 42-1c, when gNB configures both SP-CSI report on PUSCH and PUCCH, the maximum sub-configurations for SP-CSI report originally triggered on PUSCH can be 8 and the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can be 4. When PUCCH carrying SP-CSI report collides with a PUSCH, the SP-CSI report originally triggered on PUCCH can be piggybacked on the PUSCH according to the rules in 38.213. In another example, if a UE report Lmax =2 for 42-1a and Lmax =4 for 42-1c, the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can still be 4, but the SP-CSI report cannot be piggybacked on any PUSCH as 4 exceeds the Lmax reported for PUSCH. The second example will complicate the UL multiplexing rule and lead large work for both specification and UE’s implementation. So we propose the Lmax reported for PUSCH should be equal or larger than the value for reported PUCCH. And the same restriction should be applied for N.   **Proposal Nes-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.**   **Proposal Nes-4: For FG 42-1c/42-2c, delete the following notes:**   * **Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH.** * **Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH.**   **Proposal Nes-5: 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).** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 15:**  **- 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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}  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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | In RAN1#116 meeting, the following Notes were removed from FG 42-1a and FG 42-2a. However, they still existing in FG 42-1c and FG 42-2c . Since the candidate of maximum value of Lmax and the maximum value of N have already been determined, the following Notes are unnecessary and can be deleted.   * Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH * Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH   ***Proposal 3-1:*** *Delete the following notes from FG 42-1c and FG 42-2c.*   * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.*  Some modifications are proposed shown as below to avoid ambiguity. For example, the wording “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” does not clearly say whether “total number of sub-configurations across CSI report settings with sub-configuration” refers to CSI report setting for all time domain behaviors or solely to CSI report setting for semi-persistent CSI report setting. Hence, the update Table 3-1 is proposed.  ***Proposal 3-3:*** *For FG 42-1a/1b/1c and FG 43-2a/2c, the proposed modifications are shown in red in Table 3-1.*   |  |  |  |  | | --- | --- | --- | --- | | 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 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 semi-persistent CSI report settings with sub-configurations per BWP | |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-1c (SD and SP-CSI reporting on PUCCH): FG 42-1 or 42-1b as prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-1c: One of {42-1, 42-1b}** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 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 semi-persistent CSI report settings with sub-configurations per BWP, which is transmitted on PUCCH | FG 2-33, FG 2-35 | 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}  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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 6 and 7 are signaled per BC | Optional with capability signaling | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 foraperiodic 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 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} | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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** |  1. For FGs 42-1c/2c, the candidate value set for Lmax was agreed to be {2, 3, 4}. The note “Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH” may lead to confusion that whether the Lmax in the note means the maximum sub-configuration value per CSI report (already agreed to be 4) or the maximum sub-configuration value across all CSI reports (which we don’t think is the intention of the note). So we propose to delete the note. And the note “Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH” can also be deleted. 2. For FGs 42-1a/2a/1c/2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. For example, if a UE report Lmax =8 for 42-1a and Lmax =4 for 42-1c, when gNB configures both SP-CSI report on PUSCH and PUCCH, the maximum sub-configurations for SP-CSI report originally triggered on PUSCH can be 8 and the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can be 4. When PUCCH carrying SP-CSI report collides with a PUSCH, the SP-CSI report originally triggered on PUCCH can be piggybacked on the PUSCH according to the rules in 38.213. In another example, if a UE report Lmax =2 for 42-1a and Lmax =4 for 42-1c, the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can still be 4, but the SP-CSI report cannot be piggybacked on any PUSCH as 4 exceeds the Lmax reported for PUSCH. The second example will complicate the UL multiplexing rule and lead large work for both specification and UE’s implementation. So we propose the Lmax reported for PUSCH should be equal or larger than the value for reported PUCCH. And the same restriction should be applied for N.   **Proposal Nes-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 foraperiodic 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 periodic 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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.* |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-2 (PD and P-CSI reporting): NO prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-2: None (i.e., no prerequisite FG)** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 foraperiodic 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 periodic CSI report settings with sub-configurations per BWP | FG 2-33, FG 2-35 | 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 | |

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| 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 |

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| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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** |  1. For FGs 42-1c/2c, the candidate value set for Lmax was agreed to be {2, 3, 4}. The note “Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH” may lead to confusion that whether the Lmax in the note means the maximum sub-configuration value per CSI report (already agreed to be 4) or the maximum sub-configuration value across all CSI reports (which we don’t think is the intention of the note). So we propose to delete the note. And the note “Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH” can also be deleted. 2. For FGs 42-1a/2a/1c/2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. For example, if a UE report Lmax =8 for 42-1a and Lmax =4 for 42-1c, when gNB configures both SP-CSI report on PUSCH and PUCCH, the maximum sub-configurations for SP-CSI report originally triggered on PUSCH can be 8 and the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can be 4. When PUCCH carrying SP-CSI report collides with a PUSCH, the SP-CSI report originally triggered on PUCCH can be piggybacked on the PUSCH according to the rules in 38.213. In another example, if a UE report Lmax =2 for 42-1a and Lmax =4 for 42-1c, the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can still be 4, but the SP-CSI report cannot be piggybacked on any PUSCH as 4 exceeds the Lmax reported for PUSCH. The second example will complicate the UL multiplexing rule and lead large work for both specification and UE’s implementation. So we propose the Lmax reported for PUSCH should be equal or larger than the value for reported PUCCH. And the same restriction should be applied for N.   **Proposal Nes-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 15:**  **- 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.*  Some modifications are proposed shown as below to avoid ambiguity. For example, the wording “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” does not clearly say whether “total number of sub-configurations across CSI report settings with sub-configuration” refers to CSI report setting for all time domain behaviors or solely to CSI report setting for semi-persistent CSI report setting. Hence, the update Table 3-1 is proposed.  ***Proposal 3-3:*** *For FG 42-1a/1b/1c and FG 43-2a/2c, the proposed modifications are shown in red in Table 3-1.*   |  |  |  |  | | --- | --- | --- | --- | | 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 on PUSCH  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 semi-persistent CSI report settings with sub-configurations per BWP | |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-2a (PD and SP-CSI reporting on PUSCH): FG 42-2 or 42-2b as prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-2a: One of {42-2, 42-2b}** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 semi-persistent CSI report settings with sub-configurations per BWP, which is transmitted on PUSCH | FG 2-33, FG 2-35 | 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 | |

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| 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 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 | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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** |  1. For FGs 42-1c/2c, the candidate value set for Lmax was agreed to be {2, 3, 4}. The note “Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH” may lead to confusion that whether the Lmax in the note means the maximum sub-configuration value per CSI report (already agreed to be 4) or the maximum sub-configuration value across all CSI reports (which we don’t think is the intention of the note). So we propose to delete the note. And the note “Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH” can also be deleted. 2. For FGs 42-1a/2a/1c/2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. For example, if a UE report Lmax =8 for 42-1a and Lmax =4 for 42-1c, when gNB configures both SP-CSI report on PUSCH and PUCCH, the maximum sub-configurations for SP-CSI report originally triggered on PUSCH can be 8 and the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can be 4. When PUCCH carrying SP-CSI report collides with a PUSCH, the SP-CSI report originally triggered on PUCCH can be piggybacked on the PUSCH according to the rules in 38.213. In another example, if a UE report Lmax =2 for 42-1a and Lmax =4 for 42-1c, the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can still be 4, but the SP-CSI report cannot be piggybacked on any PUSCH as 4 exceeds the Lmax reported for PUSCH. The second example will complicate the UL multiplexing rule and lead large work for both specification and UE’s implementation. So we propose the Lmax reported for PUSCH should be equal or larger than the value for reported PUCCH. And the same restriction should be applied for N.   **Proposal Nes-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 aperiodic 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 | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.* |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-2b (PD and AP-CSI reporting): NO prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-2b: None (i.e., no prerequisite FG)** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 aperiodic CSI report settings with sub-configurations per BWP | FG 2-33, FG 2-35 | 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 | |

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| 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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | 1. Regarding the prerequisite feature groups for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b, since we are specifically design the NES feature with willingness of supporting deferent values from a legacy CSI report capability, there does not expect strong dependences among these FGs, and components 4)~7) are reported for each of these FGs respectively, so no prerequisite feature groups are needed. 2. 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. And the values reported for FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs only configured with legacy CSI-report(s). 3. 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** |  1. For FGs 42-1c/2c, the candidate value set for Lmax was agreed to be {2, 3, 4}. The note “Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH” may lead to confusion that whether the Lmax in the note means the maximum sub-configuration value per CSI report (already agreed to be 4) or the maximum sub-configuration value across all CSI reports (which we don’t think is the intention of the note). So we propose to delete the note. And the note “Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH” can also be deleted. 2. For FGs 42-1a/2a/1c/2c, Lmax and N are reported for SP-CSI reporting on PUCCH and PUSCH individually. For example, if a UE report Lmax =8 for 42-1a and Lmax =4 for 42-1c, when gNB configures both SP-CSI report on PUSCH and PUCCH, the maximum sub-configurations for SP-CSI report originally triggered on PUSCH can be 8 and the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can be 4. When PUCCH carrying SP-CSI report collides with a PUSCH, the SP-CSI report originally triggered on PUCCH can be piggybacked on the PUSCH according to the rules in 38.213. In another example, if a UE report Lmax =2 for 42-1a and Lmax =4 for 42-1c, the maximum sub-configurations for SP-CSI report originally triggered on PUCCH can still be 4, but the SP-CSI report cannot be piggybacked on any PUSCH as 4 exceeds the Lmax reported for PUSCH. The second example will complicate the UL multiplexing rule and lead large work for both specification and UE’s implementation. So we propose the Lmax reported for PUSCH should be equal or larger than the value for reported PUCCH. And the same restriction should be applied for N.   **Proposal Nes-1: For FG 42-1/42-1a/42-1c/42-1b/42-2/42-2a/42-2c/42-2b,**   * **No prerequisite feature groups are needed.**   **Proposal Nes-2: 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. And the values reported is applied for CCs configured with at least a CSI report containing sub-configuration(s) while the values reported in FG 2-33 is used for CCs 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/42-7,**   * **Confirm the type is “Per band” with the components related to “across all CCs” signalled per BC, as already agreed.**   **Proposal Nes-4: For FG 42-1c/42-2c, delete the following notes:**   * **Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH.** * **Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH.**   **Proposal Nes-6: 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).** |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | - Regarding limits in FG42-x for joint operation of power domain and spatial domain adaptation  It was agreed in RAN1#116 to introduce FG42-x 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 12: Add a note in FG 42-x 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 13: 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 14:**  **- 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 15:**  **- 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 16:**  **- 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 17:**  **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’.** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | In RAN1#116 meeting, the following Notes were removed from FG 42-1a and FG 42-2a. However, they still existing in FG 42-1c and FG 42-2c . Since the candidate of maximum value of Lmax and the maximum value of N have already been determined, the following Notes are unnecessary and can be deleted.   * Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH * Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH   ***Proposal 3-1:*** *Delete the following notes from FG 42-1c and FG 42-2c.*   * *Note: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH* * *Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH*   The “Prerequisite feature groups” for NES feature groups have not been discussed. Considering that the FG of spatial/power domains are split based on the CSI report setting time domain behavior, there is no need to have a “Prerequisite feature groups”.  ***Proposal 3-2:*** *No need to have a “Prerequisite feature groups” for FG 42-1/1a/1b/1c and FG 43-2/2a/2b/2c.*  Some modifications are proposed shown as below to avoid ambiguity. For example, the wording “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” does not clearly say whether “total number of sub-configurations across CSI report settings with sub-configuration” refers to CSI report setting for all time domain behaviors or solely to CSI report setting for semi-persistent CSI report setting. Hence, the update Table 3-1 is proposed.  ***Proposal 3-3:*** *For FG 42-1a/1b/1c and FG 43-2a/2c, the proposed modifications are shown in red in Table 3-1.*   |  |  |  |  | | --- | --- | --- | --- | | 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 semi-persistent CSI report settings with sub-configurations per BWP | |
| MediaTek [13] |  |
| LG Electronics [14] | **FG 42-2c (PD and SP-CSI reporting on PUCCH): FG 42-2 or 42-2b as prerequisite**  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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP   It is observed that FG 2-35 related to CSI-RS resource/port counting is 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.  **Proposal #2: For FGs 42-1/1a/1b/1c/2/2a/2b/2c, 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** * **Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP** |
| Qualcomm Incorporated [15] | This section provides our views on the remaining aspects of the agreed UE feature groups in supporting spatial and/or power domain adaptation. In particular, one of the open issues is the prerequisite for the feature groups. Since one of the components in feature groups for spatial or power domain adaptation is “Support of single-panel type 1 codebook”, it is our understandings that FG 2-36 should be prerequisite for FGs 42-1/1a/1b/1c and FGs 42-2/2a/2b/2c. In addition, for CSI reporting on PUCCH, we should also have FG 2-32a as prerequisite for FGs 42-1c/2c. Hence, we are making the following proposal:  **Proposal 1.1: FG 2-36 is prerequisite for FGs 42-1/1a/1b/1c and FG 42-2/2a/2b/2c. Additionally, FG 2-32a is prerequisite for FG 42-1c and FG 42-2c.**  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 should be used as an overall counting numbers.  **Proposal 1.2: Add the following notes to all spatial/power domain adaptation feature groups.**   * **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 1.3: 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.** |
| NTT DOCOMO, INC. [16] | 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.  **Proposal 13: FFSs on prerequisite FG column for FG42-1 family and FG42-2 family are updated as below.**   * **FG42-2c: One of {42-2, 42-2b}** |
| Ericsson [17] | Below aspect for NES UE features is discussed herein.   * Clarification of components 4,5,6,7   Some notes related to remaining issues for existing FGs (and applicable to new FGs also).   * The components 4,5,6,7 can be updated to reflect the NES condition for applying the per-CC and across-CCs limits. * Pre-requisites: For 42-1/1a/1b/2/2a/2b: adding 2-33 and 2-35 is sufficient. Since these two are mandatory with capability signaling, it is strictly not necessary to explicitly reflect them in the FG table.  1. For NES, FGs 42-1/42-1a/42-1b/42-1c/42-2/42-2a/42-2b/42-2c, update the components 4,5,6,7 as follows:    1. 4. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of simultaneous NZP-CSI-RS resources per CC    2. 5. In case a CSI report configuration(s) containing sub-configuration(s) is configured for a carrier, for that carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources per CC    3. 6. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of simultaneous NZP-CSI-RS resources in active BWPs across all CCs    4. 7. In case a CSI report configuration(s) containing sub-configuration(s) is configured for at least one carrier, Supported maximum number of total CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs |
| Apple [18] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 semi-persistent CSI report settings with sub-configurations per BWP, which is transmitted on PUCCH | FG 2-33, FG 2-35 | 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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH  Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH  Note: Components 5 and 6 are signaled per BC | Optional with capability signaling | |

**Other**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] | As for SD/PD adaptation, one CSI reporting can comprise one or more sub-reports. The UE implementation of a sub-report can reuse that of a CSI reporting such as CSI computation and memory. In order to commercialize NES features in the market as early as possible, there needs capability signaling to be able to implement the features with no or minimal implementation impact to UE. Towards this end, the components were introduced in RAN1 #115 of the supported total number of P/AP-CSI reporting settings without sub-configurations plus the total number of sub-configurations across P/AP-CSI report settings with sub-configurations per BWP. In RAN1 #116, the component was introduced in RAN1 #115 of the supported total number of SP-CSI reporting settings without sub-configurations plus the total number of sub-configurations across SP-CSI report settings with sub-configurations per BWP. On the other hand, two new parameters related to Ncpu (i.e. *simultaneousCSI-ReportsPerCC* and *simultaneousCSI-ReportsAllCC*) have been missed in UE feature list. If these new capabilities are not introduced, there could be ‘under-reporting’ issues (e.g. UE has no other choice than reporting smaller value of parameter) to support SD/PD adaptation considering implementation limitation as discussed in [4].  Figure 1 depicts the proposals with the following notes:   * Wording ‘aperiodic’ and ‘semi-persistent’ are added as shown in Figure 1. * New FGs of “simultaneousCSI-SubReportsPerCC-r18” and “simultaneousCSI-SubReportsAllCC-r18”   + Once introduced, CR for TS38.214 is needed to reflect it.  |  | | --- | | TS 38.214 v18.2.0  [...] 5.2.1.6 CSI processing criteria The UE indicates the number of supported simultaneous CSI calculations with parameter *simultaneousCSI-ReportsPerCC or simultaneousCSI-SubReportsPerCC-r18* in a component carrier, and *simultaneousCSI-ReportsAllCC* or *simultaneousCSI-SubReportsAllCC-r18* across all component carriers. If a UE supports simultaneous CSI calculations it is said to have CSI processing units for processing CSI reports. If *L* CPUs are occupied for calculation of CSI reports in a given OFDM symbol, the UE has unoccupied CPUs. If *N* CSI reports start occupying their respective CPUs on the same OFDM symbol on which CPUs are unoccupied, where each CSI report corresponds to , the UE is not required to update the requested CSI reports with lowest priority (according to Clause 5.2.5), where is the largest value such that holds.  [...] |       **Proposal 4-2: The following FGs are introduced.**   |  | | --- | | **simultaneousCSI-SubReportsPerCC-r18 (per band)**  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 | | **simultaneousCSI-SubReportsAllCC-r18 (per BC)**  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. |   In order for the new parameters (simultaneousCSI-SubReportsPerCC-r18 and simultaneousCSI-SubReportsAllCC-r18) not to be misused (e.g. the values of new parameters smaller than those of existing parameters simultaneousCSI-ReportsPerCC and simultaneousCSI-ReportsAllCC), the following is proposed.  **Proposal 4-4: UE shall report new parameters for CSI report setting being equal to or larger than the legacy parameters:**   * **simultaneousCSI-SubReportsPerCC-r18 >= simultaneousCSI-ReportsPerCC** * **simultaneousCSI-SubReportsAllCC-r18 >= simultaneousCSI-ReportsAllCC**   Since UE supporting SD/PD adaptation will report both legacy and new parameters, we propose the following clarification in the new FGs (to keep legacy behavior in case of no sub-report).  **Proposal 4-5: The following notes are added to the new FGs.**   * **For simultaneousCSI-SubReportsPerCC-r18: If UE is configured with CSI report setting without sub-configuration for the carrier, UE shall use simultaneousCSI-ReportsPerCC; otherwise, UE shall use simultaneousCSI-SubReportsPerCC-r18** * **For simultaneousCSI-SubReportsAllCC-r18: If UE is configured with CSI report setting without sub-configuration for any carrier, UE shall use simultaneousCSI-ReportsAllCC; otherwise, UE shall use simultaneousCSI-SubReportsAllCC-r18**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 42. Netw\_Energy\_NR | 42-8 | simultaneousCSI-SubReportsPerCC-r18 | 1. 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 | 2-35 | 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 1: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsPerCC*  Note 2: If UE is configured with CSI report setting without sub-configuration for the carrier, UE shall use *simultaneousCSI-ReportsPerCC*; otherwise, UE shall use *simultaneousCSI-SubReportsPerCC-r18* | Optional with capability signaling | | 42. Netw\_Energy\_NR | 42-9 | simultaneousCSI-SubReportsAllCC-r18 | 1. 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 | 2-35 | Yes |  | UE does not support spatial or power domain adaptation for aperiodic CSI reporting | Per BC | No | No | N/A | Component 1 candidate values: {5, 6, 7, ..., 32}  Note 1: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsAllCC*  Note 2: If UE is configured with CSI report setting without sub-configuration for any carrier, UE shall use *simultaneousCSI-ReportsAllCC*; otherwise, UE shall use *simultaneousCSI-SubReportsAllCC-r18* | Optional with capability signaling | |

## 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 |
| 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] | In RAN1#116, most open issues related to UE features for mobility enhancements were closed. Here we bring up a few remaining issues. The resulting updates are captured in Annex A.  FG 45-1 describes the intra-frequency reporting, where component 5 describes the maximum number of LTM CSI report configurations. Note that this is a single component, meaning that the UE can only report one value. However, the corresponding candidate values contain three lists for periodic, semi-persistent and aperiodic reporting, which indicates that the UE would report three values, but this is not possible since there is only one component. It is thus not possible for the UE to report, e.g., that it supports 2 LTM CSI report configurations for periodic and 1 LTM CSI report configuration for aperiodic reporting.  For intra-cell beam reporting, there are four separate features (2-21,2-22,2,23 and 2-23a), where the UE indicates which type of report it supports. In FG 2-35, the UE reports how many CSI report configurations it supports per BWP for periodic (component 2), semi-persistent (component 6) and aperiodic (component 4).  We note that there are two main differences between the solution for the legacy beam reporting configuration and the LTM CSI reporting:   * The legacy features are reported per BWP * The number of legacy CSI report settings can be added   We note that the RRC specification supports up to 48 LTM CSI report configurations. However, with the current formulation of FG 45-1, there is no possibility to go beyond 4 LTM CSI report configurations, and this is not future proof. For example, it is likely that the LTM CSI reporting will be extended in Rel-19, and then it is unfortunate to have a Rel-18 capability that also limits future extensions – a capability should only limit the functionality in the same release.  To resolve this issue, we propose to reuse the structure from the legacy beam reporting, where separate components are introduced for the different reporting types. Also, we propose that the capability is defined per BWP.   1. For FG 45-1, split component 5 into four components: periodic, semi-persistent on PUCCH, semi-persistent on PUSCH and aperiodic. 2. The capabilities indicate how many LTM CSI reporting configurations of the respective type are supported per BWP.   We note that a similar issue exists for component 4: the component talks about L and M, and their product, but there is still only one component. We propose to split this into three components:   1. Split component 4 into two components: L, M and M × L.   One final topic is the dependence on the Rel-17 TCI framework. In RAN1#111, RAN1 made the following agreement:  Agreement   * The beam indication of candidate cell(s) for Rel-18 LTM should be designed based on the following:   + Beam indication for Rel-18 LTM is designed based on Rel-17 unified TCI framework, if both serving cell and candidate cell support Rel-17 unified TCI framework   + FFS: whether/how to design mechanism for Beam indication for Rel-18 LTM when at least one from serving cell and candidate cell supports only Rel-15 TCI framework.   + Note: How and whether to indicate the new serving cell(s) and timing for beam indication are separately discussed   The alternative beam indication solution was to use a reference signal identity, such as an SSB index, as a beam indication.  RAN1 then decided to define a separate list of TCI states (*CandidateTCI-State-r18*) for LTM, and in RAN#115, RAN1 made the following agreement:  Agreement  The TCI state indicated in the cell switch command is associated with LTM TCI state pool of the target cell, i.e. configured under LTM-Candidate-r18.  With this agreement, there is no need to have a relation between the LTM TCI states, and the TCI states of the target cell: the UE receives the LTM cell switch command, which refers to a *CandidateTCI-State-r18,* and uses the information in the indicated LTM TCI state to perform the initial tracking. Once the UE has decoded the target configuration, it follows the configuration of the target, which of course, includes a set of TCI states. The procedures are not dependent on that the target (or source) is configured with Rel-17 TCI states: the procedures work equally well if the target (or source) is configured with Rel-15 TCI states. Currently, FG 45-3 and FG 45-4 have the Rel-17 TCI framework as pre-requisites (FG 23-1-1 and FG 23-10-1), and we propose to remove that pre-requisite:   1. Remove the pre-requisite FG 23-1-1 and 23-10-1 from FG 45-3 and FG 45-4 respectively.  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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  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 | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values:  {1, 2, 3, 4}  Component 4 candidate values:  {1, 2, 3, 4}  Component 5 candidate values:  {1,2,3,4, 6, 8, 9, 12, 16}  ~~L: {1, 2,3,4}~~  ~~M: {1, 2,3,4}~~  ~~M × L: {1,2,3,4, 6, 8, 9, 12, 16}~~  Component 6 candidate values:  ~~Aperiodic:~~ {~~0,~~1,2,3,4}  Component 7 candidate values:  ~~Periodic:~~ {0,1,2,3,4}  Component 8 candidate values:  ~~Semi-persistent:~~ {0,1,2,3,4} | Optional with capability signalling | | 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 | 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 | 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 | |
| Apple [18] |  |

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| 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | FFS | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Early PRACH transmission to a candidate cell is one of the options UE can choose to reduce interruption time in LTM procedure. Thus, the basic LTM feature group to be defined in RAN2 can be prerequisite of FG45-5, similar as the prerequisite of FG45-3. After a UE transmits a PRACH to a candidate cell, the UE expects to receive the TA of the target cell in the cell switch command. Thus, FG45-7 should also be prerequisite of FG45-5.  **Proposal Ltm-1: The prerequisite of FG45-5 are “RAN2 FG for LTM” and FG45-7.** |
| Intel Corporation [4] |  |
| Vivo [5] | According to the updated UE feature list, the prerequisite of FG 45-5 has not been determined. In our view, the LTM-related configuration, e.g., the PRACH configuration of candidate cell(s), is the prerequisite of early RACH for LTM. Besides, we think FG 45-7 is also the prerequisite of early RACH for LTM. If TA is not allowed to be included in the cell switch command, early RACH has no benefit. Therefore, we think RAN2 FG for LTM and FG 45-7 are the prerequisite for FG 45-5.   1. ***Support RAN2 FG for LTM and FG 45-7 as the prerequisite for FG 45-5 as follows:***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | ~~FFS~~  RAN2 FG for LTM, FG 45-7 | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-7, RAN2 FG for LTM | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | A list of UE features (45-5/5a) are developed in [2] for Rel-18 Timing advance management to reduce latency, and then we will share our views on remaining open issues for these two features, as follows.   * For FG 45-5, we think that TA acquisition should be performed on which candidate cell depends on L1 based measurement and reporting. Thus, we prefer to set FG 45-1 or FG 45-1a as prerequisite for 45-5. * For FG 45-5a, this UE capability signaling can be defined as per band pair per band combination since similar capability has been introduced in RAN4, as below:  |  | | --- | | **Issue 4-4-2: Granularity of Interruption due to RF retuning for PDCCH- ordered RACH**  **< Agreement>\_RAN4#110 meeting**   * + Regarding the capability for interruption on DL symbols due to PDCCH-ordered RACH, the reported granularity is Per band pair (between the target band for RACH transmission and band under UE’s current band combo) per band combination. Details of signalling design is up to RAN2. |   ***Proposal 4-1:*** *For FG 45-5/5a ‘TA acquisition related FGs’, the following modifications are proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | ~~FFS~~  45-1 or 45-1a | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| MediaTek [13] | In RAN1 #115 meeting, it has been agreed in CR R1-2308711 that the Cell indicator is newly introduced in the PDCCH order DCI 1\_0, indicating the cell for the corresponding PRACH transmission if the UE is configured with higher layer parameter *EarlyUlSyncConfig,* where C is the number of candidate cells configured with higher layer parameter *EarlyUlSyncConfig*; 0 bit otherwise. As we know, the Cell Indicator in DCI 1\_0 points to the cell index carried inside the *ltm-CandidateId*. Therefore, if the UE does not receive this RRC configuration, it cannot understand the content of PDCCH order DCI 1\_0. Therefore, we believe that 45-1 should be a prerequisite feature for 45-5.  In addition, RAN1 had already agreed that for PDCCH ordered RACH, RAR is not needed, the TA value of candidate cell is indicated in cell switch command. Therefore, if the UE does not support 45-7, it cannot support PDCCH ordered RACH as well. We believe that 45-7 should also be a prerequisite feature for 45-5.  Proposal 1: Update FG 45-5, as shown in Table 1 below.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-1 and 45-7 | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | For 45-5, there is one FFS point about perquisite FG. This feature should be supported regardless of whether L1 beam measurement reporting and/or TCI state activation/indication is supported or not. On the other hand, this feature does not work unless a TA can be indicated in cell switch command. Thus, prerequisite FG should be FG 45-7.  **Proposal 14: prerequisite FG for FG 45-5 is FG 45-7.** |
| Ericsson [17] | Another open issue is the prerequisite FG for 45-5. This FG does not really rely on any of the 45-x features: the UE can implement 45-5 independently of other features. The only pre-requisite is the RAN2 pre-requisite:   1. The only pre-requisite FG for 45-5 is the RAN2 FG for LTM.  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | ~~FFS~~  RAN2 FG for LTM | Yes | No | RACH-based early TA acquisition is not supported | Per band | Component 1 candidate values {1,2,3,4,5,6,7,8} | Optional with capability signalling | |
| Apple [18] |  |

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| 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | [Per band] | No | No | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | The report granularity for FG 45-5a is still FFS. Similar as the FG45-1/45-1a/45-2 which were agreed to be reported as “per BC”, FG45-5a requires UE to simultaneously transmit on serving cell and candidate cell(s) which may be on different bands. If FG45-5a is reported ‘per band’, it means a UE would always support this feature on this band irrespective which band combination this band belongs to. It limits the implementation of such feature and reduces the probability to commercialize the feature. Considering the implementation might be different per BC, the report granularity of ‘per BC’ provides sufficient flexibility and allow UE to share the processing capability among bands within a BC. Therefore, we support ‘per BC’ for the FG 45-5a.  **Proposal Ltm-2: Support ‘per BC’ for FG 45-5a.** |
| Intel Corporation [4] |  |
| Vivo [5] | In addition, the granularity of FG 45-5a is not stable and is still in the square bracket. According to RAN4’s UE feature list [3], corresponding feature groups related to PDCCH-order RACH, e.g., FG39-4 and FG 39-5 are defined by per band pair (between the target band for RACH transmission and band under UE’s current band combo) per BC. To align with RAN4 and to make the UE feature clearer, it would be better to define the FG 45-5a with the granularity of per band pair per BC.   1. ***Support the granularity of FG 45-5a as per band pair per band combination as follows:***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | ~~[Per band]~~  Per band pair (between the target band for RACH transmission and band under UE’s current band combo) per band combination | No | No | n/a |  | Optional with capability signalling | |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | Per band pair (between the target band for RACH transmission and band under UE’s current band combo) | No | No | n/a |  | Optional with capability signalling | |
| Xiaomi [11] |  |
| ZTE Corporation [12] | A list of UE features (45-5/5a) are developed in [2] for Rel-18 Timing advance management to reduce latency, and then we will share our views on remaining open issues for these two features, as follows.   * For FG 45-5, we think that TA acquisition should be performed on which candidate cell depends on L1 based measurement and reporting. Thus, we prefer to set FG 45-1 or FG 45-1a as prerequisite for 45-5. * For FG 45-5a, this UE capability signaling can be defined as per band pair per band combination since similar capability has been introduced in RAN4, as below:  |  | | --- | | **Issue 4-4-2: Granularity of Interruption due to RF retuning for PDCCH- ordered RACH**  **< Agreement>\_RAN4#110 meeting**   * + Regarding the capability for interruption on DL symbols due to PDCCH-ordered RACH, the reported granularity is Per band pair (between the target band for RACH transmission and band under UE’s current band combo) per band combination. Details of signalling design is up to RAN2. |   ***Proposal 4-1:*** *For FG 45-5/5a ‘TA acquisition related FGs’, the following modifications are proposed in red.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | ~~[Per band]~~  Per band pair Per BC | No | No | n/a |  | Optional with capability signalling | |
| MediaTek [13] | In RAN1 #114 meeting, it has been agreed on the way of UL power allocation when the UE is capable to simultaneous/parallel transmissions.   |  | | --- | | **Agreement**   * If the UE supports simultaneous/parallel transmissions of PRACH in candidate cell and UL channels and signals in serving cell in the same frequency range, support:   + A PRACH transmission to a LTM candidate cell has the highest priority for power allocation.   Note: up to UE whether performs power scale-down or drop of UL transmission with lower priority when UL transmission power is insufficient. |   Whether UE can support simultaneous/parallel transmissions of PRACH in candidate cell and UL channels and signals in serving cell in the same frequency range depends on whether the candidate cell, relative to the serving cell, is in intra-band or inter-band. Therefore, per band reporting is not applicable for UE to report the UE capability of simultaneous/parallel transmissions of PRACH, it can only be used to refer to the target band where the candidate cell is located or refer to the source band where the serving cell is located. We prefer to use the “Per band pair” reporting method, allowing the UE to report capability for each combination of “target band for RACH transmission + band under UE’s current band” separately.  Proposal 2: Update FG 45-5a, as shown in Table 2 below.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 45. NR\_Mob\_enh2 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | [Per band pair] (between the target band for RACH transmission and band under UE’s current band combo) per band combination | No | No | n/a |  | Optional with capability signalling | |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | UE-features per band combination leads to exponentially increase complexity. Thus, the FG is specified per band.  **Proposal 15: FG45-5a is specified per band.** |
| Ericsson [17] | One issue that is also open is the type for 45-5a. Here we do not see that the NW would adapt its behavior based on this FG: it does not really matter if the UE is capable of simultaneous transmission or not.   1. The type for 45-5 is unimportant.   Of course, it should still be possible to signal the capability. |
| Apple [18] |  |

## 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 | 44-2 | NTN DMRS bundling enhancement for PUSCH in NGSO scenarios | 1. Support of DM-RS bundling for PUSCH over consecutive slots in NGSO scenarios  2. Support of pre-compensation to keep phase rotation due to timing drift within the phase difference limit  3. Maximum duration during which UE is able to maintain power consistency and phase continuity to support NTN DM-RS bundling for PUSCH over consecutive slots | At least one of {30-4a/b/c}, 26-1 | Yes | No | UE does not support DM-RS bundling enhancement for PUSCH in NGSO scenarios | Per Band | N/A | N/A | N/A | Component 3 candidate values: {4, 8, 16, 32}  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  Note: a UE that does not report support of this FG and reports support of FG 30-4 for an NTN band can perform DMRS bundling only in GSO scenario in the NTN band  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders  Note: for bands in Table 5.2.2-1 and [TBD for FR2-NTN bands] in TS 38.101-5, reported value in FG 30-4 is applied only for GSO scenario | Optional with 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 of NR NTN WID. 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, except the one for FR2-NTN operating band table, should be removed.  **Proposal NR Ntn-1: The UE feature group of FG 44-1 is updated with purple 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 |   For the note of applicable band, it is applicable for FR2-NTN, thus only the square brackets for FR2-NTN operating band table in RAN4 specification can be kept. Other square brackets in the note should be removed.  **Proposal NR Ntn-2: The UE feature group of FG 44-2 is updated in purple as following considering the above aspects:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-2 | NTN DMRS bundling enhancement for PUSCH in NGSO scenarios | 1. Support of DM-RS bundling for PUSCH over consecutive slots in NGSO scenarios  2. Support of pre-compensation to keep phase rotation due to timing drift within the phase difference limit  3. Maximum duration during which UE is able to maintain power consistency and phase continuity to support NTN DM-RS bundling for PUSCH over consecutive slots | At least one of {30-4a/b/c}, 26-1 | Yes | No | UE does not support DM-RS bundling enhancement for PUSCH in NGSO scenarios | Per Band | N/A | N/A | N/A | Component 3 candidate values: {4, 8, 16, 32}  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  Note: a UE that does not report support of this FG and reports support of FG 30-4 for an NTN band can perform DMRS bundling only in GSO scenario in the NTN band  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders  Note: for bands in Table 5.2.2-1 and [TBD] for FR2-NTN bands~~]~~ in TS 38.101-5, reported value in FG 30-4 is applied only for GSO scenario | Optional with capability signaling |   In RAN#4 110 [8], RAN4 confirmed the working assumption to use Nsample = 1 for UE Rx-Tx measurement period requirements in network verified UE location as the following:   |  | | --- | | **Issue 3-2:** **Measurement period and accuracy requirements on RTD**  **Agreement: (online agreement)**   * Nsample = 1 for UE Rx-Tx measurement period requirements * Define additionally the single satellite based RTT requirement without MG based on the existing RTT requirements, given that the RTT requirement with MG was already agreed as baseline. |   It has been a UE capability, *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED*, in Rel-17 to use only one PRS measurement sample to obtain the UE Rx-Tx time difference measurement in TN. Therefore, similarly the single sample measurement to determine the UE Rx-Tx time difference in NTN for network location verification should be also captured in the NTN UE location verification feature group, i.e. FG 44-3.  Similarly as the comment for FG 44-1/2, the square brackets should be added for the TBD table for FR2-NTN operating bands in RAN4 specification. The square brackets with respect to whether FR2-NTN is supported should be removed.  **Proposal NR Ntn-3: The UE feature group of FG 44-3 is updated in purple as following considering the above 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] | 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 18: 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** |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | FG 44-1, it’s preferred to remove the bracket of the note. 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.  ***Proposal 6-1:*** *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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | 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. Meanwhile, only if the support in TN may lead to additional issue, in such a case, the note should be back here.  **Proposal 16: 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 |   For 44-2, although there will be no definition on DMRS bundling requirement for FR2-NTN in RAN4 spec, RAN1/2 spec can support FG for the band. Then when RAN4 defines requirement for FR2-NTN, the signaling can be used without any additional RAN1/2 discussion.  **Proposal 17: Update FG 44-2 as follows.**   |  |  |  |  | | --- | --- | --- | --- | | 44-2 | NTN DMRS bundling enhancement for PUSCH in NGSO scenarios | 1. Support of DM-RS bundling for PUSCH over consecutive slots in NGSO scenarios  2. Support of pre-compensation to keep phase rotation due to timing drift within the phase difference limit  3. Maximum duration during which UE is able to maintain power consistency and phase continuity to support NTN DM-RS bundling for PUSCH over consecutive slots | Component 3 candidate values: {4, 8, 16, 32}  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 and HAPS operation bands in Clause 5.2 of TS 38.104  Note: a UE that does not report support of this FG and reports support of FG 30-4 for an NTN band can perform DMRS bundling only in GSO scenario in the NTN band  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders  Note: for bands in Table 5.2.2-1 and 5.2.3-1 in TS 38.101-5, reported value in FG 30-4 is applied only for GSO scenario |   For 44-3, similarly, capability signaling should be available for FR2-NTN bands.  **Proposal 18: 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 [17] | Even though repetition for common PUCCH is specified within the NR NTN enhancements work item, the feature as such should not be limited to non-terrestrial networks. Indeed, coverage on common PUCCH can potentially be a problem also in terrestrial networks. The need for Msg4 HARQ-ACK PUCCH repetitions in terrestrial networks was evaluated during the Rel-17 coverage enhancement study. The results in TR 38.830 were inconclusive since only a few companies evaluated this channel, but the results indicate that the Msg4 HARQ-ACK PUCCH might be the bottleneck in some FDD scenarios (see e.g. Table 5.1.1.5-2 in TR 38.830).   1. For the feature “PUCCH repetition on common PUCCH resource”, UE should be allowed to indicate support for FG 44-1 for both NTN and TN bands. Therefore, the note within brackets limiting FG 44-1 to satellite and HAPS bands should be removed (see table 1).  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 |   RAN4 sent an LS to RAN1 and RAN2 with the title “LS on UE capability to support DMRS bundling for GSO and NGSO” [3]. This was received at RAN1#116. The content of the LS is as follows:   |  | | --- | | **1. Overall Description:**  RAN4 agrees to differentiate the capability of maxDurationDMRS-Bundling-r17 for GSO and NGSO scenarios. RAN4 agrees that UE may report different max Duration capability for DMRS bundling for NGSO (e.g. [*maxDurationDMRS-Bundling-NTN-NGSO-r18*]) and max Duration for DMRS bundling for GSO in the same NTN band :   * The capabilities are applicable to NTN FR1 bands * The range of [*maxDurationDMRS-Bundling-NTN-NGSO-r18*] is same as the capability maxDurationDMRS-Bundling-r17   **2. Actions:**  **To RAN WG1/WG2 group.**  **ACTION: no action needed.** |   The differentiation between GSO and NGSO was handled at RAN1#116. But the RAN4 agreement that “the capabilities are applicable to NTN FR1 bands” is not reflected in the description of FG 44-2 that still has placeholders for the FR2-NTN bands. It is proposed to remove the references to FR2-NTN.   1. For the feature “NTN DMRS bundling enhancement for PUSCH in NGSO scenarios”, remove the references to FR2-NTN bands (see Table 2).  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 44. NR\_NTN\_enh | 44-2 | NTN DMRS bundling enhancement for PUSCH in NGSO scenarios | 1. Support of DM-RS bundling for PUSCH over consecutive slots in NGSO scenarios  2. Support of pre-compensation to keep phase rotation due to timing drift within the phase difference limit  3. Maximum duration during which UE is able to maintain power consistency and phase continuity to support NTN DM-RS bundling for PUSCH over consecutive slots | At least one of {30-4a/b/c}, 26-1 | Yes | No | UE does not support DM-RS bundling enhancement for PUSCH in NGSO scenarios NTN | Per Band | N/A | N/A | N/A | Component 3 candidate values: {4, 8, 16, 32}  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  Note: a UE that does not report support of this FG and reports support of FG 30-4 for an NTN band can perform DMRS bundling only in GSO scenario in the NTN band  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders  Note: for bands in Table 5.2.2-1 ~~and [TBD for FR2-NTN bands]~~ in TS 38.101-5, reported value in FG 30-4 is applied only for GSO scenario | Optional with capability signaling | |
| Apple [18] |  |

**Other**

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] | RAN1 agreed specifications for RACH-less HO and FR2-NTN bands. Discussion on corresponding UE capabilities is necessary.  For RACH-less HO, 38.306 already includes rachLessHandoverNTN-r18 to report capability of RACH-less HO in NTN. Meanwhile, for LTM in TN, there are two separate signaling for CG (ltm-RACH-LessCG-r18) and DG (ltm-RACH-LessDG-r18). Whether to support two separate signaling for NTN or not would be a discussion point, and our feeling is that two separate signaling can be supported in terms of common design.  For FR2-NTN bands, it seems that R17 FGs for FR2-NTN bands and thus no additional FG is necessary.  **Proposal 19: Send an LS to ask RAN2 to support two separate FGs for RACH-less HO with CG PUSCH and RACH-less HO with DG PUSCH.**  **Proposal 20: Not introduce new FGs for FR2-2.** |
| Ericsson [17] |  |
| Apple [18] |  |

## IoT\_NTN\_enh

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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 TB scheduled 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 | Summary |
| Huawei/HiSilicon [3] |  |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] | 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 | |
| Apple [18] |  |

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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] | In RAN#116, the definition of FG2-2a/2-2b/2-6a/2-6b were discussed. Two companies raised concern that current definition force UE operating in LEO only must support HARQ enhancement and GNSS for GEO. Although the working assumption in RAN1#115 was confirmed without anychange on definition of the FGs, the Chair also mentioned that RAN2 can still update the corresponding FGs and override the RAN1 agreement. According RAN2 discussion and captured in latest TS36.331 v18.1.0, the FGs2-2a/2-2b/2-6a/2-6b are reflected as follows.   |  |  | | --- | --- | | ***UE-EUTRA-Capability* field descriptions** |  | | ***ntn-GNSS-EnhScenarioSupport***  This field indicates whether the UE supports GNSS measurement enhancements in RRC\_CONNECTED for only GSO or NGSO scenario. If this field is not included, the GNSS measurement enhancements in RRC\_CONNECTED that are indicated as supported are applicable for both GSO and NGSO scenario. | 2-2a | | ***ntn-HarqEnhScenarioSupport***  This field indicates whether the UE supports UL and DL HARQ process enhancements for only GSO or NGSO scenario. If this field is not included, the UL and DL HARQ process enhancements that are indicated as supported are applicable for both GSO and NGSO scenario. | 2-6a- |  |  |  | | --- | --- | | ***UE-Capability-NB field descriptions*** |  | | ***ntn-GNSS-EnhScenarioSupport***  This field indicates whether the UE supports GNSS measurement enhancements in RRC\_CONNECTED for only GSO or NGSO scenario. If this field is not included, the GNSS measurement enhancements in RRC\_CONNECTED that are indicated as supported are applicable for both GSO and NGSO scenario. | 2-2b | | ***ntn-HarqEnhScenarioSupport***  This field indicates whether the UE supports UL and DL HARQ process enhancements for only GSO or NGSO scenario. If this field is not included, the UL and DL HARQ process enhancements that are indicated as supported are applicable for both GSO and NGSO scenario. | 2-6b- |   Thus, we propose to update the definition of FG2-2a/2-2b/2-6a/2-6b according to RAN2 specification in order to keep consistent when they are captured in TR38.822.  **Proposal IoT Ntn-2: Update the FG2-2a/2-2b/2-6a/2-6b according to RAN2 agreement.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

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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] | The prerequisite for FG2-4a and FG2-4b are not decided yet, as highlighted.  According to the following 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] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] |  |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] | 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 5-1:*** *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 | |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] | 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.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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. [16] |  |
| Ericsson [17] | For FG 2-4a and FG 2-4b, there is one remaining issue:   * Is Rel.18 2-3a a pre-requisite for 2-4a? * Is Rel.18 2-3b a pre-requisite for 2-4b?  1. Rel.18 2-3a and Rel.18 2-4a are complementary mechanisms: 2-3a allows the network to trigger a UE to perform a GNSS reacquisition when needed regardless of the UE’s remaining GNSS validity duration. 2-4a allows a UE to perform GNSS reacquisition when the network has not triggered it using 2-3a and its GNSS validity duration has ended. Therefore, 2-3a is a pre-requisite of 2-4a. 2. It was discussed in RAN1 whether a UE can ignore the GNSS reacquisition trigger command sent by the network but it was not agreed. If 2-3a is not adopted as a pre-requisite for 2-4a, a UE will be able to ignore the GNSS trigger sent by the network which was never agreed in RAN1. 3. The UE feature description for FG 2-4a also captures its dependence on FG 2-3a: “1. UE re-acquires GNSS autonomously (when configured by the network) if it does not receive eNB GNSS measurement trigger”.   Similarly, RAN1 made the following conclusion in RAN1#116 (captured in feature lead summary R1-2401790) which clearly states that the UE may re-acquire GNSS autonomously if the eNB does not trigger the UE to make a GNSS measurement. That is, the autonomous GNSS timer-based mechanism is coupled with the GNSS trigger gap.  **Conclusion**  *UE may re-acquire GNSS (when configured by the network) in the GNSS measurement timer, if eNB does not trigger UE to make GNSS measurement within duration T, where T is latest reported remaining GNSS validity duration plus UL transmission extension duration X (if any).*  The same argument (used for FG 2-4a) applies to FG 2-4b. In short, autonomous GNSS acquisition is coupled with GNSS acquisition based on the trigger command sent by the network. Therefore, we put forth the following proposals.   1. For the comeback on FG 2-4a, Rel.18 2-3a shall be a pre-requisite for 2-4a. 2. For the comeback on FG 2-4b, Rel.18 2-3b shall be a pre-requisite for 2-4b. |
| Apple [18] |  |

## NR\_netcon\_repeater

Void

## NR\_BWP\_wor

Void

## NR\_ATG

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| 56. NR\_ATG | 56-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | Support of UE specific TA calculation based on its GNSS-acquired position and the indicated BS location.  Support of open (i.e. UE autonomous TA estimation) and closed (i.e., received TA commands) loop control for TA update in RRC\_CONNECTED state.  Support of pre-compensation of the calculated TA in the uplink transmissions.  Support of frequency pre-compensation to account for the Doppler experienced on the service link.  Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated.  Support of UE receiving cell-specific K\_offset in system information. |  | Yes | N/A | If UE does not support this feature, the performance of ATG UE cannot be guaranteed due to the large propagation delay. | FFS | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Mandatory with capability signaling for UE supports NR communication via ATG |
| 56. NR\_ATG | 56-2 | UE reporting of TA information | Support UE reporting of TA information | 56-1 | Yes | N/A | If UE does not support this feature, UE cannot report the TA information to network. | FFS | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability siganling |
| 56. NR\_ATG | 56-3 | Increasing the number of HARQ processes | The maximal supported HARQ process number is X for UL and Y for DL |  | Yes | N/A | If UE does not support this feature, the HARQ process is number is limited. | FFS | No | FR1 only | N/A | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}  Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling |
| 56. NR\_ATG | 56-4 | K1 range extension | Support of extended K1 value range of (0..31) for unpaired spectrum |  | Yes | N/A | If UE does not support this feature, K1 value is limited. | FFS | TDD only | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For the granularity of per UE feature, it should be supported as a per UE feature group.  **Proposal Atg-1: The UE feature group of FG 56 is updated in purple as following considering the above aspects:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 56. NR\_ATG | 56-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | Support of UE specific TA calculation based on its GNSS-acquired position and the indicated BS location.  Support of open (i.e. UE autonomous TA estimation) and closed (i.e., received TA commands) loop control for TA update in RRC\_CONNECTED state.  Support of pre-compensation of the calculated TA in the uplink transmissions.  Support of frequency pre-compensation to account for the Doppler experienced on the service link.  Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated.  Support of UE receiving cell-specific K\_offset in system information. |  | Yes | N/A | If UE does not support this feature, the performance of ATG UE cannot be guaranteed due to the large propagation delay. | Per UE | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Mandatory with capability signaling for UE supports NR communication via ATG | | 56. NR\_ATG | 56-2 | UE reporting of TA information | Support UE reporting of TA information | 56-1 | Yes | N/A | If UE does not support this feature, UE cannot report the TA information to network. | Per UE | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability siganling | | 56. NR\_ATG | 56-3 | Increasing the number of HARQ processes | The maximal supported HARQ process number is X for UL and Y for DL |  | Yes | N/A | If UE does not support this feature, the HARQ process is number is limited. | Per UE | No | FR1 only | N/A | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}    Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling | | 56. NR\_ATG | 56-4 | K1 range extension | Support of extended K1 value range of (0..31) for unpaired spectrum |  | Yes | N/A | If UE does not support this feature, K1 value is limited. | Per UE | TDD only | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling | |
| Intel Corporation [4] |  |
| Vivo [5] |  |
| OPPO [6] |  |
| CATT [7] |  |
| Samsung [8] |  |
| CMCC [9] | Considering the new FGs introduced for NR ATG, i.e., FG 56-1, FG 56-2, FG 56-3 and FG 56-4, most of the components have been achieved based on RAN4 agreements in the last RAN1 meeting. One remaining issue is to discuss the granularity of each FG.  According to the ATG specific capability provided by RAN4 and defined in the current TS 38.331, the ATG-UE is a highly customized user equipment with a dedicated usage, which will only access to the cells configured with ATG bands. As specified in TS 38.331, the higher layer parameter, *cellBarredATG*, is configured to prevent the ATG-UE to connect to non-ATG network, corresponding description is shown below.   |  | | --- | | 1> if the access is for ATG:  2> if the UE is in RRC\_IDLE or in RRC\_INACTIVE, or if the UE is in RRC\_CONNECTED while *T311* is running; and  2> if the *cellBarredATG* in the acquired *SIB1* is set to *barred* or the *cellBarredATG* is not included in the acquired *SIB1*:  3> consider the cell as barred in accordance with TS 38.304 [20];  3> perform cell re-selection to other cells on the same frequency as the barred cell as specified in TS 38.304 [20];  ***cellBarredATG***  Value *barred* means that the cell is barred for connectivity to ATG, as defined in TS 38.304 [20]. Value *notBarred* means that the cell is allowed for connectivity to ATG. If not present, the UE considers the cell is not allowed for connectivity to ATG, as defined in TS 38.304 [20]. This field is only applicable to ATG-capable UEs. |   Regarding the granularity of each feature group, we think “per UE” type should be supported. Per our understanding, ATG-UE will be equipped under the airplane, when ATG UE is up in the air, for FG 56-1, uplink time and frequency pre-compensation, timing relationship enhancements need to be supported by ATG-UE no matter which band is configured for the cell connected to ATG. Therefore, the ATG-UE needs to support the capability of timing and frequency pre-compensation on all ATG operating bands. The working scenarios is exactly the same for the ATG UE and irrelevant to the frequency bands. Even the ATG UE works in different countries and the different bands are allocated for the ATG traffic. Once the ATG UE works in the air, the situation is the same for all the bands. Then there is no need to differentiate different operating band for the ATG UE feature.  For FG 56-2, FG 56-3 and FG 56-4, as discussed in RAN4, large guard period is required to prevent interference for new TDD pattern (30D4S6U) in ATG scenarios, and to mitigate the impact of long guard period, UE needs to report TA information. Besides, the features ‘Increasing the number of HARQ processes’ and ‘K1 range extension’ are also considered as possible solutions to mitigate the guard period impact for Rel-18 ATG. The support of all these features is not relevant to the frequency band, and there is no difference for ATG-UE to support the features between different bands. All the features are realized in the base band, once the features are supported by an ATG-UE, it can be applied to all the frequency bands. So there is no need to differentiate the bands, the FG 56-2, FG 56-3 and FG 56-4 can be supported as a per UE feature group.  **Proposal 1: For FG 56-1, FG56-2, FG56-3 and FG56-4, the granularity of each FG should be “per UE”** |
| Nokia/Nokia Shanghai Bell [10] |  |
| Xiaomi [11] |  |
| ZTE Corporation [12] |  |
| MediaTek [13] |  |
| LG Electronics [14] |  |
| Qualcomm Incorporated [15] |  |
| NTT DOCOMO, INC. [16] |  |
| Ericsson [17] |  |
| Apple [18] |  |

# Discussion Items during RAN1 #116bis

After review of contributions submitted to RAN1 #116bis in this agenda item, the following topics were identified by the moderator for discussion during RAN1 #116bis.

**General comments**

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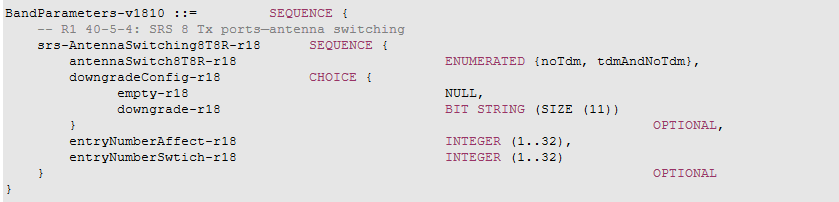
## NR\_MIMO\_evo\_DL\_UL

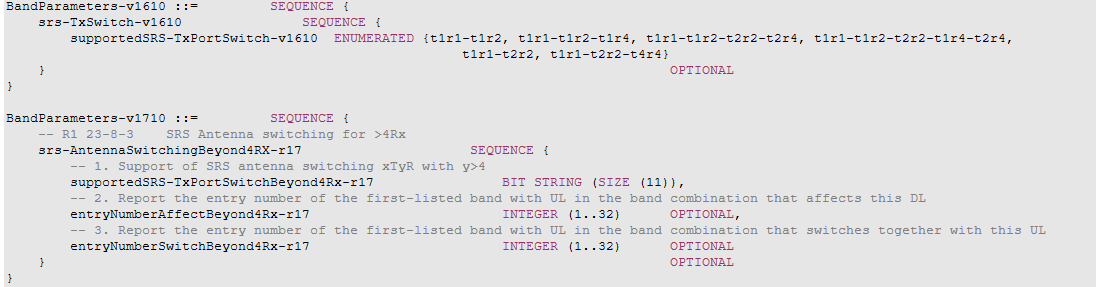
After review of contributions submitted to RAN1 #116bis in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 1-1: Question from RAN2

**“For FG 40-5-4, just checking wether we share the same understanding or not. This feature is in fact per band per band combination.  Per FS is for reusing purpose, but in this case, entry number of the band in the band combination is needed to be indicated for the band that is affected or to be switched to. This has been done for srs-TxSwitch in Rel-15/16 and also in Rel-17 for srs-AntennaSwitchingBeyond4Rx. Hence, we implemented it as Per BC. Let me know if RAN1 has different understanding and if further update is needed from RAN2 point of view.”**

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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 | Optional with capability signaling |





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| Company | Comments/Questions/Suggestions |
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### Issue 1-2: Editorial

**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 | 40-1-2a | 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. ~~M aximum~~ 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 | 40-4-1 | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-5 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type A is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1a | Basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol | 2-6 | Yes | n/a | UE does not support basic feature of Rel.18 enhanced DMRS ports for PDSCH for ~~mapping~~ scheduling of type B | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for ~~mapping~~ scheduling of type A | Support of Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port for ~~mapping~~ scheduling of type A | 40-4-1 | Yes | n/a | Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port is not supported for ~~mapping~~ scheduling of type A | Per FS | No | No | n/a |  | Optional with capability signaling |
| 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 |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-6-3g | Codebook multi-DCI based STx2P PUSCH+PUSCH – Partially ~~=~~overlapping PUSCHs in time, non- overlapping in frequency | Support of partially overlapping PUSCHs in time, non-overlapping in frequency | 40-6-3a | Yes | N/A | Partially overlapping PUSCHs in time, non-overlapping in frequencyfor codebook multi-DCI based STx2P PUSCH+PUSCH is not supported | Per Band | n/a | FR2 only | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-3: FG 40-1-3

**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 | 40-1-3 | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP | Support of per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP | 40-1-1 | yes | n/a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in S-DCI based MTRP is not supported | Per band | n/a | n/a | n/a | Component candidate values: {per resource, per resource set, both}  Note: when the UE supports NCJT CSI under 23-7-1 or CJT under 40-1-4, component value {per resource} is declared | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-4: FG 40-1-12

**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 | 40-1-12 | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP | 1. Support of common multi-CC TCI state ID update and activation for single-DCI based multi-TRP  2. Maximum number of CC list(s) | 40-1-1 ~~or 40-1-2~~ | yes | n/a | Common multi-CC TCI state ID update and activation for single-DCI based multi-TRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-5: FG 40-2-2

**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 | 40-2-2 | Basic feature for multi-DCI based inter-cell Multi-TRP operation with two TA enhancement | 1. Support of two TA enhancement for multi-DCI based inter-cell Multi-TRP operation  2. Maximum number of n-TimingAdvanceOffset value per serving cell | 23-4 | yes | n/a | Two TA enhancement for multi-DCI based inter-cell Multi-TRP operation is not supported | Per FSPC | n/a | n/a | n/a | Component 2 candidate values: {1,2} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-6: FG 40-2-7

**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 | 40-2-7 | Two TAs for multi-DCI STxMP PUSCH+PUSCH | Support of two TAs for multi-DCI STxMP PUSCH+PUSCH | 40-2-1 or 40-2-2, 40-6-3a or 40-6-3b | yes | n/a | Two TAs for multi-DCI STxMP PUSCH+PUSCH is not supported | Per FSPC | n/a | n/a | n/a | Note: support of any overlap duration with no reduction of any of UL transmissions for two UL transmissions in multi-DCI based Multi-TRP with 2 TA | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-7: FG 40-3-1-24

**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 | 40-3-1-24 | Timeline for regular eType-II-CJT CSI, or for port selection FeType-II-CJT CSI | Timeline relaxation parameter | 40-3-1-1, or 40-3-1-5 | Yes | N/A | Relaxed timeline is not supported | Per band and Per-BC | No | N/A | N/A | Component candidate value: {0, Z2’}  Note: A UE that supports FG 40-3-1-1 or FG 40-3-1-5 must signal this FG | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-8: FG 40-3-2-11

**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 | 40-3-2-11 | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | 1. Aperiodic CSI report timing relaxation, w, for doppler codebook based on Type-II codebook.  2. Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook | At least one of {40-3-2-1, 40-3-2-4} | Yes | N/A | Aperiodic CSI report timing relaxation for doppler codebook based on Type-II codebook is unknown | Per FS | N/A | N/A | N/A | Component 1 candidate values:  UE reports candidate value, w, independently for each SCS in unit of symbols: {14\*(KP–1)\*d, 14\*KP\*d, 14, 28}  Note: Kp is according to Component 10 of FG 40-3-2-1, or according to Component 9 of FG 40-3-2-4  Note: d=4 (minimum periodicity of periodic CSI-RS)  ~~For 15kHz SCS: {0, 4, 8, 16, 32}~~  ~~For 30kHz SCS: {0, 8, 16, 32, 64}~~  ~~For 60kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 120kHz SCS: {0, 16, 32, 64, 128}~~  ~~For 480kHz SCS: {0, 64, 128, 256, 512}~~  ~~For 960kHz SCS: {0, 128, 256, 512, 1024}~~  Component 2 candidate values: ~~[~~{CAP1, CAP2}~~]~~  For N4 = 1  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP1 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m, Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w, Z'2)  For N4 > 1 and CAP2 in component 2  1) For AP CSI-RS: (Z,Z’) = (Z2 + 14\*(K–1)\*m + Z'2, 2Z'2)  2) For P/SP CSI-RS: (Z,Z’) = (Z2 + w + Z'2, 2Z'2)  Z2/Z'2 are defined in Table 5.4-2 in TS38.214  K = {4,8,12}, is the number of AP CSI-RS resources for the CMR in a CSI report setting  M = {1,2}, is the offset between two adjacent AP CSI-RS resources for the CMR in slots  Note: A UE that supports FG 40-3-2-1 or FG 40-3-2-4 must signal this FG | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-9: FG 40-4-1 family

**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 | 40-4-1b | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1, 40-4-1j | Yes | n/a | UE does not support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1g | DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Support of DMRS type for Rel.18 enhanced DMRS ports for PDSCH | 40-4-1 | Yes | n/a | UE does not support DMRS type for Rel.18 enhanced DMRS ports for PDSCH | Per FS | No | No | n/a | Component 1 candidate values: {etype 1, both etype 1 and etype 2}  Note: A UE supporting one of FG 40-4-1 or FG 40-4-1a must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-1j | Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port for mapping type A | Support of Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port for mapping type A | 40-4-1 | Yes | n/a | Support 1 symbol FL DMRS and 2 additional DMRS symbols for ~~at least~~ one port is not supported for mapping type A | Per FS | No | No | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-10: FG 40-4-5a

**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 | 40-4-5a-1 | 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 |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-5a-2 | 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 1-11: FG 40-4-6/10 families

**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 | 40-4-6 | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port | 2-16 | Yes | n/a | Basic feature of Rel.18 enhanced DMRS ports for PUSCH for scheduling type A for Rel.18 enhanced DMRS ports is not supported | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-6k | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | 40-4-1 | Yes | n/a | UE does not support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Per FS | No | No | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-10-1 | DMRS port configuration for PUSCH with rank 5-8 and Rel-15 DMRS for 8Tx | DMRS port configuration for PUSCH with rank 5-8 and 8Tx for Rel 15 dMRS ~~and Rel. 18~~ | ~~40-4-6~~ 2-16 | Yes | n/a | DMRS port configuration for PUSCH with ~~8Tx~~ rank 5-8 and Rel-15 DMRS is not supported for 8Tx | Per FS | No | No | n/a | ~~Candidate values: {Rel. 15 DMRS, Rel. 15 DMRS and Rel. 18 DMRS}~~  Note: A UE supporting 8 Tx must support this FG | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-4-10-2 | DMRS port configuration for PUSCH with 8Tx for Rel-18 DMRS | DMRS port configuration for PUSCH with 8Tx for Rel-18 DMRS | 40-4-6, 40-4-10 | Yes | n/a | DMRS port configuration for PUSCH with Rel-18 DMRS is not supported for 8Tx | Per FS | No | No | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-12: FG 40-5 family

**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 | 40-5-1a | Comb offset hopping time-domain behavior when repetition factor R>1 | Supported comb offset hopping granularity in time when repetition factor R>1 is configured | 40-5-1 | Yes | n/a | Comb offset hopping ~~time-domain behavior when repetition factor R>1~~ is not supported when repetition factor R>1 | Per band | n/a | n/a | n/a | Component candidate values: {‘per SRS symbol’,’per R SRS symbols’, ‘both’} | Optional with capability signaling |
| 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-13: FG 40-5 family (RAN2 LS)

**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 | 40-5-1b | SRS comb offset hopping combined with ~~legacy~~ group/sequence hopping | Support of SRS comb offset hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) | 40-5-1 | Yes | n/a | SRS comb offset hopping combined with legacy group/sequence hopping supported in NR SRS basic feature (FG 2-52) is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-5-2b | SRS cyclic shift hopping combined with ~~legacy~~ group/sequence hopping | Support of SRS cyclic shift hopping combined with ~~legacy~~ group/sequence hopping supported in NR SRS basic feature (FG 2-52) | 40-5-2 | Yes | n/a | SRS cyclic shift hopping combined with legacy group/sequence hopping supported in NR SRS basic feature (FG 2-52) is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-14: FG 40-7-1 family

**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—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  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 8TX ports for codebook1 | 40-7-1 | Yes | n/a | Codebook-based 8Tx PUSCH—codebook1 is not supported | Per FSPC | No | No | No | Component 1 candidate values: {noTDM SRS, TDM and noTDM SRS}  ~~2.~~ Component 2 candidate values: {(4,1), (2,2), 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 8TX ports for 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 8TX ports for 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 8TX ports for 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 |
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### Issue 1-15: FG 40-6-1

**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 | 40-6-1 | Single-DCI based STx2P SDM scheme for PUSCH—codebook | 1. Dynamic switching by DCI 0\_1/0\_2 between single-DCI STxMP SDM and sTRP for PUSCH—codebook  2. 1 PTRS port for single-DCI based STx2P SDM scheme for PUSCH—codebook  3. Support of two SRS resource sets with usage set to 'codebook'  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  7. Max number of NZP PUSCH ports associated with one SRS resource set  8. Maximum number of SRS antenna ports for each SRS resource in each SRS resource set  9. Support of separate configured maximum output power for each of indicated joint/UL TCI states | 2-14 | Yes | N/A | Single-DCI based STx2P SDM scheme for PUSCH—codebook is not supported | Per FSPC | No | FR2 only | n/a | Component 4 candidate values: {1, 2 ,4}  Component 5 candidate values: {1, 2}  Component 7 candidate values: {1, 2 ,4}  Component 8 candidate values: {1, 2 ,4}  Note: For component 7, if a row of the TPMI consists of all 0’s, the corresponding PUSCH port is not counted  Note: If value 4 is reported for component 4, UE also reports value 4 in FG 16-5c | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-16: 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(2) at one symbol  9. Support of separate configured maximum output power for each of indicated joint/UL TCI states | 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(2) 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 1-17: FG 40-6-4

**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 | 40-6-4 | Single-DCI based STx2P SFN scheme for PUCCH | 1. Support of single-DCI based STx2P SFN scheme for PUCCH  2. Supported PUCCH formats for STxMP SFN scheme  3. Support of separate configured maximum output power for each of indicated joint/UL TCI states |  | Yes | n/a | Single-DCI based STx2P SFN scheme for PUCCH is not supported | Per FS | n/a | FR2 only | n/a | Component 2 candidate values: {PF0/2, PF1/3/4, PF0-4) | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-18: FG 40-6-6

**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 | 40-6-6 | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | Support of out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH | 40-6-3a or 40-6-3b | Yes | N/A | Out-of-order operation for multi-DCI based STx2P PUSCH+PUSCH is not supported | Per FSPC | N/A | ~~N/A~~ FR2 only | N/A |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-19: FG 40-7-1g family

**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 | 40-7-1g | 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~~  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 8 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: The first, second, third or fourth state 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 1-20: New FG on support of PHR reporting related to STx2P

**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 | 40-1-14 | Two PHR reporting for STx2P | Support of PHR reporting related to STx2P | 40-6-1, 40-6-1a, 40-6-2, 40-6-2a, 40-6-3a, 40-6-3b | yes | n/a | 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 | n/a | FR2 only | n/a | 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 1-21: New FG on the maximum number of configured DMRS types for across all DL DCI formats (except DCI format 1\_0)

**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 | 40-4-XX | Maximum number of configured DMRS types for across all DL DCI formats (except DCI format 1\_0) | Maximum number of configured DMRS types for across all DL DCI formats (except DCI format 1\_0) | 2-10, 40-4-1 | Yes | n/a | Capability on the maximum number of configured DMRS types for across all DL DCI formats is not supported (except DCI format 1\_0) | Per FS | No | No | n/a | Component candidate values: {2, 3, 4} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-22: New FG on support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port by Rel-18 enhanced DMRS ports for PUSCH

**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 | 40-4-6b | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | Support of 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH | 40-4-6 | Yes | n/a | 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port for Rel.18 enhanced DMRS ports for PUSCH is not supported | Per FS | No | No | n/a |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-23: New FG on codebook type(s) for TDMed 8TX SRS

**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 | 40-7-XX | Codebook-based 8Tx PUSCH—codebook type(s) for TDMed 8TX SRS | 1. Supported codebook type(s) for TDMed 8TX SRS  2. Support of (N1, N2) for codebook-based 8Tx PUSCH—codebook1 | 40-7-1 | Yes | n/a | Supported codebook type(s) of codebook-based 8Tx PUSCH for TDMed 8TX SRS is not supported | Per  FSPC | No | No | No | Component 1 candidate value: Combination (including empty) of {codebook1, codebook2, codebook3, codebook4}  Component 2 candidate value: {N/A, (4,1), (2,2), both}  A UE that supports Component 3 of FG 40-7-1 as “TDM and noTDM” must support this FG. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-24: New FGs on UE STxMP processing capability

**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 | 40-6-3a-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 | 40-6-3a | Yes | n/a | UE should process multiple TBs within legacy timeline | FR2 only | Per  FSPC | No | FR2 only | No | Component 1 candidate values:  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}  Note: UE reports candidate value independently for each SCS in unit of symbols  Note: This FG can be applied for CG+DG also if UE can support those FG | Optional with capability signalling |
| 40. NR\_MIMO\_evo\_DL\_UL | 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 | 40-6-3b | Yes | n/a | UE should process multiple TBs within legacy timeline | FR2 only | Per  FSPC | No | FR2 only | No | Component 1 candidate values:  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}  Note: UE reports candidate value independently for each SCS in unit of symbols  Note: This FG can be applied for CG+DG also if UE can support those FG | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-25: New FGs on dynamic switching

**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 | 40-1-14a | Dynamic switching - scheme A | Support of dynamic switching between single-TRP and PDSCH SFN scheme A by TCI selection field in DCI formats 1\_1, 1\_2 | 40-1-4, 23-6-1a | Yes | n/a | dynamic switching between single-TRP and PDSCH SFN scheme A by TCI selection field in DCI formats 1\_1, 1\_2 is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-1-14b | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI selection field in DCI formats 1\_1, 1\_2 | 40-1-4, 23-6-2a | Yes | n/a | dynamic switching between single-TRP and PDSCH SFN scheme B by TCI selection field in DCI formats 1\_1, 1\_2 is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-26: New FGs for M-TRP CJT

**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 | 40-3-1-24 | The maxmum total number of supported SD basis for M-TRP CJT | The maxmum total number of supported SD basis for M-TRP CJT |  | Yes | n/a | SD basis selection for M-TRP CJT is not supported. | Per band and per BC | n/a | n/a | n/a | Candidate values for component 1:  {2, 4, 6, 8, 10, 12, 16} | Optional with capability signaling |
| 40. NR\_MIMO\_evo\_DL\_UL | 40-3-1-25 | The supported subset of linkages | The supported subset of linkages |  | Yes | n/a | The linkages of the parameter combination is not supported. | Per band and per BC | n/a | n/a | n/a |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-27: New FG for per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP

**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 | 40-1-3a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP | Support of per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP | 40-1-7 | yes | n/a | Per aperiodic CSI-RS resource/resource set configuration for TCI selection in M-DCI based MTRP is not supported | Per band | n/a | n/a | n/a | Component candidate values: {per resource, per resource set, both} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-28: New FG for supported maximum periodicity of CMR when configured as periodic CSI-RS

**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 | 40-3-2-[12] | Supported maximum periodicity of CMR when configured as periodic CSI-RS | Maximum periodicity of periodic CSI-RS (in slots) UE can handle for Type-II-Doppler CSI report | At least one of {40-3-2-1, 40-3-2-4} | Yes | n/a | UE cannot handle a long periodicity CSI-RS configured by gNB | Per-band  Per-BC | No | n/a | n/a | Component candidate values (in slots): {4,5,8,10} | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 1-29: New FGs for single-DCI based STx2P SDM/SFN scheme for PUSCH and repetition in time

**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 | 40-6-1c | 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 | 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 | Note: For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14  Note: For component 2, UE also reports FG11-6  Note: 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 | 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 | Note: For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14  Note: For component 2, UE also reports FG11-6  Note: 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 1-30: New FG on multi-DCI based STx2P for PUSCH+PUSCH and repetition in time for at least one of the PUSCHs

**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 | 40-6-3q | 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 | Note: For component 1, UE also reports FG5-17, and/or FG5-16, and/or FG5-14  Note: For component 2, UE also reports FG11-6  Note: 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 1-31: New FG on multi-DCI STx2P PUSCH with different PHY priorities

**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 | 40-6-3r | 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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## NR\_pos\_enh2

After review of contributions submitted to RAN1 #116bis in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

**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 | 41-1-1 | Common SL PRS Processing Capability in a SL BWP | 1. Maximum SL PRS bandwidth in MHz in a resource pool for positioning, which is supported and reported by UE for SL-PRS measurement  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  3. Maximum number of slots with active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  4. Minimum time after the end of a slot carrying the active SL-PRS resource(s) assuming maximum number of symbols and maximum bandwidth for a UE to finish the SL-PRS resource and the associated PSCCH processing which is supported and reported by UE |  | Yes | No | The UE does not support the reception and processing of SL PRS | ~~WA:~~ Per Band | n/a | n/a | n/a | Component 1 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  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  Component 3 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Component 4 candidate values: {20ms, 30ms, 40ms, 50ms, 80ms, 100ms, 160ms}  Note: a 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  Need for location server/ UE to know if the feature is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-2: FG 41-1-1a

**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 | 41-1-1a | Common SL PRS Processing Capability | 1. Maximum number of active SL PRS resources across all configured RPs across all bands in a slot assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  2. Maximum number of slots with active SL PRS resources across all configured RPsacross all bands assuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE | 41-1-1 | Yes | No | The UE does not support the reception and processing of SL PRS | Per UE | No | No | No | Component 1 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  Component 2 candidate values:  FR1: {1, 2, 3, 4, 6, 8} FR2: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Need for location server/ UE to know if the feature is supported  ~~This row/FG is a WA~~ | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-3: FG 41-1-2

**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, ~~15-4,~~ 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  ~~[~~UE indicating support of FG 41-1-1 must indicate either this feature group or feature group 41-1-3 is supported or both are supported~~]~~ | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-4: 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 | ~~[~~15-1, ~~15-4,~~ 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  ~~[~~UE support of FG 41-1-1 must indicate either this feature group or feature group 41-1-2 is supported or both are supported~~]~~ | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-5: FG 41-1-4a

**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, *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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-6: FG 41-1-4b

**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 | 41-1-4b | 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, *p0-OLPC-Sidelink-r17* | 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-7: FG 41-1-4c

**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 | 41-1-4c | 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 | ~~[15-[x], 41-1-3],~~ 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-8: FG 41-1-7 family

**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, 41-1-1a | 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  Compo~~o~~nent 3 candidate values: {1,2,3,4} | Optional with capability signaling |
| 41. NR\_pos\_enh2 | 41-1-7b | SL PRS measurement for SL RTOA | 1. Support SL RTOA measurement based on SL-PRS  2. Support SL RTOA measurement reporting  3. Maximum number of SL RTOA measurementreporting for different SL-PRS reception for the same pair of UEs | 41-1-1, 41-1-1a | No | No | UE does not support SL PRS measurement for SL RTOA | 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 | 41-1-7c | 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, 41-1-1a, 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, 41-1-1a, 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 | 41-1-7e | SL PRS measurement for SL PRS-RSRP | 1. Support SL PRS-RSRP measurement based on SL-PRS  2. Support SL PRS-RSRP measurement reporting | 41-1-1, 41-1-1a | No | No | SL PRS measurement for SL PRS-RSRP 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 | 41-1-7f | SL PRS measurement for SL PRS-RSRPP | 1. Support SL PRS-RSRPP measurement based on SL-PRS  2. Support SL PRS-RSRPP measurement reporting | 41-1-1, 41-1-1a | No | No | SL PRS measurement for SL PRS-RSRPP 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 | 41-1-7g | SL PRS measurement for SL AoA | 1. Support SL AoA measurement based on SL-PRS  2. Support SL AoA measurement reporting types. Candidate values: bitmap {GCS, LCS with translation, LCS without translation}. | 41-1-1, 41-1-1a | No | No | SL PRS measurement for SL AoA 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-9: 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 | ~~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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-10: FG 41-1-17

**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 | 41-1-17 | 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-11: 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 DL PRS-RSRP and DL RSTD measurements inside the indicated time window only for DL TDoA | Support to perform DL PRS-RSRP and DL RSTD 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 DL PRS-RSRP and DL RSTD 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 and UE Rx-Tx time difference measurements inside the indicated time window only for multi-RTT | Support to perform DL PRS-RSRP and UE Rx-Tx time difference 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 DL PRS-RSRP and UE Rx-Tx time difference 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 and DL PRS-RSRPP measurements inside the indicated time window only for DL AoD | Support to perform DL PRS-RSRP and DL PRS-RSRPP 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 DL PRS-RSRP and DL PRS-RSRPP 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 | Comments/Questions/Suggestions |
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### Issue 2-12: FG 41-2-11

**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 | 41-2-11 | 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 |
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### Issue 2-13: 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 |
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### Issue 2-14: FG 41-4-6

**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 | 41-4-6 | Positioning SRS bandwidth aggregation in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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.  Note: For component 2, it shall be less than or equal to the maximum aggregated transmission bandwidth associated with IE ca-BandwidthClassUL-NR. Additionally, it shall be less than or equal to the maximum aggregated bandwidth for the supported CA configuration in Table 5.5A.1-1 in TS 38.101-1 for FR1 bands or Table 5.5A.1-1 in TS 38.101-2 for FR2 bands for the band where aggregated SRS CCs is configured.  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Note: A UE that support FG 13-8a must signal a non-zero value for components 6 and 7 for aperiodic  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-15: FG 41-4-7

**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 | 41-4-7 | Positioning SRS bandwidth aggregation independent from UL communication CA in RRC\_CONNECTED | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period in microseconds  10. Power class of supported aggregated carriers in intra band contiguous 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~}  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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~~ms~~, 30~~ms~~, 100~~ms~~, 140~~ms~~, 200~~ms~~}  Component 10 candidate values:   * For 2 in component 1: {PC2, PC3} * For 3 in component 1: {PC2, PC3}   Note: Component 10 is only applicable for FR1 bands  Note: For a given band, independent of the band combination, the UE must signal the same guard period  Note: The UE supports the simultaneous transmission in a coherent manner of 2 or 3 SRS resources in 2 or 3 intra-band contiguous CCs.  Note: each two or three linked SRS resources are counted as 1 resource  Need for location server to know if the feature is supported. UE only reports the number on bands for the current configured CA band combination.  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-16: FG 41-4-8

**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 | 41-4-8 | Positioning SRS bandwidth aggregation in RRC\_INACTIVE | 1. The number of supported aggregated carriers in intra band contiguous carriers  2. Maximum aggregated UL SRS bandwidth in MHz, which is supported and reported by UE  5. Max number of aggregated SRS resource sets for positioning supported by UE for SRS bandwidth aggregation  6. Maximum number of aggregated SRS resources for bandwidth aggregation  7. Maximum number of aggregated SRS resources for bandwidth aggregation per slot  8. Support the same SRS power reduction across aggregated carriers  9. Guard period in microseconds  10. Power class of supported aggregated carriers in intra band contiguous 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 1 candidate values: {2,3,2and3}  Component 2 candidate values:  For 2 in Component 1:  FR1 bands: {20, 40, 50, 80, 100, 160, 180, 190, 200~~M~~ }  FR2 bands: {50, 100, 200, 400, 600, 800}  For 3 in Component 1:  FR1 bands: {80, 100, 160, 200, 240, 300}  FR2 bands: {50, 100, 200, 300, 400, 600, 800, 1000, 1200}  Component 5 candidate values: {1, 2, 4, 8, 12, 16}  Component 6 candidate values:  Periodic: {1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  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~~ms~~, 30~~ms~~, 100~~ms~~, 140~~ms~~, 200~~ms~~}  Component 10 candidate values:   * For 2 in component 1: {PC2, PC3} * For 3 in component 1: {PC2, PC3}   Note: Component 10 is only applicable for FR1 bands  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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### Issue 2-17: FG 41-4-9

**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 | 41-4-9 | Affected bands if guard period is needed in SRS bandwidth aggregation | Indicate which other bands in the band combination are affected due to the need of a guard period | 41-4-7 or 41-4-8 | Yes | n/a | If not reported, all the bands of the UE are affected when a guard period is needed in SRS bandwidth aggregation | Per FS | n/a | n/a | n/a | For each band in the band combination, the UE can indicate which other bands in the band combination are affected by the SRS switch.  Note: UE may indicate no other bands in the band combination are affected by the SRS switch  Note: Guard period is needed before and after the aggregated SRS transmissions when SRS resource is configured within a CC without PUSCH/PUCCH is linked for aggregation with an SRS resource configured within an UL active BWP of a UL communication CC | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-18: FG 41-5 family

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

* **Alt. 1**

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| 41. NR\_pos\_enh2 | 41-5-1 | PRS measurement with Rx frequency hopping within a MG and measurement reporting RRC\_CONNECTED for RedCap UEs | 1. Maximum DL PRS bandwidth across all hops  3. Maximum number of hops  4. Duration of DL PRS symbols N3 in units of ms a UE can process every T3 ms  5. RF Rx retune times between consecutive hops  6. Overlapping PRB(s) between adjacent hops | 13-1, one of {28-1, 48-1} | Yes | n/a | PRS measurement with Rx frequency hopping within a MG and measurement report in RRC\_CONNECTED for RedCap UEs is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 3 candidate values: {2,3,4,5,6}  Component 4 candidate values:  T3: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N3: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 5 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 6 candidate values: {0, 1, 2, 4}  Note 1: The maximum DL PRS bandwidth per hop follows component 1 of FG 13-1  Note 2: DL PRS buffering capability follows component 2 of FG 13-1  Need for location server to know if the feature is supported. | Optional with capability signalling |

* **Alt. 2**

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| 41. NR\_pos\_enh2 | 41-5-1 | PRS measurement with Rx frequency hopping within a MG and measurement reporting RRC\_CONNECTED for RedCap UEs | 1. Maximum DL PRS bandwidth across all hops  3. Maximum number of hops  4. Duration of DL PRS symbols N3 in units of ms a UE can process every T3 ms  5. RF Rx retune times between consecutive hops  6. Overlapping PRB(s) between adjacent hops | 13-1~~, one of {28-1, 48-1}~~ | Yes | n/a | PRS measurement with Rx frequency hopping within a MG and measurement report in RRC\_CONNECTED for RedCap UEs is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 3 candidate values: {2,3,4,5,6}  Component 4 candidate values:  T3: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N3: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 5 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 6 candidate values: {0, 1, 2, 4}  Note 1: The maximum DL PRS bandwidth per hop follows component 1 of FG 13-1  Note 2: DL PRS buffering capability follows component 2 of FG 13-1  Need for location server to know if the feature is supported. | Optional with capability signalling |
| 41. NR\_pos\_enh2 | 41-5-2 | Support of positioning SRS with Tx frequency hopping in RRC\_CONNECTED for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 13-8~~, one of {28-1,48-1}~~ | Yes | n/a | Positioning SRS with Tx hopping in RRC\_CONNECTED is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 2 candidate values: {2,3,4,5,6}  Component 3 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 4 candidate values:  {100us, 140us, 200us, 300us, 500us}  Component 7 candidate values:  Periodic: {1,2,4,8,16,32,64}  Aperiodic: {0,1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  Note: No additional UE requirements shall be specified for the case of Tx hopping with non-overlapping hops compared to the case of Tx hopping with overlapping hops, e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops  Need for location server to know if the feature is supported | Optional with capability signalling |
| 41. NR\_pos\_enh2 | 41-5-2a | Support of positioning SRS with Tx frequency hopping in RRC\_INACTIVE for RedCap UEs | 1. Maximum SRS bandwidth across all hops  2. Maximum number of hops  3. RF Tx retuning time between consecutive hops  4. Switching time between active BWP and frequency hop  5. Overlapping PRB(s) between adjacent hops  6. Support of {0,1,2,4} overlapping PRB(s) between adjacent hops  7. Maximum number of positioning SRS resources with Tx frequency hopping | 27-15b~~, one of {28-1,48-1}~~ | Yes | n/a | Positioning SRS with Tx hopping in RRC\_INACTIVE is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values:  FR1: {40, 50, 80, 100}  FR2: {100, 200, 400}  Component 2 candidate values: {2,3,4,5,6}  Component 3 candidate values:  FR1: {70us, 140us, 210us}  FR2: {35us, 70us, 140us}  Component 4 candidate values:  {100us, 140us, 200us, 300us, 500us}  Component 7 candidate values:  Periodic: {1,2,4,8,16,32,64}  Semi-persistent: {0,1,2,4,8,16,32,64}  Note: No additional UE requirements shall be specified for the case of Tx hopping with non-overlapping hops compared to the case of Tx hopping with overlapping hops, e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops  Need for location server to know if the feature is supported | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-19: New FG for support of SL PRS Rx for a band configured with SL CA

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

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| 41. NR\_pos\_enh2 | 41-1-20a | 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 |

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| Company | Comments/Questions/Suggestions |
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### Issue 2-20: New FG for support of SL PRS Tx for a band configured with SL CA

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

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| 41. NR\_pos\_enh2 | 41-1-20b | 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 |
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### Issue 2-21: New FG for SL-PRS transmission request in physical layer

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

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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 |
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## Netw\_Energy\_NR

After review of contributions submitted to RAN1 #116bis 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 42-1

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

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| 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 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 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}  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: 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   Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | On the note to report the same values across different FGs,   |  | | --- | | Note: 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   Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP |   It may be good to create a separate FGs rather than enforcing UE to report the same values (it seems unnecessary signaling overhead otherwise).  On the other hand, the component “Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP” should not be enforced to be the same values UE report as there are separate capabilities have been defined for periodic, aperiodic, and semi-persistent CSI reporting setting.  **Suggestions:**   * Delete the following components from 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   + [note from Apple: Do not delete “Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP”] * Add a new FG 42-3   + 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   + Need for the gNB to know if the feature is supported     - Yes   + Applicable to the capability signalling exchange between UEs (Sidelink WI only)     - [Blank]   + 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   + Need of FDD/TDD differentiation     - No   + Need of FR1/FR2 differentiation     - No   + Capability interpretation for mixture of FDD/TDD and/or FR1/FR2     - N/A   + Note     - Component 1 candidate values:       * SD Type 1: {1, 2, 3 … 32}       * SD Type 2: {1, 2, 3 … 32}       * PD: {1, 2, 3 … 32}     - Component 2 candidate values:       * SD Type 1: {8, 16, 24, … 128 }       * SD Type 2: {8, 16, 24, … 128 }       * PD: {8, 16, 24, … 128 }     - Component 3 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}       * PD: {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64}     - Component 4 candidate value:       * SD Type 1: {8, 16, 24, …, 248, 256}       * SD Type 2: {8, 16, 24, …, 248, 256}       * PD: {8, 16, 24, …, 248, 256}   + Mandatory/Optional     - Optional with capability signaling |

### Issue 3-2: FG 42-1a

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

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| 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 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 semi-persistent CSI report settings with sub-configurations per BWP which is transmitted on PUSCH | ~~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}  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: 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   Note: A UE shall declare the same value for component 9 to indicate the combined total limit for PUCCH and PUSCH  Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-3: FG 42-1b

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

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| 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 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 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}  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: 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   Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-4: FG 42-1c

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

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| 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 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 semi-persistent CSI report settings with sub-configurations per BWP which is transmitted on PUCCH | ~~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}  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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH~~  ~~Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH~~  Note: Components 6 and 7 are signaled per BC  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   Note: A UE shall declare the same value for component 9 to indicate the combined total limit for PUCCH and PUSCH  Note: 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  Note: 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  Note: 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)  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-5: FG 42-2

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

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| 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 foraperiodic 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 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: 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   Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-6: FG 42-2a

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

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| 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 semi-persistent CSI report settings with sub-configurations per BWP which is transmitted on PUSCH | ~~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: 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   Note: A UE shall declare the same value for component 8 to indicate the combined total limit for PUCCH and PUSCH  Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-7: FG 42-2b

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

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| 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 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: 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   Note: 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  Note: 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  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-8: FG 42-2c

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

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| 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 semi-persistent CSI report settings with sub-configurations per BWP which is transmitted on PUCCH | ~~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: Maximum value of Lmax is no larger than 8 for semi-persistent CSI reporting on PUCCH~~  ~~Note: Maximum value of N is no larger than 4 for semi-persistent CSI reporting on PUCCH~~  Note: Components 5 and 6 are signaled per BC  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   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: 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  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)  Note: 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 * Supported total number of CSI reporting settings without sub-configurations plus the total number of sub-configurations across CSI report settings with sub-configurations per BWP | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | The same comment as above |

### Issue 3-9: New FGs

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

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| 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 | 2-35 | 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 1: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsPerCC*  Note 2: If UE is configured with CSI report setting without sub-configuration for the carrier, UE shall use *simultaneousCSI-ReportsPerCC*; otherwise, UE shall use *simultaneousCSI-SubReportsPerCC-r18* | 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 | 2-35 | Yes |  | UE does not support spatial or power domain adaptation for aperiodic CSI reporting | Per BC | No | No | N/A | Component 1 candidate values: {5, 6, 7, ..., 32}  Note 1: UE shall report the value in this feature group being equal to or larger than that in *simultaneousCSI-ReportsAllCC*  Note 2: If UE is configured with CSI report setting without sub-configuration for any carrier, UE shall use *simultaneousCSI-ReportsAllCC*; otherwise, UE shall use *simultaneousCSI-SubReportsAllCC-r18* | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Apple | Support |

## NR\_Mob\_enh2

After review of contributions submitted to RAN1 #116bis 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 45-1

**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: FGs 45-3 and 45-4

**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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### Issue 4-3: FG 45-5

**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 | 45-5 | RACH-based early TA acquisition | 1. Maximum number of candidate cells for TA acquisition based on PDCCH ordered CFRA procedure before receiving cell switch command MAC-CE  2. Power ramping for PRACH retransmission based on PDCCH order indication  3. Support of dropping the serving cell UL to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | ~~FFS~~ 45-7, RAN2 FG for LTM | Yes | No | RACH-based early TA acquisition is not supported | Per band | No | No | n/a | Component 1 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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### Issue 4-4: FG 45-5a

**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 | 45-5a | RACH-based early TA acquisition with simultaneous transmission | Support of simultaneous transmission to handle the overlap between UL transmission on serving cell(s) and PRACH on candidate cell(s) | 45-5 | Yes | No | Support of RACH-based early TA acquisition with simultaneous transmission is not supported | ~~[~~Per band~~]~~ pair per band combination (between the target band for RACH transmission and band under UE’s current band combo) | No | No | n/a |  | 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 #116bis 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 ~~[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 44-2

**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 | 44-2 | NTN DMRS bundling enhancement for PUSCH in NGSO scenarios | 1. Support of DM-RS bundling for PUSCH over consecutive slots in NGSO scenarios  2. Support of pre-compensation to keep phase rotation due to timing drift within the phase difference limit  3. Maximum duration during which UE is able to maintain power consistency and phase continuity to support NTN DM-RS bundling for PUSCH over consecutive slots | At least one of {30-4a/b/c}, 26-1 | Yes | No | UE does not support DM-RS bundling enhancement for PUSCH in NGSO scenarios | Per Band | N/A | N/A | N/A | Component 3 candidate values: {4, 8, 16, 32}  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  Note: a UE that does not report support of this FG and reports support of FG 30-4 for an NTN band can perform DMRS bundling only in GSO scenario in the NTN band  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders  Note: for bands in Table 5.2.2-1 and ~~[TBD for FR2-NTN bands]~~ in TS 38.101-5, reported value in FG 30-4 is applied only for GSO scenario | Optional with capability signaling |

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

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| Company | Comments/Questions/Suggestions |
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### Issue 5-4: LS to RAN2

**Proposal: Send an LS to ask RAN2 to support two separate FGs for RACH-less HO with CG PUSCH and RACH-less HO with DG PUSCH**

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

After review of contributions submitted to RAN1 #116bis in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 6-1: 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  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 |
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### Issue 6-2: Support of NGSO

**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 |
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### Issue 6-3: 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 |
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## NR\_netcon\_repeater

Void

## NR\_BWP\_wor

Void

## NR\_ATG

After review of contributions submitted to RAN1 #116bis in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

### Issue 9-1: Type of 56-x family

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

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| 56. NR\_ATG | 56-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | Support of UE specific TA calculation based on its GNSS-acquired position and the indicated BS location.  Support of open (i.e. UE autonomous TA estimation) and closed (i.e., received TA commands) loop control for TA update in RRC\_CONNECTED state.  Support of pre-compensation of the calculated TA in the uplink transmissions.  Support of frequency pre-compensation to account for the Doppler experienced on the service link.  Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated.  Support of UE receiving cell-specific K\_offset in system information. |  | Yes | N/A | If UE does not support this feature, the performance of ATG UE cannot be guaranteed due to the large propagation delay. | ~~FFS~~ Per UE | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Mandatory with capability signaling for UE supports NR communication via ATG |
| 56. NR\_ATG | 56-2 | UE reporting of TA information | Support UE reporting of TA information | 56-1 | Yes | N/A | If UE does not support this feature, UE cannot report the TA information to network. | ~~FFS~~ Per UE | No | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability siganling |
| 56. NR\_ATG | 56-3 | Increasing the number of HARQ processes | The maximal supported HARQ process number is X for UL and Y for DL |  | Yes | N/A | If UE does not support this feature, the HARQ process is number is limited. | ~~FFS~~ Per UE | No | FR1 only | N/A | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}  Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling |
| 56. NR\_ATG | 56-4 | K1 range extension | Support of extended K1 value range of (0..31) for unpaired spectrum |  | Yes | N/A | If UE does not support this feature, K1 value is limited. | ~~FFS~~ Per UE | TDD only | FR1 only | N/A | Note: This UE feature group is applicable only for bands defined in Section 5.2J in TS 38.101-1 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Conclusion

Agreements reached during RAN1 #116bis as part of this agenda item are summarized in [19].

# References

1. R1-2401709, Updated RAN1 UE features list for Rel-18 NR after RAN1 #116, 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. R1-2402008, UE features for other Rel-18 WIs (Topics B). Huawei/HiSilicon
4. R1-2402143, UE features for Rel-18 Work Items (Topics B), Intel Corporation
5. R1-2402229, Discussion on UE features for Topic B, vivo
6. R1-2402315, UE features for other Rel-18 work items (Topics B), OPPO
7. R1-2402365, Remaining issues on UE features for MIMO and Positioning, CATT
8. R1-2402453, UE features for other Rel-18 work items (Topic B), Samsung
9. R1-2402552, Discussion on UE features for NR ATG, CMCC
10. R1-2402605, Remaining issues of UE Features for Other Topics B (MIMO, FePos, NES, MobEnh, NCR, IoT-NTN, NR-NTN, BWP\_wor), Nokia/Nokia Shanghai Bell
11. R1-2402647, Discussion on UE features for NR MIMO evolution, Xiaomi
12. R1-2402702, UE features for other Rel-18 work items (Topics B), ZTE Corporation
13. R1-2402955, UE features for other Rel-18 work items (Topics B), MediaTek
14. R1-2403116, Discussion on UE features for NES, LG Electronics
15. R1-2403181, UE features for other Rel-18 work items (Topics B), Qualcomm Incorporated
16. R1-2403231, Discussion on UE features for other Rel-18 work items (Topics B), NTT DOCOMO, INC.
17. R1-2403271, Rel-18 UE features topics set B, Ericsson
18. R1-2403409, Views on UE features for other Rel-18 work items (Topics B), Apple
19. R1-24nnnnn, Session Notes of AI 8.5.3, Ad-Hoc Chair (NTT DOCOMO, INC.)