**3GPP TSG RAN WG1 #109-e R1-2204849**

**e-Meeting, May 9th – 20th, 2022**

**Agenda Item: 8.16.1**

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

**Title: Summary of UE features for further enhancements on NR-MIMO**

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

# Introduction

This document presents the summary of email discussion/approval [109-e-R17-UE-features-MIMO-01] during RAN1 #109-e. According to the Chairman’s Notes:

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| [109-e-R17-UE-features-MIMO-01] Email discussion on UE features for further enhancements on NR-MIMO – Ralf (AT&T)   * 1st check point for LS to RAN2: May 13 * Final check point for any remaining issues: May 20 |

The following was discussed and/or agreed during RAN1 #109-e within the scope of [109-e-R17-UE-features-MIMO-01]. All proposals are based on the latest RAN1 UE features list for Rel-17 NR in [1].

# Summary of Contributions Submitted to RAN1 #109-e

The following is the moderator’s summary of contributions submitted to RAN1 #109-e in this agenda item.

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| 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. WA: The maximum number of configured joint TCI states [per BWP per CC] [in a band] [in a band combination] 3. One MAC-CE activated joint TCI state per CC [in a band] [in a band combination] 4. TCI state indication [mode]: update and activation [in case of updates]a) MAC CE based TCI state indication [for one active TCI state] 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a | FFS: how to count the MAC-CE activated joint TCI | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***Unified TCI framework***  It was agreed in RAN#106-e that the maximum number of configured TCI state pools across BWPs and CCs in a band is reported as UE capability.  **Agreement (RAN1#106-e)**  On Rel.17 unified TCI framework, confirm the following working assumption as an agreement with a minor refinement highlighted in red  For common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of [configured] CCs/BWPs:   * RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC as in Rel-15/16   + Note: Such RRC-configured TCI state pool(s) configuration doesn’t imply that separate DL/UL TCI state pool is excluded or supported * RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC, and replaced with a reference to RRC-configured TCI state pool(s) in a reference BWP/CC   + In the PDSCH configuration (*PDSCH-Config*) of the reference BWP/CC, RRC-configured TCI state pool(s) shall be configured   + For a BWP/CC where the PDSCH configuration contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC, the UE applies the RRC-configured TCI state pool(s) in the reference BWP/CC * When the BWP/CC ID (i.e. *bwp-Id* or *cell*) for QCL-Type A/D source RS in a *QCL-Info* of the TCI state is absent, the UE assumes that QCL-Type A/D source RS is in the BWP/CC to which the TCI state applies * Introduce a UE capability to report maximum number of TCI state pools it can support across BWPs and CCs in a band, and the candidate value at least includes 1 * FFS: Introduce a UE capability to report maximum number of configured TCI states that it can support across BWPs and CCs in a band * FFS: How to define reference BWP/CC   In addition, to reduce memory consumption at UE, similar to legacy UE feature 2-4/2-59 in Rel-15/16, it should be supported to report the maximum number of configured unified TCI states across BWPs/CCs in a band in a band combination and the maximum number of configured unified TCI states per BWP per CC in a band in a band combination.  With above analysis, we propose the following:  ***Proposal 2-1: For FG 23-1-1, confirm the WA of component 2 with related brackets removed, and introduce a new component 2a***   * + ***Component 2: The maximum number of configured joint TCI states per BWP per CC in a band in a band combination.***   + ***Component 2a: The maximum number of configured joint TCI states across all BWPs and all CCs in a band in a band combination***   It was agreed in RAN#105-e that the maximum number of activated UL TCI states or joint TCI state is reported as UE capability.  **Agreement (RAN1#105-e)**  On path-loss measurement for Rel.17 unified TCI framework, a PL-RS (configured for path-loss calculation) is either included in UL TCI state or (if applicable) joint TCI state or associated with UL TCI state or (if applicable) joint TCI state.   * Whether a UE supports “beam misalignment or not” (detailed definition FFS) between the DL source RS in the UL or (if applicable) joint TCI state to provide spatial relation indication and the PL-RS is a UE capability   + Note: The term “beam misalignment” is for discussion purpose only * Whether it is ‘included in’ or ‘associated with’ (including the manner it is performed and the signaling) is up to RAN2 * The UE maintains the PL-RS of the activated UL TCI state or (if applicable) joint TCI state * The maximum number of activated UL TCI states or (if applicable) joint TCI states per band per cell is a UE capability * FFS: detailed aspects of PL-RS, e.g. CSI-RS type(s), restriction on configuration * FFS: For the definition of “beam misalignment or not”, at least consider the case where the periodic DL source RS in the UL or (if applicable) joint TCI state to provide spatial relation indication is configured/associated as the PL-RS * Note: PL-RS is assumed to be periodic   Similarly, as one band can belong to more than one BC, it is more flexible to add “per BC” restriction in component 5 in FG 23-1-1. In addition, we also prefer per CC UE capability on maximum number of MAC-CE activated joint TCI states. So we have the following proposal.  ***Proposal 2-3: Add “per BC” restriction in component 5 and introduce a new component 5a in FG 23-1-1***   * + ***Component 5: The maximum number of MAC-CE activated joint TCI states across all CCs in a band in a band combination.***   + ***Component 5a: The maximum number of MAC-CE activated joint TCI states per CC in a band in a band combination.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. ~~WA:~~ The maximum number of configured joint TCI states ~~[~~per BWP per CC~~]~~ ~~[~~in a band~~]~~ ~~[~~in a band combination~~]~~   2a. The maximum number of configured joint TCI states across all BWPs and all CCs in a band in a band combination   1. One MAC-CE activated joint TCI state per CC [in a band] [in a band combination] 2. TCI state indication [mode]: update and activation [in case of updates]a) MAC CE based TCI state indication [for one active TCI state] 3. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band in a band combination   5a. The maximum number of MAC-CE activated joint TCI states per CC in a band in a band combination |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a | FFS: how to count the MAC-CE activated joint TCI | Optional with capability signalling | |
| ZTE [3] | **23-1-1 Unified TCI for intra- and inter-cell beam management**  Firstly, in the main feature, we need to explicit that the following components should be supported as part of the basic features in 23-1-1: 23-1-1b, 23-1-1d/e/f (for UE supporting CA), 23-1-1h, 23-1-1i/j.  ***Proposal 1:*** *For unified TCI for intra- and inter-cell beam management, the following should be supported as basic features: 23-1-1: 23-1-1b, 23-1-1d/e/f (for UE supporting CA), 23-1-1h, 23-1-1i/j.*  Then, we have the following comments for the remaining issues for FG 23-1-1:   * Regarding inter-cell beam management, we prefer to have a unified FG for both intra- and inter-cell beam management, although we are open to have some additional FGs for indicating some specific features. * Regarding component-2 ‘The maximum number of configured joint TCI states’ should be across all CC in a band, for accommodating the feature of sharing common TCI state pool across all CC * Regarding how to count MAC-CE activated joint TCI, considering that the unified TCI state can apply to both FR1 and FR2, once there are different RS(s) w.r.t QCL-TypeA or QCL-TypeD, the activated TCI states should be counted individually. * Regarding the candidate values for this FG, we have the suggestion as in the following proposal.   ***Proposal 2:*** *For unified TCI for intra- and inter-cell beam management, the following modification in red is proposed.*   |  |  |  | | --- | --- | --- | | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- ~~[~~and inter-cell~~]~~ beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. ~~WA:~~ The maximum number of configured joint TCI states across all CC~~[per BWP per CC] [~~in a band~~] [in a band combination]~~   🡪 Candidate values: {64, 128, 192, 256, 512}   1. One MAC-CE activated joint TCI state per CC ~~[~~in a band~~] [in a band combination]~~ 2. TCI state indication ~~[~~mode~~]~~: update and activation ~~[in case of updates]~~ a) MAC CE based TCI state indication ~~[~~for one active TCI state~~]~~ 3. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band   🡪 Candidate values: {2, 3, 4, 6, 8, 10, 12, 14, 16, 20, 24, 28, 32, 36, 40, 44, 48, 64}  🡪 Note: activated TCI states with different reference RS w.r.t QCL-TypeA or QCL-TypeD, should be counted separately. | |
| Vivo [4] | The current UE feature for unified TCI framework only includes joint TCI, the separate TCI mode should be introduced as UE feature groups. At least two FGs are needed, one for the MAC CE based TCI state indication and another for DCI based beam indication. For inter-cell beam management, it is also preferred to have a separate FG.   1. Introduce separate TCI mode as UE feature groups for both intra-cell beam management and inter-cell beam management.  |  |  |  |  | | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- ~~[and inter-cell]~~ beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. WA: The maximum number of configured joint TCI states [per BWP per CC] [in a band] [in a band combination] 3. One MAC-CE activated joint TCI state per CC [in a band] [in a band combination] 4. TCI state indication [mode]: update and activation [in case of updates]a) MAC CE based TCI state indication [for one active TCI state] 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- ~~[and inter-cell]~~ beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. [The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS] 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination] 4. [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1k | Unified TCI with separate DL/UL TCI update for intra-cell beam management | Support separate DL/UL TCI update with one MAC-CE activated separate TCI state pair per CC [in a band] [in a band combination] | 23-1-1 | Yes | | 23. NR\_FeMIMO | 23-1-1l | Unified TCI with separate DL/UL TCI update for intra-cell beam management with DCI-based TCI state indication per CC | 1. TCI state indication [mode]: update and activation [in case of updates]   1) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) 2) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)   1. The maximum number of MAC-CE activated separate TCI states per CC [in a band] [in a band combination] | 23-1-1 | Yes | | 23. NR\_FeMIMO | 23-1-1m | Unified TCI with joint DL/UL TCI update for and inter-cell beam management | Support joint DL/UL TCI update with one MAC-CE activated separate TCI state pair per CC [in a band] [in a band combination] | 23-1-1 |  | | 23. NR\_FeMIMO | 23-1-1n | Unified TCI with joint DL/UL TCI update for inter-cell beam management with DCI-based TCI state indication per CC | 1. TCI state indication [mode]: update and activation [in case of updates]   1) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) 2) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)   1. The maximum number of MAC-CE activated separate TCI states per CC [in a band] [in a band combination] | 23-1-1 |  | | 23. NR\_FeMIMO | 23-1-1o | Unified TCI with separate DL/UL TCI update for inter-cell beam management | Support separate DL/UL TCI update with one MAC-CE activated separate TCI state pair per CC [in a band] [in a band combination] | 23-1-1 | Yes | | 23. NR\_FeMIMO | 23-1-1p | Unified TCI with separate DL/UL TCI update for inter-cell beam management with DCI-based TCI state indication per CC | 1. TCI state indication [mode]: update and activation [in case of updates]   1) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) 2) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)   1. The maximum number of MAC-CE activated separate TCI states per CC [in a band] [in a band combination] | 23-1-1 | Yes | |
| Xiaomi [5] |  |
| Samsung [6] | Regarding the name of FG 23-1-1 and FG 23-1-1b which should be basic features that enables Rel-17 unified TCI framework for both intra-cell and inter-cell beam management, we support to remove bracket for “[and inter-cell]” in the name of FG to confirm that this FG can enable basic functionalities for both intra- and inter-cell beam management for Unified TCI.  **Proposal 1:** Remove the bracket for “[and inter-cell]” in the name of FG to support functionalities for both intra- and inter-cell beam management on FG 23-1-1 and FG 23-1-1b.  Regarding the Components 2 and 5 for FG 23-1-1 as below,   |  | | --- | | 1. WA: The maximum number of configured joint TCI states [per BWP per CC] [in a band] [in a band combination] 2. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |   For FG 23-1-1, in order to avoid duplicated functionality for the “counting” features as above components 2 and 5., e.g., if UE supports *N* TCI states for intra-cell, it should support *N* for inter-cell as well.  **Proposal 6:** Supportsame value for “counting” features for both intra-cell and inter-cell beam management. |
| OPPO [7] |  |
| Ericsson [8] | During RAN1#108-e, there was significant progress on content of the FG 23-1-1 family. The content is stabilizing, and we are starting to clean up FFSs and removing brackets.  For FG 23-1-1, there are one WA, one FFS and some brackets. Here we propose:   1. Confirm the WA The maximum number of configured joint TCI states. 2. Remove the FFS: how to count the MAC-CE activated joint TCI   The release 17 TCI framework is built upon the three-stage signalling: RRC+MAC-CE+DCI. TCI states that can be indicated by DCI are activated using DCI. There is no ambiguity.  In addition, FG 23-1-1 contain a number of brackets. Most of these statements in brackets can be removed – they are either wrong or unnecessary. Here we propose the following modifications:   |  | | --- | | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured joint TCI states ~~[~~per BWP per CC~~]~~ ~~[in a band] [in a band combination]~~ 3. One MAC-CE activated joint TCI state per CC ~~[in a band] [in a band combination]~~ 4. TCI state indication ~~[mode]~~: update and activation ~~[in case of updates]~~ a) MAC CE based TCI state indication ~~[for one active TCI state]~~ 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |   For several of the FGs, there is a note on what FGs need to be part of the basic functionality. On this aspect, we propose   1. The following FGs in the 23-1-1- family are part of the basic functionality: FG 23-1-1, FG 23-1-1b, FG 23-1-1d, and FG 23-1-1f.  |  |  |  | | --- | --- | --- | | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- ~~[~~and inter-cell~~]~~ beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured joint TCI states ~~[~~per BWP per CC~~]~~ ~~[in a band] [in a band combination]~~ 3. One MAC-CE activated joint TCI state per CC ~~[in a band] [in a band combination]~~ 4. TCI state indication ~~[mode]~~: update and activation ~~[in case of updates]~~ a) MAC CE based TCI state indication ~~[for one active TCI state]~~   The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band | |
| LG Electronics [9] |  |
| Apple [10] | * We propose to have a separate FG for TCI for inter-cell beam management, since inter-cell beam management is a separate feature.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. WA: The maximum number of configured joint TCI states in a band 3. One MAC-CE activated joint TCI state per CC in a band 4. TCI state indication mode: update and activation a) MAC CE based TCI state indication 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra-cell beam management is not supported | Per band | n/a | n/a | n/a | Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 5 candidate value {1, 2, 4, 8}  The TCI states are counted as 1 if the reference signals for TCI states are the same or share the same QCL property. | Optional with capability signalling | | 23. NR\_FeMIMO | 23-1-1-1 | Unified TCI with joint DL/UL TCI update for inter-cell beam management | 1. Support of SSB associated with a PCI different from serving cell PCI to be configured as QCL source in joint TCI state 2. Support of a CORESET associated with at least a Type3 CSS/USS and at least a Type 0/0a/1/2 CSS 3. Support of a PDSCH scheduled by PDCCH in Type3 CSS or USS with scheduling offset smaller than threshold reported in FG 2-2   Support of aperiodic CSI-RS with scheduling offset smaller than threshold reported in FG 2-28 | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for inter-cell beam management is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1, we have the following suggestion:   * FG23-1-1 should include both intra-and inter cell. It is not necessary to report the same set of capabilities for intra cell and inter cell separately. * Component 2: We support to confirm the WA with “per BWP per CC”, considering that TCI state is configured per BWP. We don’t believe reporting “per band combination” is necessary. * Component 3: We believe reporting per CC in a band is enough. Or, it is also fine to remove all of “[in a band] [in a band combination]. We don’t believe reporting “per band combination” is necessary. * Component 3: We don’t have strong view on “[mode]”, but we can simply say as “TCI state indication for update and activation”. We think it is good to clarify a) means supporting only one active TCI state, but we are also fine to remove it, because it is obvious.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured joint TCI states per BWP per CC in a band 3. One MAC-CE activated joint TCI state per CC in a band 4. TCI state indication for update and activationa) MAC CE based TCI state indication for one active TCI state 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management is not supported | Per band | n/a | n/a | n/a | FFS: how to count the MAC-CE activated joint TCI | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] | Given the current structure of unified TCI update FGs, the following can be considered:  **Proposal:**   * **Confirm 23-1-1 and 23-1-1b as applicable for both intra-cell and inter-cell updates.** * **Confirm (new) 23-1-1k and (new) 23-1-1l as applicable for intra-cell and inter-cell updates.** |
| MediaTek Inc. [13] | On component 2 in current FG 23-1-1, following the principle of Rel-15/16 UE capability, the maximum number of configured joint TCI states is reported per BWP per CC. We suggest to confirm the WA with the following change:   * 2. The maximum number of configured joint TCI states ~~[~~per BWP per CC~~] [in a band] [in a band combination]~~   On component 3 in current FG 23-1-1, since the component is already agreed to be per CC, “in band” and “in a band combination” are not needed. We suggest the followings:   * 3. One MAC-CE activated joint TCI states per CC ~~[in a band] [in a band combination]~~   On component 4 in current FG 23-1-1, the main bullet is redundant thus can be removed, and the sub-bullet can be modified as the main bullet of this component. For the bracketed contend is the sub-bullet is also redundant and can be removed since it is already clear in spec that MAC-CE based TCI state indication is used only when only a single TCI state is activated. We suggest the following change:   * 4. ~~TCI state indication [mode]: update and activation [in case of updates] a)~~ MAC CE based TCI state indication ~~[for one active TCI state]~~   On how to count the MAC-CE activated joint TCI, it should be clarified in the note that the MAC-CE activated joint TCI state(s) should include the activated joint TCI states for all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions. Otherwise, it may be ambiguous that whether the TCI state(s) not activated for the indicated Rel-17 TCI state (e.g., a TCI state activated for a CORESET not following the indicated Rel-17 TCI state) should be taken into account.  **Proposal 1: On FG 23-1-1, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. ~~WA:~~ The maximum number of configured joint TCI states ~~[~~per BWP per CC~~]~~ ~~[in a band] [in a band combination]~~ 3. One MAC-CE activated joint TCI state per CC ~~[in a band] [in a band combination]~~ 4. ~~TCI state indication [mode]: update and activation [in case of updates] a)~~ MAC CE based TCI state indication ~~[for one active TCI state]~~ 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a | ~~FFS: how to count the MAC-CE activated joint TCI~~  Note: The MAC-CE activated joint TCI state(s) should include the activated joint TCI states for all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions | Optional with capability signalling | |
| Intel Corporation [14] | * + The brackets around “inter-cell” should be removed in the FG name   + In component 2, the WA should be confirmed, and the component should be per BWP per CC in a band   + Component 3 should be in a band   + In component 4, “in case of updates” is not needed and in 4a, the case is for single active TCI state and this part should be retained  |  |  |  |  | | --- | --- | --- | --- | | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra- ~~[~~and inter-cell~~]~~ beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. ~~WA:~~ The maximum number of configured joint TCI states ~~[~~per BWP per CC~~] [~~in a band~~] [in a band combination]~~ 3. One MAC-CE activated joint TCI state per CC ~~[~~in a band~~] [in a band combination]~~ 4. TCI state indication [~~mode]~~: update and activation ~~[in case of updates]~~ a) MAC CE based TCI state indication ~~[~~for one active TCI state~~]~~ 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band | FFS: how to count the MAC-CE activated joint TCI | |
| Qualcomm Incorporated [15] | ***Proposal 2-2***: For FG 23-1-1, suggest the following changes   * Different combinations of TCI types and intra/inter-cell BM should have different FGs, because communication can work with only 1 combination, e.g. joint TCI + intra-cell BM   + Separate FG for joint TCI + intra-cell BM   + Separate FG for joint TCI + inter-cell BM   + Separate FG for separate TCI + intra-cell BM   + Separate FG for separate TCI + inter-cell BM * For component 3, prefer in a band * For FFS on how to count activated TCI, we prefer to add the following note   + Note: Activated joint TCI state(s) include those activated by R17 signalling as well as by reusing R15/16 signalling |

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| 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. [The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS] 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination] 4. [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: [{2, …}]  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | Similar to proposal 2-3, for FG 23-1-1b, we support component 3 and prefer to introduce a new component 3a as follows.  ***Proposal 2-4: Remove the brackets in component 3, and introduce a new component 3a in FG 23-1-1b***   * + ***Component 3: The maximum number of MAC-CE activated joint TCI states per CC in a band in a band combination.***   + ***Component 3a: The maximum number of activated joint TCI states across all CCs in a band in a band combination***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. [The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS] 3. The maximum number of MAC-CE activated joint TCI states per CC ~~[~~in a band~~]~~ ~~[~~in a band combination~~]~~   3a. The maximum number of configured joint TCI states across all CCs in a band in a band combination  [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: [{2, …}]  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | Optional with capability signalling | |
| ZTE [3] | Then, we have the following comments for the remaining issues for FG 23-1-1b:   * Regarding component-2, the component has been agreed in RAN1#108-e, and the following candidate values can be added accordingly. * After that, we fail to understand the reason why need to introduce additional UE feature for component-4. The corresponding parameter can be indicated by FG 2-2 (PDSCH beam switching) well.  |  | | --- | | **Agreement**  The value range of beamAppTime-r17 is (1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336) symbols.   * Discuss the applicability of 84, 98, 112, 224, 336 for FR2/FR2-2 in UE features session   + These values are not applicable for FR1 |   ***Proposal 3:*** *For unified TCI for intra- and inter-cell beam management, the following modification in red is proposed.*   |  |  |  | | --- | --- | --- | | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- ~~[~~and inter-cell~~]~~ beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication ~~[~~mode~~]~~: update and activation ~~[in case of updates]~~ b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. ~~[~~The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS~~]~~   🡪 Candidate values: {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336}, where {84, 98, 112, 224, 336 } only can be indicated in FR2/FR2-2.   1. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination] 2. ~~[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]~~ | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | Regarding the name of FG 23-1-1 and FG 23-1-1b which should be basic features that enables Rel-17 unified TCI framework for both intra-cell and inter-cell beam management, we support to remove bracket for “[and inter-cell]” in the name of FG to confirm that this FG can enable basic functionalities for both intra- and inter-cell beam management for Unified TCI.  **Proposal 1:** Remove the bracket for “[and inter-cell]” in the name of FG to support functionalities for both intra- and inter-cell beam management on FG 23-1-1 and FG 23-1-1b.   |  | | --- | | 2. [The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS]  4. [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] |   Regarding Component 2 for FG 23-1-1b as above, we support the component for minimum beam activation latency (Y symbols). The candidate values for the minimum Y per SCS can be discussed further. Note that Y is configurable by the NW. Regarding Component 4 for FG 23-1-1b as above, since there is no corresponding agreement in RAN1, we don’t see any necessity.  **Proposal 3:** Support Component 2 for FG 23-1-1b, i.e., “[The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS]”, and the candidate values per SCS can be discussed further.  **Proposal 4:** Delete Component 4 for FG 23-1-1b, i.e., “[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]”.   |  | | --- | | 1. TCI state indication [mode]: update and activation [in case of updates]b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The maximum number of MAC-CE activated joint TCI states across per CC [in a band] [in a band combination] |   Regarding the Components 1 and 3 for FG 23-1-1b as above, a UE that supports Rel-17 unified TCI framework should support at least 4 activated TCI states by MAC-CE+DCI-based TCI indication with and without DL assignment for both intra-cell and inter-cell beam management (as a basic feature).  **Proposal 5:** On TCI state indication and maximum number of MAC-CE activated joint TCI states:   * As a Rel-17 TCI basic feature, support 4 activated TCI states by MAC-CE+DCI-based TCI indication with and without DL assignment for both intra-cell and inter-cell beam management. |
| OPPO [7] |  |
| Ericsson [8] | For FG 23-1-1b, there is some yellow remaining highlighting on the definition of beam application time. RAN1 has spent a lot of time to define the beam application time, and component 2 is consistent with the RAN1 agreement. Component 4 is irrelevant – there is no need for such a component. Also in this case, most of the remaining brackets seem unnecessary:   |  | | --- | | 1. TCI state indication ~~[mode]~~: update and activation ~~[in case of updates]~~  b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. ~~[~~The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS~~]~~ 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination] 4. ~~[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]~~ |   For several of the FGs, there is a note on what FGs need to be part of the basic functionality. On this aspect, we propose   1. The following FGs in the 23-1-1- family are part of the basic functionality: FG 23-1-1, FG 23-1-1b, FG 23-1-1d, and FG 23-1-1f.  |  |  |  | | --- | --- | --- | | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication ~~[mode]~~: update and activation ~~[in case of updates]~~  b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. ~~[~~The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS~~]~~ 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination]   ~~[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]~~ | |
| LG Electronics [9] | * Component 2: This FG was agreed, so we suggest to remove the brackets. For the description of the component, it should be changed as ‘The minimum beam application time in Y symbols per SCS’ since the definition of Y symbols is not the offset between PUCCH of ACK and the first slot based on the agreement below.   **Agreement**  On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot to apply the indicated TCI is at least Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.   * Note: The Y symbols are configured by the gNB based on UE capability, which is also reported in units of symbols.   For the component 2 candidate values, adopt the agreed value range of BAT and the applicability of some values for FR2/FR2-2 can be discussed further as below  **Agreement**  The value range of beamAppTime-r17 is (1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336) symbols.   * Discuss the applicability of 84, 98, 112, 224, 336 for FR2/FR2-2 in UE features session   + These values are not applicable for FR1 * Component 4: Component 2 seems sufficient and we see no need to define this component   **Proposal 2: Adopt the following table for 23-1-1b.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time in Y symbols per SCS 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination] | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: (1, 2, 4, 7, 14, 28, 42, 56, 70, [84, 98, 112, 224, 336]) symbols  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS 3. The maximum number of MAC-CE activated joint TCI states per CC in a band 4. [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {14, 28, 42, 56, 70}  Component 3 candidate values: {2, 3, 4, 5, 6, 7, 8}  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1b, we have the following suggestion:   * FG23-1-1b should include both intra-and inter cell. It is not necessary to report the same set of capabilities for intra cell and inter cell separately. * Component 1: We don’t have strong view on “[mode]”, but we can simply say as “TCI state indication for update and activation”. * Component 2: We agree to have component 2. Beam application timing is counted from HARQ-ACK, which is already specified as higher layer parameter *BeamAppTime\_r17*, and its value range is agreed as {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336} symbol in RAN1#108e. We can use the agreed value range for value range of component 2. We can clarify “ 84, 98, 112, 224, 336” are only for FR2/FR2-2.  |  | | --- | | **Agreement** (RAN1#108e)  The value range of beamAppTime-r17 is (1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336) symbols.   * Discuss the applicability of 84, 98, 112, 224, 336 for FR2/FR2-2 in UE features session   + These values are not applicable for FR1 |  * Component 3: We don’t believe reporting “per band combination” is necessary. * Component 4: We believe we should remove component 4. The main intention of the agreement in RAN1#105e is to agree time gap between HARQ-ACK and beam application timing. It also mentions the time gap between PDCCH and beam application timing, however, it is just a note, and our understanding of the note is the Rel.15 UE capability of *timeDurationForQCL*. The Rel.15 UE capability of *timeDurationForQCL* is only reported in FR2, hence we don’t need to care about the time gap between PDCCH and beam application timing, because Rel.15-16 does not have such a time gap in FR1. Moreover, if UE has concern of the short time gap, UE can simply report the large value by component 2. Hence, there is no need to have component 4.  |  | | --- | | Agreement (RAN1#105e)  On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot that is at least X ms or Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.   * Note: The gap between the last symbol of the beam indication DCI and that first slot shall satisfy the UE capability * FFS: Application time and whether additional offset is needed for the application time in case of cross carrier beam indication and common TCI state ID update across a set of configured CCs if CCs have different SCSs * FFS: Whether inter-cell beam switching needs higher X/Y values than intra-cell * FFS: Whether application time can be indicated/determined dynamically for different scenarios, e.g. cross CC, inter-cell, inter-panel without reverting previous RAN1 agreements |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication for update and activation b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS 3. The maximum number of MAC-CE activated joint TCI states per CC in a band | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336}  Note: values larger than 70 is FR2/FR2-2 only.  Component 3 candidate values: [{2, …}]  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] | Given the current structure of unified TCI update FGs, the following can be considered:  **Proposal:**   * **Confirm 23-1-1 and 23-1-1b as applicable for both intra-cell and inter-cell updates.** |
| MediaTek Inc. [13] | On component 1 in current FG 23-1-1b, the main bullet is redundant thus can be removed, and the two sub-bullets can be modified as two individual components.   * ~~1. TCI state indication [mode]: update and activation [in case of updates]~~ ~~b)~~ 1. MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) ~~c)~~ 2. MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)   On component 2 in current FG 23-1-1b, the wording is incorrect. The definition of Y symbols is not the offset between PUCCH of ACK and the first slot. In order to avoid confusion, we suggest the following change:   * 2. The minimum configured BeamAppTime\_r17 ~~beam application time between PUCCH of ACK and the first slot in Y symbols~~ per SCS  |  | | --- | | **Agreement**  On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot to apply the indicated TCI is at least Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.   * Note: The Y symbols are configured by the gNB based on UE capability, which is also reported in units of symbols. |   On component 3 in current FG 23-1-1b, since the component is already agreed to be reported per CC, “in band” and “in a band combination” are not needed. We suggest the followings:   * 3. The maximum number of MAC-CE activated joint TCI states per CC ~~[in a band] [in a band combination]~~   On component 4 in current FG 23-1-1b, some companies mentioned that this one is captured by the following agreement:   |  | | --- | | **Agreement**  On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot that is at least X ms or Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.   * + Note: The gap between the last symbol of the beam indication DCI and that first slot shall satisfy the UE capability |   However, it is just a note to clarify the gap between the last symbol of the beam indication DCI and that first slot shall satisfy the UE capability captured in component 2, as shown in the following figure, instead of introducing a UE capability (note that it is a “note”).  圖片1  **Figure 1. The gap between the last symbol of the beam indication DCI and that first slot always satisfies the UE capability**  **Proposal 2: On FG 23-1-1b, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. ~~TCI state indication [mode]: update and activation [in case of updates] b)~~ MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) 2. ~~c)~~ MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 3. ~~[~~The minimum configured BeamAppTime\_r17 ~~beam application time between PUCCH of ACK and the first slot in Y symbols~~ per SCS~~]~~ 4. The maximum number of MAC-CE activated joint TCI states per CC ~~[in a band] [in a band combination]~~ 5. ~~[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]~~ | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component ~~3~~ 4 candidate values: [{2, …}]  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5  Note: The MAC-CE activated joint TCI state(s) should include the activated joint TCI states for all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions | Optional with capability signalling | |
| Intel Corporation [14] | * + For component 1, it should be written as: “TCI state indication: update and activation”   + For component 2, the brackets should be removed   + For component 3, it should be per band   + The last unnumbered component for time gap seems redundant and should be removed  |  |  |  |  | | --- | --- | --- | --- | | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication ~~[mode]~~: update and activation ~~[in case of updates]~~ b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. ~~[~~The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS~~]~~ 3. The maximum number of MAC-CE activated joint TCI states per CC ~~[~~in a band~~] [in a band combination]~~ 4. ~~[The minimum time gap between the beam indication PDCCH and first slot where beam is applied]~~ | Component 3 candidate values: [{2, …}]  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5 | |
| Qualcomm Incorporated [15] | ***Proposal 2-3***: For FG 23-1-1b, suggest the following changes   * Prefer separate FG for inter-cell+ * For component 3, prefer in a band * Prefer to add the following note   + Note: Activated joint TCI state(s) include those activated by R17 signalling as well as by reusing R15/16 signalling |

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| 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  [2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR] |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | To reflect UE processing capability on number of CCs with beam failure recovery running, there needs to be a UE feature on maximum number of CCs on which spCell/SCell in Rel-15/16 under Rel-17 unified TCI framework can be configured. We then propose the following:  ***Proposal 2-5: Remove all the brackets in component 2 in FG 23-1-1c as follows***   * + ***Component 2: Maximum number of CCs configured with SCell BFR with unified TCI framework in a band with SpCell BFR, with candidate values {1, 2, 3, 4, …, FFS}***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  ~~[~~2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR~~]~~ |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| ZTE [3] | Then, we have the following comments for the remaining issues for FG 23-1-1c:   * Regarding component-2, we do not identify the necessity of this component, considering that we have already specified well the FGs for SCell and PCell-BFR.   ***Proposal 4:*** *For unified TCI for intra- and inter-cell beam management, the following modification in red is proposed.*   |  |  |  | | --- | --- | --- | | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  ~~[2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR]~~ | |
| Vivo [4] | For FG 23-1-1c, in Rel-17 unified TCI framework, PCell and SCell BFR are both supported and specified. The following UE capability for supporting PCell BFR with unified TCI framework should be included in this FG since for FR1 this feature is not mandatory.   1. Support independent FG for PCell BFR.  |  |  |  |  | | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1o | PCell BFR with unified TCI framework | 1. Support of PCell BFR with unified TCI framework | |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | For FG 23-1-1c, there is a strange component, which proposes to introduce a limitation on the total number of CCs configured with BFR. For this component, there is no relation to the Rel-17 TCI framework. The motivation that was brought forward was that this component would change the interpretation of a Rel-16 feature. This will not work: the NW will not check Rel-17 UE features to enable Rel-16 features. If necessary, a Rel-16 CR could be considered. In any case, component 2 should be removed:   |  | | --- | | 1. Support of SCell BFR with unified TCI framework  ~~[2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR]~~ |  |  |  |  | | --- | --- | --- | | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  ~~[2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR]~~ | |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  2. Maximum number of CCs configured with SCell BFR with unified TCI framework in a band with SpCell BFR |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {0, 1, 2, 4} | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1c, we have the following suggestion:   * Component 2: We don’t think the component 2 is needed, because we don’t need to repeat UE capabilities of all Rel.16 features by Rel.17 UE capability. Meanwhile, we can accept to have component 2. For“ [in a band with SpCell BFR]”, we understand Rel.16 issue if UE reports the number of CCs for SCell BFR as X, it means UE needs to support X+1 BFR in a band with SpCell, because gNB may configure both SCell BFR and SpCell BFR in the same band. However, if we agree with “in a band with SpCell BFR”, it is not clear the value of “in a band without SpCell BFR”. Considering that the issue already exist in Rel.16, we can simply remove [in a band with SpCell BFR]. If this is controversial, we simply suggest to remove component 2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  2. Maximum number of CCs configured with SCell BFR with unified TCI framework |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * + Component 2 should be same as legacy, and we don’t see the need to introduce this for unified TCI framework and should be deleted.  |  |  |  |  | | --- | --- | --- | --- | | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  ~~[2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR]~~ |  | |
| Qualcomm Incorporated [15] | ***Proposal 2-4***: For FG 23-1-1c, prefer to keep component 2 |

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| 23. NR\_FeMIMO | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 | Yes |  | Per BWP TCI state pool configuration for CA mode is not supported | Per band | n/a | n/a | n/a | FFS: A UE that supports 23-1-1 together with CA must indicate this FG is supported] | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | For FG 23-1-d, there is an FFS on if a UE needs to support 23-1-1d if it supports 23-1-1, i.e., if it’s part of the basic support of the unified TCI. Support of TCI states per CC is part of the basic support in Rel-15, and should remain also for Rel-17:   1. A UE that supports 23-1-1 must also support 23-1-1d.   For several of the FGs, there is a note on what FGs need to be part of the basic functionality. On this aspect, we propose   1. The following FGs in the 23-1-1- family are part of the basic functionality: FG 23-1-1, FG 23-1-1b, FG 23-1-1d, and FG 23-1-1f.  |  |  |  | | --- | --- | --- | | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | |
| LG Electronics [9] |  |
| Apple [10] | * We have strong concern to mandate UE to report FG 23-1-1d, which mandates UE to report more than 1 TCI state pools, since this reverts previous agreement as follows.  |  | | --- | | **Agreement**  On Rel.17 unified TCI framework, confirm the following working assumption as an agreement with a minor refinement highlighted in red  For common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of [configured] CCs/BWPs:   * RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC as in Rel-15/16   + Note: Such RRC-configured TCI state pool(s) configuration doesn’t imply that separate DL/UL TCI state pool is excluded or supported * RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC, and replaced with a reference to RRC-configured TCI state pool(s) in a reference BWP/CC   + In the PDSCH configuration (*PDSCH-Config*) of the reference BWP/CC, RRC-configured TCI state pool(s) shall be configured   + For a BWP/CC where the PDSCH configuration contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC, the UE applies the RRC-configured TCI state pool(s) in the reference BWP/CC * When the BWP/CC ID (i.e. *bwp-Id* or *cell*) for QCL-Type A/D source RS in a *QCL-Info* of the TCI state is absent, the UE assumes that QCL-Type A/D source RS is in the BWP/CC to which the TCI state applies * Introduce a UE capability to report maximum number of TCI state pools it can support across BWPs and CCs in a band, and the candidate value at least includes 1 * FFS: Introduce a UE capability to report maximum number of configured TCI states that it can support across BWPs and CCs in a band * FFS: How to define reference BWP/CC |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 | Yes |  | Per BWP TCI state pool configuration for CA mode is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1d/23-1-1e, we have the following suggestion:   * As we commented in RAN1#108e, we believe it is important to make basic function that all UE support. Considering that we have the following agreement that UE capability of the max number of TCI state pools, we believe we should make FG23-1-1e as basic function. * Component 2 of FG23-1-1e, we don’t believe multiple TCI state pools can be configured for FG23-1-1e, and UE only need to report “1”. Hence, we believe component 2 can be removed.  |  | | --- | | **Agreement (RAN1#106e)**  On Rel.17 unified TCI framework, confirm the following working assumption as an agreement with a minor refinement highlighted in red  For common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of [configured] CCs/BWPs:   * RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC as in Rel-15/16   + Note: Such RRC-configured TCI state pool(s) configuration doesn’t imply that separate DL/UL TCI state pool is excluded or supported * RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC, and replaced with a reference to RRC-configured TCI state pool(s) in a reference BWP/CC   + In the PDSCH configuration (*PDSCH-Config*) of the reference BWP/CC, RRC-configured TCI state pool(s) shall be configured   + For a BWP/CC where the PDSCH configuration contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC, the UE applies the RRC-configured TCI state pool(s) in the reference BWP/CC * When the BWP/CC ID (i.e. *bwp-Id* or *cell*) for QCL-Type A/D source RS in a *QCL-Info* of the TCI state is absent, the UE assumes that QCL-Type A/D source RS is in the BWP/CC to which the TCI state applies * Introduce a UE capability to report maximum number of TCI state pools it can support across BWPs and CCs in a band, and the candidate value at least includes 1 * FFS: Introduce a UE capability to report maximum number of configured TCI states that it can support across BWPs and CCs in a band * FFS: How to define reference BWP/CC |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 | Yes |  | Per BWP TCI state pool configuration for CA mode is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * + The FFS in the note should be assumed since this is similar to legacy operation  |  |  |  |  | | --- | --- | --- | --- | | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | ~~FFS:~~ A UE that supports 23-1-1 together with CA must indicate this FG is supported~~]~~ | |
| Qualcomm Incorporated [15] | ***Proposal 2-5***: For FG 23-1-1d, suggest the following changes   * Prefer to agree on the FFS, i.e. A UE that supports 23-1-1 together with CA must indicate this FG is supported |

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| 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: FFS  FFS: A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [2] | As one band can belong to more than one BC, it is more flexible to add “per BC” restriction in component 2 in FG 23-1-1e.  ***Proposal 2-2: Add “per BC” restriction in component 2 in FG 23-1-1e as follows,***   * + ***Component 2: The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band in a band combination.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band in a band combination. | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: FFS  FFS: A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling | |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | The corresponding FFS exists for 23-1-1e, but this is related to the new reference CC feature. In contrast to 23-1-1d, this is new functionality which should be optional:   1. FG 23-1-1d is optional, and a UE that supports 23-1-1 may or may not support 23-1-1e.  |  |  |  | | --- | --- | --- | | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8}  FFS: A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1d/23-1-1e, we have the following suggestion:   * As we commented in RAN1#108e, we believe it is important to make basic function that all UE support. Considering that we have the following agreement that UE capability of the max number of TCI state pools, we believe we should make FG23-1-1e as basic function. * Component 2 of FG23-1-1e, we don’t believe multiple TCI state pools can be configured for FG23-1-1e, and UE only need to report “1”. Hence, we believe component 2 can be removed.  |  | | --- | | **Agreement (RAN1#106e)**  On Rel.17 unified TCI framework, confirm the following working assumption as an agreement with a minor refinement highlighted in red  For common TCI state ID update and activation to provide common QCL information at least for UE-dedicated PDCCH/PDSCH and/or common UL TX spatial filter(s) at least for UE-dedicated PUSCH/PUCCH across a set of [configured] CCs/BWPs:   * RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC as in Rel-15/16   + Note: Such RRC-configured TCI state pool(s) configuration doesn’t imply that separate DL/UL TCI state pool is excluded or supported * RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (*PDSCH-Config*) for each BWP/CC, and replaced with a reference to RRC-configured TCI state pool(s) in a reference BWP/CC   + In the PDSCH configuration (*PDSCH-Config*) of the reference BWP/CC, RRC-configured TCI state pool(s) shall be configured   + For a BWP/CC where the PDSCH configuration contains a reference to the RRC-configured TCI state pool(s) in a reference BWP/CC, the UE applies the RRC-configured TCI state pool(s) in the reference BWP/CC * When the BWP/CC ID (i.e. *bwp-Id* or *cell*) for QCL-Type A/D source RS in a *QCL-Info* of the TCI state is absent, the UE assumes that QCL-Type A/D source RS is in the BWP/CC to which the TCI state applies * Introduce a UE capability to report maximum number of TCI state pools it can support across BWPs and CCs in a band, and the candidate value at least includes 1 * FFS: Introduce a UE capability to report maximum number of configured TCI states that it can support across BWPs and CCs in a band * FFS: How to define reference BWP/CC |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * + The reference BWP support can be an optional feature and hence the 2nd FFS in the note should not be needed   + For component 2, up to K=4 should be supported by UE. An option could be to support K where the component value of K is reported but we think K=4 can be supported.  |  |  |  |  | | --- | --- | --- | --- | | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | Component 2 candidate values: FFS  ~~FFS: A UE that supports 23-1-1 together with CA must support this FG]~~ | |
| Qualcomm Incorporated [15] | ***Proposal 2-6***: For FG 23-1-1e, prefer to delete the FFS, i.e. make this FG as optional |

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| 23. NR\_FeMIMO | 23-1-1f | Common multi-CC TCI state ID update and activation | Common multi-CC TCI state ID update and activation | 23-1-1 | Yes |  | Common multi-CC TCI state ID update and activation is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | For several of the FGs, there is a note on what FGs need to be part of the basic functionality. On this aspect, we propose   1. The following FGs in the 23-1-1- family are part of the basic functionality: FG 23-1-1, FG 23-1-1b, FG 23-1-1d, and FG 23-1-1f. |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a | FFS: FR2 only | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | Regarding the description of FG 23-1-1g, we do not support to include beam alignment related parameters/proposals for PLRS until we have a RAN1 agreement.  **Proposal 2:** Do not support FG 23-1-1g without the corresponding RAN1 agreement. |
| OPPO [7] |  |
| Ericsson [8] | In FG 23-1-1g, there is an FFS on the applicability in FR1. Clearly, a spatial relation is only relevant in FR1, but it is not clear to us why the note is needed. There is no need for the UE to report it, and even if the UE reports that it supports beam misalignment in FR1, the NW will ignore the reported capability. |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling | |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a | FR2 only | Optional with capability signaling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | Yes |  | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS is not supported | Per band | n/a | n/a | n/a | [Note: A UE that supports FG 23-1-1 must indicate this FG is supported] | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | For FG 23-1-1h, there is a note in brackets if 23-1-1h is part of the basic functionality. Here we do not see that this is needed:   1. FG 23-1-1h is optional, and a UE that supports 23-1-1 may or may not support 23-1-1h. |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | Yes |  | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1h/23-1-1i/23-1-1j, we are fine to remove [ ].   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | Yes |  | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS is not supported | Per band | n/a | n/a | n/a | Note: A UE that supports FG 23-1-1 must indicate this FG is supported | Optional with capability signaling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | On FG 23-1-1h, we see this can be supported as basic functionality of unified TCI framework. Thus, we suggest to remove the brackets from the note.  **Proposal 3: On FG 23-1-1h, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | Yes |  | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS is not supported | Per band | n/a | n/a | n/a | ~~[~~Note: A UE that supports FG 23-1-1 must indicate this FG is supported~~]~~ | Optional with capability signaling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 2-7***: For FG 23-1-1h, suggest to delete the blue note. |

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| 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication  [A UE that supports 23-1-1 must indicate this FG is supported] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | In FG 23-1-1i, the open issues regarding SRS configuration have been resolved, and the brackets in 23-1-1i can be removed:   |  | | --- | | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[~~, and SRS~~]~~ (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) |   Also, there is a note in FG 23-1-1i that discusses if 23-1-1i should be part of the basic functionality. Here we do not see that this is needed.   |  |  |  | | --- | --- | --- | | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[~~, and SRS~~]~~ | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[~~, and SRS~~]~~ (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-1-1i-1 | Indication/configuration of R17 TCI states for SRS | Support of indication/configuration of R17 TCI states for SRS based on separate MAC CE | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1h/23-1-1i/23-1-1j, we are fine to remove [ ].   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH , and SRS | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH , and SRS (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH , and SRS reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication  A UE that supports 23-1-1 must indicate this FG is supported | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | On FG 23-1-1i, we prefer to separate SRS as a new FG since UE may have different capabilities to support DL and UL. Meanwhile, this should not be a basic functionality of unified TCI framework.  **Proposal 4: On FG 23-1-1i, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | ~~Note: This has no impact on detail signaling design for SRS TCI indication~~  ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling |   **Proposal 5: Introduce the following new FG:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1k | Indication/configuration of R17 TCI states for SRS | Support of indication/configuration of R17 TCI states for SRS (except for periodic/semi-persistent SRS for BM) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for SRS reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 2-8***: For FG 23-1-1i, suggest to delete the blue note |

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| 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | [A UE that supports 23-1-1 must indicate this FG is supported] | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] | 1. Update FG 23-1-1j as follows.  |  |  |  |  | | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 [and the respective PDSCH] reception reusing the Rel-15/16 signaling/configuration design(s) | |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-1h/23-1-1i/23-1-1j, we are fine to remove [ ].   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | A UE that supports 23-1-1 must indicate this FG is supported | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | On FG 23-1-1j, this should not be a basic functionality of unified TCI framework.  **Proposal 6: On FG 23-1-1j, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 2-9***: For FG 23-1-1j, suggest to modify the blue note as A UE that supports inter-cell BM must indicate this FG is supported |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K[=4] SSBRI-RSRP [pairs/beams] in one report [where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported] (FFS: if K is a component candidate value)  3. The maximum number of [RRC-configured] PCI(s) different from serving cell PCI for L1-RSRP measurement] (FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI [across all CC]  [5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI [across all CC]]  [6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]  [7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]  [8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}]  [9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement] | [2-24, 2-29] | Yes |  | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] is not supported | per band | n/a | n/a | n/a | [Note: Whether component 4 and/or 5 are also counted in FG16-1g/16-1g-1] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***Inter-cell measurement and reporting***  As discussed in RAN1#106bis-e, regarding the number of configured additional PCIs (PCI different from serving cell PCI) for beam measurement, it is agreed that two independent X values (X1 and X2) are reported as UE capability for two different assumptions on additional SSB time domain position and periodicity with respect to serving cell SSB. In addition, it was agreed that this UE capability has FR1 and FR2 differentiation. It has been agreed that from RRC signaling perspective, the number of configured additional PCIs can be {1, 2, 3, 4, 5, 6, 7}.  Currently, UE capabilities (X1 and X2) corresponding to the number of configured additional PCIs are only included in FG23-4 (i.e., FG for inter-cell MTRP operation). There is a concern that if UE support inter-cell beam management but does not support inter-cell MTRP operation, UE will not report the value of X1 and X2 and hence gNB cannot know the number of configured additional PCIs for beam measurement. Hence, we suggest introducing two dedicated components in 23-1-2 for UE to reporting the number of configured additional PCIs for beam measurement.  For the number of configured additional PCIs for inter-cell beam management (component 10 and 11 in FG 23-1-2) and the number of configured additional PCIs for inter-cell MTRP operation (component 2 and 3 in FG 23-4), UE can report one of them or both of them. If only one of them is reported, it can be used for both inter-cell beam management and inter-cell MTRP operation.  ***Proposal 2-6: Introduce two components (component 10 and component 11 as follows) in FG 23-1-2 for the reporting of X1/X2 for inter-cell beam management.***   * + ***Component 10: The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI;***   + ***Component 11: The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI;***   ***Note: For the number of configured additional PCIs for inter-cell beam management (component 10 and 11 in FG 23-1-2) and the number of configured additional PCIs for inter-cell MTRP operation (component 2 and 3 in FG 23-4), UE can report one of them or both of them. If only one of them is reported, it can be used for both inter-cell beam management and inter-cell MTRP operation.***  Regarding the number of SSBs with PCI(s) different from serving cell PCI for L1 beam measurement, to keep the memory consumption and computing complexity at UE under control, and also to put a limit on total number of SSB resources with PCI(s) same as or different from serving cell PCI, we propose the following:  ***Proposal 2-7: Remove the brackets in component 4/5 in FG 23-1-2 as follows***   * + ***Component 4: The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CCs.***   + ***Component 5: The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI across all CCs.***   Inter-cell L1 measurement and inter-cell L3 measurement can be based the same SSB or different SSB. If they are based on different SSB, additional complexity will be introduced. Hence, it is reasonable to have a UE capability for this. Hence, we suggest supporting component 6 and remove the bracket.  ***Proposal 2-8: Remove the bracket in component 6 in FG 23-1-2.***   * + ***Component 6: Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement.***   In current spec, the total number of resources used for all kinds of DL measurements, including beam management, pathloss measurement, BFD, RLM and new beam identification is reported with UE capability FG 16-1g/16-1g-1. As inter-cell beam management is also a kind of DL measurement. So, the number of resources for inter-cell beam management should be counted into FG 16-1g/16-1g-1. Hence we suggest adding a note for this.  ***Proposal 2-9: Add a note in FG 23-1-2: Components 4 and 5 are also counted in FG 16-1g/16-1g-1.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K[=4] SSBRI-RSRP [pairs/beams] in one report [where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported] (FFS: if K is a component candidate value)  3. The maximum number of [RRC-configured] PCI(s) different from serving cell PCI for L1-RSRP measurement] (FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]~~  ~~[~~5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]]~~  ~~[~~6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement~~]~~  [7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]  [8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}]  [9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]  10. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  11. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | [2-24, 2-29] | Yes |  | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] is not supported | per band | n/a | n/a | n/a | ~~[~~Note: ~~Whether~~ component 4 and~~/or~~ 5 are also counted in FG16-1g/16-1g-1~~]~~ | Optional with capability signalling | |
| ZTE [3] | **Inter-cell measurement and reporting (for inter-cell BM and mTRP)**  Firstly, based on already agreement, the maximum value of supported K is a UE capability, and then the corresponding candidate value should be provided, e.g., {1, 2, 4} as legacy beam reporting.  After that, we have the following comments for other potential UE features captured by the moderator.   * Regarding the basic feature, in our views, component 1~5 can be considered. To be more specific, the component-3 should be considered as the maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement per CC in a band, and thus this feature can report individual values for FR1 and FR2, which implies that this component should be indicated per band at least. Then, this parameter is just relevant to RRC CSI-SSB resource set configuration, and we do not need to consider time domain behavior for measurement/report. * Regarding component 6 (relationship between L1 and L3 measurement), we think that, based on the gNB configuration for this L1 inter-cell measurement (as intra-cell beam measurement), we do not identify the relationship. * Regarding component 7, 8, and 9, if needed, RAN4 can request some related UE feature to RAN2 directly.   ***Proposal 5:*** *For inter-cell measurement and reporting (for inter-cell BM and mTRP), the following modification is proposed in red*   * *Components-{1, 2, 3, 4, 5} should be supported as a basic feature.*  |  |  |  | | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting ~~[~~(for inter-cell BM [and mTRP])~~]~~ | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K~~[=4]~~ SSBRI-RSRP [pairs/beams] in one report ~~[~~where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported~~] (FFS: if K is a component candidate value)~~  🡪 Candidate values: {1, 2, 4}.  3. The maximum number of ~~[~~RRC-configured~~]~~ PCI(s) different from serving cell PCI for L1-RSRP measurement in a band ~~(FFS: whether to split this for FR1 and FR2)~~ ~~(FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)~~  🡪 Candidate values: {1, 2, 3, 4, 5, 6, 7}.  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]~~ in a band  ~~[~~5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]]~~ in a band  ~~[6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]~~  ~~[7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]~~  ~~[8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}]~~  ~~[9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]~~ | |
| Vivo [4] | 1. For FG 23-1-2 on the inter-cell beam measurement/report, suggest considering the following changes.  * Suggest removing the bracket on “for both inter-cell BM and mTRP”, since the measurement should be applicable to both scenarios. * For component 2, suggest removing THE“at least one [pair/beam]”, since beam selection and report rule is up to UE implementation, no need to be specified. * For component 3, prefer to have different reported numbers of RRC configured PCI(s) for L1-RSRP measurement associated with periodic, aperiodic, and semi-persistent reporting in FR1 and FR2, respectively. * For component 4, 5, suggest removing the bracket on “across all CC”. * For component 6, 7, suggest deleting the component since the measurement is always outside SMTC. * For component 4,5, they should be counted in FG16-1g/16-1g-1, since an inter-cell L1-RSRP measurement is still an L1-RSRP measurement. * For component 8, 9, suggest combining the two components and keeping 8. The bracket of component 8 can be removed since the non-overlapped measurement resources would be simpler than overlapped cases from the UE perspective. * Additionally, to improve the DL resource efficiency, simultaneous reception of PDCCH/PDSCH and SSBs for L1-RSRP measurement on the same REs should be supported by UE. Otherwise, in addition to serving cell SSBs, the PDCCH/PDSCH also needs to be rate matched around the SSBs configured for inter-cell L1-RSRP measurement. Therefore, a new feature group is introduced in FG 23-1-2a.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting ~~[(~~for inter-cell BM ~~[~~and mTRP~~])]~~ | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K~~[=4]~~ SSBRI-RSRP [pairs/beams] in one report ~~[~~where ~~at least one~~ [pair/beam] associated with a PCI different from serving cell PCI can be reported~~]~~ (FFS: if K is a component candidate value)  3. The maximum number of [RRC-configured] PCI(s) different from serving cell PCI for L1-RSRP measurement] (FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]~~  [5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]~~]  ~~[6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]~~  ~~[7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]~~  [8. Supported mode of measurement over ~~overlapped~~SSBs: {non-overlapped, both overlapped and non-overlapped}]  ~~[9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]~~ | [2-24, 2-29] | Yes |  | ~~Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] is not supported~~ | per band | n/a | n/a | n/a | [Note: Whether component 4 and/or 5 are also counted in FG16-1g/16-1g-1~~]~~ | Optional with capability signalling | | 23. NR\_FeMIMO | 23-1-2a | simultaneous reception of PDSCH/PDCCH and SSB on the same RE | 1. support simultaneous reception of PDCCH/PDSCH and SSBs for inter-cell L1-RSRP measurement on the same REs |  |  |  |  | per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Xiaomi [5] |  |
| Samsung [6] | Regarding FG 23-1-2, this feature should cover both inter-cell beam measurement and reporting. Since the components which are relevant to inter-cell beam management are already included in FG 23-1-1, we would like to rename this feature to support of inter-cell beam measurement and reporting.  **Proposal 7:** Rename FG 23-1-2 as “Inter-cell beam measurement and reporting”. |
| OPPO [7] |  |
| Ericsson [8] | In FG 23-1-2, the inter-cell beam measurements are discussed, and several components are still highlighted.  The first highlighting is related to the name of the FG: should it be for inter-cell beam management only, or should inter-cell mTRP be included in the same FG? Here we propose to include both use cases in the same FG:   1. FG 23-1-2 includes both inter-cell BM and inter-cell mTRP.   The benefit of component 2 is that it could indicate the maximum number of beams that can be included in the RSRP report. However, the actual reporting of an inter-cell beam measurement is not more complicated than an intra-cell beam measurement, which is described by the intra-cell reporting beam reporting feature ***maxNumberNonGroupBeamReporting.*** Hence, component 2 can be reformulated:  2. Support of up to K~~[=4]~~ SSBRI-RSRP ~~[~~pairs~~/beams]~~ in one report ~~[~~where at least one ~~[~~pair~~/beam]~~ is associated with a PCI different from serving cell PCI can be reported~~]~~ ~~(FFS: if K is a component candidate value)~~ K is equal to ***maxNumberNonGroupBeamReporting***  For component 3, there are two FFSs: whether to split for FR1/FR2 and if to split for different types of reporting. Since the capability is reported per band, the FR1/FR2 differentiation exists automatically, and that FFS can be removed. Regarding the reporting type (periodic/aperiodic/semi-persistent), any potential difference in complexity would be captured by the general reporting capabilities, e.g., ***csi-ReportFramework.*** Hence, the second FFS can also be removed.  Component 5 proposes to limit the number of SSB resources that can be configured for inter-cell beam measurements. The target is to limit memory consumption of the UE.  The current assumption is that one *additionalPCIIndex-r17* is configured for every SSB in a *CSI-SSB-ResourceSet.* Hence, the UE would at most be configured with 3 additional bits for SSB index for other PCIs.The additional memory that the UE needs for this purpose would thus be insignificant. Hence, we propose   1. Component 5 in FG 23-1-2 is removed, since the additional memory required is marginal.   The idea with component 6 is to define a baseline mode of operation where only the PCIs that are configured for L3 mobility measurements can be reported in an inter-cell beam report. In this baseline mode of operation, the UE could reuse the measurements it anyway performs for L3 mobility and report only those over L1. However, the default operation in NR (and LTE) is that the UE is not configured with specific PCIs for L3 mobility. Instead, the measurement object contains only an ARFCN, and the UE finds all the relevant PCIs. Since it is not clear how component 6 would be relevant for this normal configuration, we propose to remove component 6.   1. Remove component 6, since it is unclear how it would apply in case no PCIs are configured for L3 mobility measurements.   Regarding component 7, the input from RAN4 [2] is important: For FR2, RAN4 will not define requirements for inter-cell L1-RSRP measurements for the case when all the SSB of the cell with different PCI overlap with the SMTC window. For FR1, RAN4 will define requirements for any SSB-SMTC overlaps.  For almost all NR deployments, the SMTC window covers all SSB transmissions: it is a waste of resources to transmit SSBs that the UE is not able to measure. It is thus imperative to have support for that case. However, in FR2, the only measurement for which there will be requirements is the case where not all the SSBs overlap with the SMTC window. The important cases would thus be inside SMTC for FR1 and outside SMTC for FR2. To avoid fragmentation, we propose to remove the component.  All NR deployments rely on overlapping SSB transmissions: essentially it is assumed that all cells can transmit all SSBs. A UE that cannot perform measurements on overlapping SSBs would in practice not support inter-cell beam measurements. Hence, component 8 and 9 can be removed:   1. Component 8 and 9 in FG 23-1-2 can be removed since measurements on overlapping SSBs are required.   Since RAN4 assumes that the timing offset between the serving cell SSB and SSBs of a cell with another PCI is smaller than the CP, performing measurements is not associated with any significant additional complexity.  In summary, we propose the following modification of FG 23-1-2:   |  |  |  | | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting ~~[~~(for inter-cell BM [and mTRP])~~]~~ | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K~~[=4]~~ SSBRI-RSRP ~~[~~pairs~~/beams]~~ in one report ~~[~~where at least one ~~[~~pair~~/beam]~~ is associated with a PCI different from serving cell PCI can be reported~~]~~ ~~(FFS: if K is a component candidate value)~~ K is equal to ***maxNumberNonGroupBeamReporting***  3. The maximum number of ~~[~~RRC-configured~~]~~ PCI(s) different from serving cell PCI for L1-RSRP measurement] ~~(FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)~~  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI ~~[~~across all CC~~]~~  ~~[5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI [across all CC]]~~  ~~[6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]~~  ~~[7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]~~  ~~[8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}]~~  ~~[9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]~~ | |
| LG Electronics [9] | * FG description: ‘for inter-cell BM [and mTRP]’ seems redundant, so suggest to delete it. * Component 3: Remove the ‘FFS: whether to split this for FR1 and FR2’ since the number of additional PCIs for beam measurement can be typically common for FR1 and FR2.   Moreover, remove the brackets on ‘RRC configured’ as agreed in RAN1#106bis-e   * Component 4-9: We see no strong need for these components. Component 4 and 5 can be addressed by existing 16-1g or a new component for Rel-17 analogous to 16-1g, e.g. 23-5-1a.   **Proposal 3: Adopt the following table for 23-1-2.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K[=4] SSBRI-RSRP [pairs/beams] in one report [where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported] (FFS: if K is a component candidate value)  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement] (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement) | [2-24, 2-29] | Yes |  | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] is not supported | per band | n/a | n/a | n/a | [Note: Whether component 4 and/or 5 are also counted in FG16-1g/16-1g-1] | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP in one report  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC  5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI across all CC  6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement  9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement | [2-24, 2-29] | Yes |  | Inter-cell beam measurement and reporting [(for inter-cell BM [and mTRP])] is not supported | per band | n/a | n/a | n/a | Component 2 candidate value: {1, 2, 3, 4}  Component 3 candidate value: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate value: {1, 2, 4, 8}  Component 5 candidate value: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Component 9 candidate value: {0, 1, 2, 3, 4, 5, 6, 7}  Note: component 4 and/or 5 are also counted in FG16-1g/16-1g-1 | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-2, we have the following suggestion:   * Component 5/6/8/9: gNB cell-specifically transmit SSBs and the SSB location is determined to operate network for Rel.15 UEs. Even if Rel.17 UE has preference of SSB location of different cells, it is very difficult for gNB to change SSB location only for the Rel.17 UE. Hence, these components should be removed. * Pre-requisite as FG2-24/2-29: We don’t understand why we need the pre-requisite features only for FG23-1-2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K=4 SSBRI-RSRP pairs in one report where at least one pair can be associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI per CC  7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC} |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | [Note: Whether component 4 and/or 5 are also counted in FG16-1g/16-1g-1] | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] | One specific aspect of inter-cell TCI state updates are the related measurements. The following updates are proposed to FG23-1-2:   |  |  |  |  | | --- | --- | --- | --- | | 23-1-1n | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K=4 SSBRI-RSRP [pairs/beams] in one report ~~[where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported] (FFS: if K is a component candidate value)~~  3. The maximum number of [RRC-configured] PCI(s) different from serving cell PCI for L1-RSRP measurement] (FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI [across all CC]  ~~[5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI [across all CC]]~~  ~~[6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]~~  7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}  8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}   1. ~~[9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]~~ | [2-24, 2-29] | |
| MediaTek Inc. [13] | On component 3 in current FG 23-1-2, it should be clarified that the maximum number of additional PCIs for L1-RSRP measurement should be counted across all CCs or per CC, and prefer to count it across all CCs. Meanwhile, we don't see the need to have different values for different time domain behaviours of measurement. However, we prefer to have different reports for FR1 and FR2 since the implementation overhead could be different in FR1 and FR2.  **Proposal 9: On FG 23-1-2, adopt the following changes to component 3:**   * + **The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement across all CCs**   + **Separation for FR1 and FR2** |
| Intel Corporation [14] | * + This FG should apply to both inter-cell beam management and inter-cell mTRP   + Components 5-9 are not required  |  |  |  |  | | --- | --- | --- | --- | | 23-1-2 | Inter-cell beam measurement and reporting ~~[~~(for inter-cell BM [and mTRP])~~]~~ | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K~~[~~=4~~]~~ SSBRI-RSRP ~~[~~pairs~~/beams]~~ in one report ~~[~~where at least one [pair/beam] associated with a PCI different from serving cell PCI can be reported~~] (FFS: if K is a component candidate value)~~  3. The maximum number of ~~[~~RRC-configured~~]~~ PCI(s) different from serving cell PCI for L1-RSRP measurement] ~~(FFS: whether to split this for FR1 and FR2) (FFS: whether/how to capture different values/behaviors for periodic/aperiodic/semi-persistent L1-RSRP measurement)~~  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI ~~[across all CC]~~  [~~5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI [across all CC]]~~  ~~[6. Support on that SSB(s) with PCI(s) different from serving cell PCI configured for L1 beam measurement and report are not included in SSBs with PCIs configured for L3 mobility measurement]~~  ~~[7. Supported mode inter-cell measurement: {inside SMTC, both inside and outside SMTC}]~~  ~~[8. Supported mode of measurement over overlapped SSBs: {overlapped, both overlapped and non-overlapped}]~~  ~~[9. Maximum number of overlapped SSBs in one SSB resource for L1-RSRP measurement]~~ |  | |
| Qualcomm Incorporated [15] | ***Proposal 2-10***: For FG 23-1-2, suggest the following changes   * Clarify dependency field as 2-23 for UE supporting inter-cell BM, and 2-24 for UE supporting inter-cell mTRP * For component 2, prefer pairs * For component 3, prefer keep “RRC-configured” * Support the note to count component 4 and 5 in FG 16-1g/16/1g-1 |

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| 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced [PHR] reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | [MPE mitigation is not supported] | Per Band | n/a | n/a | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value [{8, 12, 16, 28, 32, 48, 64}]  Note: FR2 only | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | Based on the following agreement, the N P-MPR values and corresponding SSBRI(s)/CRI(s) can be reported in the PHR as in approved TS 38.321. Then, based on the following highlighted part, we need to further consider another new UE feature of maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation. As a candidate value, we think that the FFS part of ‘{8, 12, 16, 28, 32, 48, 64}’ should be supported.  ***Proposal 6:*** *For MPE mitigation, the following modification is proposed in red*   |  |  |  | | --- | --- | --- | | 23-1-3 | MPE mitigation | 1. Support of enhanced ~~[~~PHR~~]~~ reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation  🡪 Candidate value comprises {8, 12, 16, 28, 32, 48, 64}. | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | FG 23-1-3 describes enhancements to the P-MPR reporting. The basic capability would include support for a N (P-MPR,SSBRI/CRI) pairs in a new PHR MAC CE. The name of the FG is “MPE mitigation”, which is not really accurate: there are other means to perform MPE mitigation.  In addition to the naming of the feature, there are only small details to finish in this FG: a few brackets and candidate values. In the component description, we propose to remove the brackets:   |  | | --- | | 1. Support of enhanced ~~[~~PHR] reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |   For the name of the FG, we propose to describe what the feature does: “Enhanced PHR”, and the consequence if not supported would then simply be “Enhanced PHR not supported”:   1. Rename FG 23-1-3 “Enhanced PHR”, and update “consequence if not supported” accordingly.   Also, the candidate values for component 3 are highlighted. The proposed values seem sufficient: this would probably mean that all candidate RSs would be confined to the same cell: there are not enough candidate RSs to configure them in several cells. This is probably OK.  We propose the following changes:   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-1-3 | ~~MPE mitigation~~ Enhanced PHR | 1. Support of enhanced ~~[~~PHR~~]~~ reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | ~~[MPE mitigation is not supported]~~ Enhanced PHR is not supported | Per Band | n/a | n/a | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value ~~[~~{8, 12, 16, 28, 32, 48, 64}~~]~~  Note: FR2 only | |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced [PHR] reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | MPE mitigation is not supported | Per Band | n/a | FR2 only | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value {2, 4, 8, 12, 16, 28, 32, 48, 64}  Note: FR2 only | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-3, we have the following suggestion:   * Component 1: we support to keep the text “PHR” * Component 3: we support current candidate values.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced PHR reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | [MPE mitigation is not supported] | Per Band | n/a | n/a | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value {8, 12, 16, 28, 32, 48, 64}  Note: FR2 only | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] | * + - Component 3 candidate values: In order to enable the UE to find an new candidate beam, the pool of configured RS should be as large as possible to enable UE to find new candidate beams, i.e. 64 RS. |
| MediaTek Inc. [13] | On component 3 in current FG 23-1-3, the candidate RS resources for MPE mitigation should be counted in FG16-1g/16-1g-1 as well since they can be considered as BM RS. Then, we can confirm the candidate value for component 3. Regarding the consequence if the feature is not supported by the UE, it should be “Enhanced [PHR] reporting is not supported”.  **Proposal 10: On FG 23-1-3, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced [PHR] reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | ~~[MPE mitigation is not supported]~~  Enhanced [PHR] reporting is not supported | Per Band | n/a | n/a | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value ~~[~~{8, 12, 16, 28, 32, 48, 64}~~]~~  Note: FR2 only  Note: Component 3 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 2-11***: For FG 23-1-3, prefer to use P-MPR instead of PHR |

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| 23. NR\_FeMIMO | 23-1-4 | MPUE support for UL | 1. Supported UE capability value [sets] and corresponding max number of SRS ports for each UE capability value [set] |  | Yes |  | [MPUE support for UL is not supported] | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value [sets] each with one value of {[0,]1,2,4}  Note: the reported list contains only unique value [sets]  This FG is a working assumption | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107bis-e, the following FG has been introduce for MPUE report for UL.   * Based on RAN1 agreement, we have already agreed the terminology of ‘UE capability value set’, so we prefer to use the same terminology to aligned with already agreement and RAN1 spec * After that, based on the latest RAN1 agreement, introducing ‘0’ in the candidate value set has been precluded.   ***Proposal 7:*** *For MPUE support for UL, the following modification is proposed in red*   |  |  |  | | --- | --- | --- | | 23-1-4 | MPUE support for UL | 1. Supported UE capability value ~~[~~sets~~]~~ and corresponding max number of SRS ports for each UE capability value ~~[~~set~~]~~  🡪 Component 1 candidate values: Up to 4 value ~~[~~sets~~]~~ each with one value of {~~[0,]~~1,2,4} | |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | Regarding Component in FG 23-1-4 as below,   |  | | --- | | 1. Supported UE capability value [sets] and corresponding max number of SRS ports for each UE capability value [set] |   Since RAN1 can only agree on one UE capability for this feature (i.e. max # SRS ports, and concluded no consensus on the support of other types), it is still not clear why “value set” is needed. It should be replaced with “value” in the above description, so we would like to remove [sets] in the above description.  **Proposal 9:** Remove [sets] in the Component description in FG 23-1-4. |
| OPPO [7] |  |
| Ericsson [8] | FG 23-1-4 describes the feature where the UE can include a capability index in its beam report. The current name of the feature is misleading since multi-panel UEs are inherently supported already in Rel-15. The consequence if not supported is also misleading.  We first note that the description includes [set]. RAN2 has now defined RRC signaling without “set”, so it would be appropriate to remove “[set]” from the description.  Furthermore, by reporting this quantity, the UE would also have to support to include the capability value in the beam report – otherwise the functionality would be useless. This functionality is enabled using the RRC parameter reportQuantity-r17- This should be part of the component description.  In summary, we propose   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-1-4 | ~~MPUE support for UL~~  Capability value reporting | 1. Supported UE capability value ~~[sets]~~ and corresponding max number of SRS ports for each UE capability value ~~[set]~~  2. Support reportQuantity-r17 |  | Yes |  | ~~[MPUE support for UL is not supported]~~  Capability value reporting is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value ~~[sets]~~ each with one value of {~~[0,]~~1,2,4}  Note: the reported list contains only unique value ~~[sets]~~  ~~This FG is a working assumption~~ | |
| LG Electronics [9] | * Remove the description ‘This FG is a working assumption’ since this FG was agreed in the last meeting.   **Proposal 4: Adopt the following table for 23-1-4.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-1-4 | MPUE support for UL | 1. Supported UE capability value [sets] and corresponding max number of SRS ports for each UE capability value [set] |  | Yes |  | [MPUE support for UL is not supported] | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value [sets] each with one value of {[0,]1,2,4}  Note: the reported list contains only unique value [sets] | Optional with capability signalling | |
| Apple [10] | * We propose to introduce the following two elements on AP/SP report to reflect the new agreement in RAN1 #108 below for FG 23-1-4.  |  | | --- | | **Agreement**  On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, all types of time-domain behavior, i.e., periodic, semi-persistent, and aperiodic reporting, are supported for the enhanced beam report with index(es) of UE capability value [set].   * Support of aperiodic and semi-persistent reporting is optional |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-4 | MPUE support for UL | 1. Supported UE capability value [sets] and corresponding max number of SRS ports for each UE capability value [set]  2. Time domain behavior for capability index report |  | Yes |  | [MPUE support for UL is not supported] | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value [sets] each with one value of {[0,]1,2,4}  Component 2 candidate value: {aperiodic, aperiodic+periodic, aperiodic+semi-persistent, aperiodic+periodic+semi-persistent}  Note: the reported list contains only unique value [sets]  This FG is a working assumption | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-1-4, we think the text “sets” can be removed. Candidate value ‘0’ can be removed since we had a conclusion that there is no consensus to support DL only panel. “This FG is a working assumption” can be removed since we had reached an agreement in the last meeting.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-4 | MPUE support for UL | 1. Supported UE capability value sets and corresponding max number of SRS ports for each UE capability value set |  | Yes |  | [MPUE support for UL is not supported] | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value sets each with one value of {1,2,4}  Note: the reported list contains only unique value sets | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] | * + - RAN1 already agreed that UE reports a list of UE capability value sets, the correspondence between each reported CSI-RS and/or SSB resource index and one of the UE capability value sets in the reported list is determined by the UE (analogous to Rel-15/16) and is informed to NW in a beam reporting instance.     - Remove note that WG is a working assumption |
| MediaTek Inc. [13] | On FG 23-1-4, this feature has been already agreed by RAN1, thus it is not a WA. On the other hand, since reporting “DL-only” panel is not supported in this feature due to no RAN1 consensus, the candidate value 0 for component 1 should be removed. Regarding the consequence if the feature is not supported by the UE, it should be “reporting of UE capability value [sets] is not supported”.  **Proposal 11: On FG 23-1-4, adopt the following changes marked in red:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-4 | MPUE support for UL | 1. Supported UE capability value [sets] and corresponding max number of SRS ports for each UE capability value [set] |  | Yes |  | ~~[MPUE support for UL is not supported]~~  Reporting of UE capability value [sets] is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value [sets] each with one value of {~~[0,]~~1,2,4}  Note: the reported list contains only unique value [sets]  ~~This FG is a working assumption~~ | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 2-12***: For FG 23-1-4, prefer to remove set |

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| 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs [with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)] including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one. | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***Multi-TRP PDCCH repetition***  Regarding the multi-TRP PDCCH repetition enhancement, three schemes have been agreed as SFN, TDM and FDM in Rel-17. For capability on SFN PDCCH, this has been captured as UE capability in HST-SFN feature. For FDM based PDCCH reception for FR2, as it requires two QCL-TypeD capability, it can be reported by FG 23-2-2. To make it clear, a note can be added to FG 23-2-1.  ***Proposal 3-1: Remove the brackets around the component 1 in FG 23-2-1,***   * + ***1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs with non-SFN scheme TDM and FDM (except FDM based PDCCH repetition for FR2) including PDCCH repetition for Type 3 CSS.***   + ***Add a note to FG 23-2-1: Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[~~with ~~[~~non-SFN scheme~~]~~ TDM and FDM (except FDM based PDCCH repetition for FR2)~~]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one. | Optional with capability signalling | |
| ZTE [3] | On MTRP PDCCH repetition enhancement, several FGs (23-2-1 ~ 23-2-4) are listed in [1]. We have some comments on these FGs as below.  For FG 23-2-1, we are agreeable to it in principle. Regarding the limitation “except FR2” of FDM scheme in component 1, it is NOT in line with any agreement in the previous RAN1 meetings so far, hence we think it should be removed.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[~~with ~~[~~non-SFN scheme~~]~~ TDM and FDM ~~(except FDM based PDCCH repetition for FR2)]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  |  |  |  |  |  |  |  | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one. | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | Based on the discussion in RAN1#108-e, the latest version of FGs (23-2-1, 23-2-1a, 23-2-2, 23-2-4) have been agreed.  Regarding the description of Component 1 for FG 23-2-1 as follows,   |  | | --- | | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs [with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)] including PDCCH repetition for Type 3 CSS |  * We are fine the wording only “with TDM and FDM (except FR2)” since it seems “non-SFN scheme” and “TDM and FDM” are duplication, and since FDM in FR2 is supported only when FG 23-2-2 is supported, the clarification on FR2 is fine for us.   **Proposal 10:** Support “with TDM and FDM (except FR2)”, “including PDCCH repetition for Type 3 CSS” in the Component 1 and the above Note in FG 23-2-1. |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * Component 1: we are fine to remove “[with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)]” but prefer to make a note that this FG does not include supporting two QCL-TypeD in time-domain overlapping CORESETs in FR2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  [Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  [Note: for component 3, each unique pair of overlaps is counted as one.  Note: this FG does not include supporting two QCL-TypeD in time-domain overlapping CORESETs in FR2. | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {0,1,2,3 }  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one. | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-2-1, we have following suggestion.   * Component 1: we think all the text in yellow can be removed. PDCCH repetition based on two linked SS sets already refers to TDM and FDM scheme (non-SFN scheme). “except FDM based PDCCH repetition for FR2”can be remove because we have FG23-2-2 for two QCL-TypeD for FDM repetition in FR2, so we do not need to make an exception of FDM in FR2 in this FG.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one. | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | We propose to add a note for this FGI to clarify this feature is only applicable for Multi-TRP scenarios. It should be noted that the WID under which this feature was developed specifically notes the objective to be improvements in the Multi-TRP scenarios:  *Enhancement on the support for multi-TRP deployment, targeting both FR1 and FR2:*   * 1. *Identify and specify features to improve reliability and robustness for channels other than PDSCH (that is, PDCCH, PUSCH, and PUCCH) using multi-TRP and/or multi-panel, with Rel.16 reliability features as the baseline*   **Proposal 12: Add a note to clarify FG 23-2-1 is applicable to Multi-TRP scenarios only.**  We agree with the description of component 1 of FG 23-2-1 and propose to remove the square brackets.  **Proposal 13: Remove the square brackets from description of component 1 of FG 23-2-1.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[~~with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)~~]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, FFS more}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG is applicable to Multi-TRP Scenarios only. | Optional with capability signalling | |
| Intel Corporation [14] | * for FG 23-2-1 component-1, FDM multiplexing in FR2 would need reception of 2 QCL Type-D beams, no need to consider SFN as a reference scheme, also not necessary that CORESETs should be TDM/FDM  |  |  |  |  | | --- | --- | --- | --- | | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[with [non-SFN scheme] TDM and FDM [~~(except FDM based PDCCH repetition for FR2)] including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3,5,10,20,40 ~~FFS more~~}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2. | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | [23-2-1] | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * 23-2-1 should be prerequisite for this FG because it is about overlapping case between individual candidate and linked candidate.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | 23-2-1 | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | For FG23-2-1a, the prerequisite FG should be kept.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | 23-2-1 | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | ~~[~~23-2-1~~]~~ | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition [with non-SFN TDM and/or FDM sheme] | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | 1.Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[~~with non-SFN TDM ~~and/or FDM sheme]~~  2. Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition with non-SFN FDM sheme | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |
| ZTE [3] | For FG 23-2-2, we think the wording “with non-SFN TDM and/or FDM schem” is redundant and should be remove, because its pre-requisite is FG 23-3-1 which already mentions the same thing.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~ |  |  |  |  |  |  |  |  |  | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * Remove “[with non-SFN TDM and/or]” since this FG has no relation with SFN and TDM.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition FDM sheme | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | Fn/a |  | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For FG23-2-2, we think the text “with non-SFN TDM and/or FDM scheme” can be kept since this FG is only for non-SFN.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition with non-SFN TDM and/or FDM scheme | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * for FG 23-2-2, no need to consider SFN as a reference scheme  |  |  |  |  | | --- | --- | --- | --- | | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~ | [23-2-1, ~~23-6-1, 23-6-2~~] | |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~ | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-2-4 | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | Support of simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | 23-2-1, 16-2a | Yes |  | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | Regarding FG 23-2-4 supporting simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP, since it was agreed that two linked PDCCH candidates are not expected to be associated with different CORESETPoolIndex values as in RAN1#107-e, it would be better to capture the above sentence as a Note.  **Proposal 11:** In FG 23-2-4, add a Note “Two linked PDCCH candidates are not expected to be associated with different CORESETPoolIndex values”. |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 [,4]} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | On MTRP PUSCH/PUCCH enhancements, several UE features (23-3-1 ~ 23-3-2c) are listed in [1]. We have some further comments on the details as below.  For FG 23-3-1 family, we have the following comments:   * For component 4 in FG 23-3-1, the candidate value is 4 corresponds to Rel-16 UL full power transmission mode 2 for CB scheme actually. However, due to there is no agreement/conclusion that Rel-17 MTRP PUSCH can be enable to full power mode, hence the value is 4 should be removed.  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set |  |  |  |  |  |  |  |  | Component 4 candidate values: {1,2 ~~[,4]~~} | |
| Vivo [4] | For the number of SRS resources configured in one SRS resource set for codebook-based transmission, candidate value 4 for Component 4 is only supported when UL full power transmission *fullpowerMode2* is enabled. So, we suggest to remove it.   1. Support separate UE feature group for multi-TRP PUSCH repetition supporting *fullpowerMode2*.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~[,4]~~} | |
| Xiaomi [5] | FG23-3-1: Multi-TRP PUSCH repetition (type A) -codebook based  On component 4, the UL full power transmission fullpowerMode2 should be considered. Based on the Rel-16 UE feature FG 16-5c, the candidate values of number of SRS resources in one SRS resource set can be set as {1,2,4}.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  [- cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set  FFS: Support PUSCH operations: CB based and NCB based and corresponding parameters including number of SRS resources | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~[~~,4~~]~~} | Optional with capability signalling | |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * + - Component 4: support 4 as a candidate value given that 4 is already supported in Rel-16.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set  F | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ,4} | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2} | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For M-TRP PUSCH, for FG23-3-1, we have following suggestion.   * For prerequisite FG, we think FG2-14 (i.e., Codebook based PUSCH MIMO transmission) should be its prerequisite FG * For component 4, we support ‘4’ as candidate value. 4 SRS resources can be configured for full power mode 2 and we think M-TRP PUSCH repetition can be supported together with full power mode 2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ,4} | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | In component 4, the number of SRS resources is signalled per SRS resource set, so a value 4 in Component 4 is not needed.  **Proposal 15:** **The candidate value set of Component 4 in FG 23-3-1 is {1, 2}.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | FFS | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2} | Optional with capability signalling | |
| Intel Corporation [14] | * For FG 23-3-1, support component 4 candidate values to be {1, 2, 4}.  |  |  |  |  | | --- | --- | --- | --- | | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions ~~equal to or~~ larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | Component 4 candidate values: {1,2 ~~[~~,4~~]~~} | |
| Qualcomm Incorporated [15] | * For FGs 23-3-1 and 23-3-1-1, the candidate value of 4 for component 3 should be kept and a note can be added “Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c”. We do not see any reason to exclude UL full power Mode 2 (4 SRS resources for CB-based PUSCH) for mTRP PUSCH repetition.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  ~~3~~2. Support of two SRS resource sets with usage set to 'codebook'  ~~4~~3. Supported number of SRS resources in one SRS resource set | ~~FFS~~ 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component ~~4~~3 candidate values: {1,2 ~~[~~,4~~]~~}  Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-3-1-2 | Multi-TRP PUSCH repetition (type A) - non-codebook based | 1. Support of multi-TRP PUSCH repetition for non-codebook based PUSCH (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to 'nonCodebook'  3. Supported number of SRS resources in one SRS resource set | 2-15 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for non-codebook based | per FS | n/a | n/a | n/a | Component 3: {1,2,3,4} | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1-2a | Two associated CSI-RS resources | Support of up to two NZP CSI-RS resources associated with the two SRS resource sets for non-codebook-based mTRP PUSCH | 2-15a, 23-3-1-2 | Yes |  | Two associated CSI-RS resources are not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | [Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {1 to 8}  Component 4: {1 to 16}  Component 5: {1,2}] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * For components 1/2/3 in FG 23-3-2b, given that Rel-17 MTRP PUSCH is based on TDM scheme, only one CSI-RS is associated with a SRS resource set in a transmission occasion (as the legacy in Rel-15/16). Hence, components 1/2/3 should be the maximum number of P/SP/A SRS resources associated with one (the first or the second) CSI-RS per BWP, rather than two CSI-RSs (the first one and the second one) simultaneously. Consequently, the candidate values of components 1/2/3 should be {1 to 4}. Likewise, component 4 should be the UE can process Y SRS resources associated with one (the first and second) CSI-RS, and its candidate values should be {1 to 8}.   According to the above check points, we have the following proposal.  ***Proposal 10:*** *For multi-TRP PUSCH enhancements, the following modification in red is proposed.*   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first ~~and~~or second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first ~~and~~or second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first ~~and~~or second CSI-RS per BWP  4. UE can process Y SRS resources associated with first ~~and~~or second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously |  |  |  |  |  |  |  |  | [Component 1: {1 to 4~~8~~}  Component 2: {1 to 4~~8~~}  Component 3: {1 to 4~~8~~}  Component 4: {1 to 8~~16~~}  Component 5: {1,2}] | |
| Vivo [4] |  |
| Xiaomi [5] | FG23-3-1-2b: CSI-RS processing framework for SRS with two associated CSI-RS resources   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | ~~[~~Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {1 to 8}  Component 4: {~~1~~0 to 16}  Component 5: {1,2}~~]~~ | Optional with capability signalling |   To align with FG 2-15b in Rel-15 (shown as follows), on components 1, 2, and 4, the current candidate values can be confirmed since there is two CSI-RS per BWP. On component 3, value 0 can be added as the candidate values, i.e., the the candidate values can be set as {0 to 8}. As for component 5, we support the current candidate values.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | 2-15b | CSI-RS processing framework for SRS | 1. Maximum number of periodic SRS resources associated with CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with CSI-RS per BWP  4. UE can process Y SRS resources associated with CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS.  5. UE can process X SRS resources associated with CSI-RS resources simultaneously across all CCs. Includes P/SP/A SRS. | 2-15a | Yes | Association between CSI-RS and SRS is not supported | Type 3 | N.A. | N.A. |  | NOTE: Other MIMO capability other than component 5 may further restrict (reduce) the number of SRS associated with CSI-RS that the UE has to simultaneously derive. |  | Component-1 candidate values: {1, 2, 3, 4}  Component-2 candidate values {1, 2, 3, 4}  Component-3 candidate values: {0, 1, 2, 3, 4}  Component-4  candidate values: {from 1 to 8}  Component-5:  candidate values: {from 5 to 32} |  | |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {1 to 8}  Component 4: {1 to 16}  Component 5: {1,2} | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {1 to 8}  Component 4: {1 to 16}  Component 5: {1,2} | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | Since the number of SRS resources in the two SRS resource sets are restricted to be the same by the specification, Components 1-4 do not need to have odd values as candidate values.  As for Component 5, we support to have candidate values {1, 2} for simultaneous processing of CSI-RS resources.  **Proposal 16:** **The candidate values for the components of FG 23-3-1-2b are**   * **Component 1: {2, 4, 6, 8}** * **Component 2: {2, 4, 6, 8}** * **Component 3: {0, 2, 4, 6, 8}** * **Component 4: {2, 4, 6, 8, 10, 12, 14, 16}** * **Component 5: {1, 2}**  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | Component 1: {2, 4, 6, 8}  Component 2: {2, 4, 6, 8}  Component 3: {0, 2, 4, 6, 8}  Component 4: {2, 4, 6, 8, 10, 12, 14, 16}  Component 5: {1, 2} | Optional with capability signalling | |
| Intel Corporation [14] | * For FG 23-3-1-2b, the component 3 candidate values can be {0 to 8}, support other components’ candidate values.  |  |  |  |  | | --- | --- | --- | --- | | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  ~~[~~5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously~~]~~ | ~~[~~Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {~~1~~ 0 to 8}  Component 4: {1 to 16}  Component 5: {1,2}~~]~~ | |
| Qualcomm Incorporated [15] | * In FG 23-3-1-2b, for components 1-4, we suggest the following to be consistent with Rel-15 FG 2-15b (for SP-SRS, candidate value can be 0):   + Component 1: {1 to 8}   + Component 2: {1 to 8}   + Component 3: {0 to 8}   + Component 4: {1 to 16}  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | ~~[~~Component 1: {1 to 8}  Component 2: {1 to 8 }  Component 3: {~~1~~ 0 to 8}  Component 4: {1 to 16}  Component 5: {1,2}~~]~~ | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-3-1a | Cyclic mapping for Multi-TRP PUSCH repetition | Support of cyclic mapping when the number of repetitions is larger than 2 | 23-3-1 or 23-3-1-2 | Yes |  | Cyclic mapping for Multi-TRP PUSCH repetition is not supported | Per Band | n/a | n/a | n/a | Candidate component values: {for repetition Type A, for repetition Type B, both} | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1b | Second TPC field for Multi-TRP PUSCH repetition | Support of second TPC field for per TRP closed-loop power control for PUSCH with DCI formats 0\_1 / 0\_2 | 23-3-1 or 23-3-1-2 | Yes |  | Second TPC field for Multi-TRP PUSCH repetition is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***Multi-TRP PUSCH repetition***  In order to reduce the implementation complexity for a UE for the PHR calculation and report in MTRP across all CCs in a band, the max number of PHR report across CCs should be a UE capability.  ***Proposal 3-3: Support to add the component 2 in FG 23-3-1c,***   * + ***2. The maximum number of supported PHR reporting across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) is a UE capability, FFS on candidate value, which is no more than 2\*the number of supported CCs.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | 1. Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.)  2. The maximum number of PHR reporting across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a | FFS: on candidate value for component 2, […, 2\*the number of supported CCs]. | Optional with capability signalling | |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-3-1e | A-CSI report | Support of A-CSI report on two PUSCH repetitions | 23-3-1 or 23-3-1-2 | Yes |  | A-CSI report on two PUSCH repetitions is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1f | SP-CSI report | Support of SP-CSI report on two PUSCH repetitions | 23-3-1 or 23-3-1-2 | Yes |  | SP-CSI report on two PUSCH repetitions is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1-1 or 23-3-1-2 | Yes |  | CG PUSCH transmission towards M-TRPs using a single CG configuration is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | One of the prerequisite FGs should be FG 23-3-1 (repetition type A), instead of FG 23-3-1-1 (repetition type B).  **Proposal 17: The prerequisite FG 23-3-1-1 of FG 23-3-1-1g is replaced by FG 23-3-1.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1 or 23-3-1-2 | Yes |  | CG PUSCH transmission towards M-TRPs using a single CG configuration is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2[,4]} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * For component 3 in FG 23-3-1-1, due to the similar reason to component 4 in FG 23-3-1, its candidate value is 4 should be removed.  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-3-1-1 codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set |  |  |  |  |  |  |  |  | Component 3 candidate values: {1,2~~[,4]~~} | |
| Vivo [4] | For the number of SRS resources configured in one SRS resource set for codebook-based transmission, candidate value 4 for Component 4 is only supported when UL full power transmission *fullpowerMode2* is enabled. So, we suggest to remove it.   1. Support separate UE feature group for multi-TRP PUSCH repetition supporting *fullpowerMode2*.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[,4]~~} | |
| Xiaomi [5] | FG: 23-3-1-1: Multi-TRP PUSCH repetition (type B) -codebook based  On component 4, similar to PUSCH repetition type A, the candidate values can be set as {1,2,4}.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’ |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[~~,4~~]~~} | Optional with capability signalling | |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * + - Component 3: support 4 as a candidate value given that 4 is already supported in Rel-16.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  . Supported number of SRS resources in one SRS resource set |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,4} | Optional with capability signalling | |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2} | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | In component 3, the number of SRS resources is signalled per SRS resource set, so a value 4 in Component 3 is not needed.  **Proposal 18:** **The candidate value set of Component 3 in FG 23-3-1-1 is {1, 2}.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set |  | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2} | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | * For FGs 23-3-1 and 23-3-1-1, the candidate value of 4 for component 3 should be kept and a note can be added “Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c”. We do not see any reason to exclude UL full power Mode 2 (4 SRS resources for CB-based PUSCH) for mTRP PUSCH repetition.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[~~,4~~]~~}  Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set |  | Yes |  | Non-codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set | 2-15, 11-5 | Yes |  | Non-codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)- sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource | FFS | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Note: power control parameter sets only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] | For M-TRP PUCCH, for FG23-3-2, we have following suggestion.   * We support to keep the note “Note: power control parameter sets only apply to FR1” |
| MediaTek Inc. [13] | The term “Scheme 1” is only used in the RAN1 discussions. We prefer to use “slot-based repetition” for Scheme 1.  **Proposal 19:** **Rename FG 23-3-2 as “Multi-TRP PUCCH repetition - slot based”.**  **Proposal 20:** **The description of Component 1 in FG 23-3-2 is modified as “Support of multi-TRP PUCCH slot-based repetition”.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition - slot based | 1. Support of multi-TRP PUCCH slot-based repetition  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource | FFS | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Note: power control parameter sets only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | * The highlighted note in FG 23-3-2 can be modified as “Note: power control parameter sets (w/o spatial relation info) only applies to FR1” * Supported PUCCH format(s) need to be indicated for each of the Scheme 1 and Scheme 3, i.e., a bitmap of size 5 can be added as a component to indicate support for PUCCH formats 0-4 for both 23-3-2 and 23-3-3. This is because Rel-17 introduced PUCCH repetition for PUCCH formats 0 and 2, which did not exist before. Also, UE may support the feature for only a subset of PUCCH formats depending on the use case. At the very least, distinguishing between short PFs and long PFs is needed.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)- sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Note: power control parameter sets (w/o spatial relation info) only applies to FR1  Note: spatial relation info only applies to FR2  Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-3-2b | Cyclic mapping for multi-TRP PUCCH repetition | Support of cyclic mapping for beam mapping/power control parameter set mapping for PUCCH repetitions scheme 1 and/or 3 when the number of repetitions is larger than 2 | 23-3-2 | Yes |  | Cyclic mapping for multi-TRP PUCCH repetition is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | For FG 23-3-2 family, we have the following comments:   * For FG 23-3-2b, the candidate values can be 4 and 8 should be included when considering the previous agreements in RAN1 as follows.  |  |  | | --- | --- | | **Agreement** (in RAN1#105-e)  Confirm the working assumption with removing brackets on [consecutive] and adding UE capability.   * For PUCCH reliability enhancement, support multi-TRP intra-slot repetition (Scheme 3) for all PUCCH formats.   + The same PUCCH resource carrying UCI is repeated for X = 2 ~~[~~consecutive~~]~~ sub-slots within a slot.   + Refer the design details related to sub-slot configurations (e.g. other values of X) to Rel-17 eIIoT * Note1: The decision of supporting scheme 3 is only applicable for multi-TRP operation.   This feature is optional.  **Agreement** (in RAN1#107-e)  For sub-slot based PUCCH repetition, the following agreement from Cov. Enh. WI for slot-based PUCCH repetition is adopted also for sub-slot based PUCCH repetition:   |  | | --- | | Agreement   * In Rel-17, reuse the Rel-16 PUCCH repetition factors 2, 4, 8. * Do not support PUCCH repetition factor larger than 8 In Rel-17. | |   According to the above check points, we have the following proposal.  ***Proposal 11:*** *For multi-TRP PUCCH enhancements, the following modification in red is proposed.*   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-3-2b | Cyclic mapping for multi-TRP PUCCH repetition | Support of cyclic mapping for beam mapping/power control parameter set mapping for PUCCH repetitions scheme 1 and/or 3 when the number of repetitions is larger than 2 |  |  |  |  |  |  |  |  | Candidate values: {4, 8} | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-3-2c | Second TPC field for multi-TRP PUCCH repetition | Support of second TPC field for per TRP closed-loop power control for PUCCH with DCI formats 1\_1 / 1\_2 | 23-3-2 | Yes |  | Second TPC field for multi-TRP PUCCH repetition is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions | FFS | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | To support intra-slot mTRP PUCCH repetition (scheme 3), two sets of power control parameter per PUCCH resource in FR1 or two spatial relation infos per PUCCH resource in FR2 should be supported. Therefore, the component 2 in FG 23-3-2 is needed also for FG 23-3-3. We suggest to add component 2 of FG 23-3-2 as basic feature of FG 23-3-3 and also same note as follow:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | 1. Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  ~~[~~- cyclic mapping for 2 repetitions~~]~~  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource | FFS | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a | Note: power control parameter sets only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling | |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * + - Component 2 of 23-3-2 should be also added in 23-3-3 given that without 2 PC sets or 2 spatial relation info per PUCCH resource intra-slot PUCCH repetition cannot be supported.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | 1. Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource | FFS | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | The term “Scheme 3” is only used in the RAN1 discussions. Besides, “intra-slot” can have different implementations, so we prefer to use “subslot-based repetition” for Scheme 3.  **Proposal 21:** **Rename FG 23-3-3 as “Multi-TRP PUCCH repetition - subslot based”.**  **Proposal 22:** **The description of Component 1 in FG 23-3-3 is modified as “Support of multi-TRP PUCCH subslot-based repetition”.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition - subslot based | Multi-TRP PUCCH repetition - subslot based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions | FFS | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | * Supported PUCCH format(s) need to be indicated for each of the Scheme 1 and Scheme 3, i.e., a bitmap of size 5 can be added as a component to indicate support for PUCCH formats 0-4 for both 23-3-2 and 23-3-3. This is because Rel-17 introduced PUCCH repetition for PUCCH formats 0 and 2, which did not exist before. Also, UE may support the feature for only a subset of PUCCH formats depending on the use case. At the very least, distinguishing between short PFs and long PFs is needed.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | 1. Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {[0,]1,2,3,[4,5,6,]7}  Component 3 candidate values: {0,1,2,3,[4,5,6,]7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  FFS: how to count X1 and X2  [Note: case1 and case2 cannot be enabled simultaneously] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***Inter-cell multi-TRP operation***  It has been agreed that from RRC signaling perspective, the number of configured additional PCIs can be {1, 2, 3, 4, 5, 6, 7}. Therefore, to support more flexibility of gNB configuration and schedule, we propose the following:  ***Proposal 3-4: Support component 2 and 3 with candidate values {0, 1, 2, 3, 4, 5, 6, 7} in FG 23-4 and remove the corresponding brackets.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {~~[~~0,~~]~~1,2,3,~~[~~4,5,6,~~]~~7}  Component 3 candidate values: {0,1,2,3,~~[~~4,5,6,~~]~~7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  FFS: how to count X1 and X2  [Note: case1 and case2 cannot be enabled simultaneously] | Optional with capability signalling | |
| ZTE [3] | One UE feature (23-4) has been listed for inter-cell MTRP enhancements in [1]. We have some further comments on the details as below.  For FG 23-3-4, we have the following comments:   * For component 3, the current draft description is NOT in line with the agreement in RAN1#106bis-e as below. Note that case 1 means the configurations of SSB time domain positions and periodicity of the additional PCIs **is the same as** SSB time domain positions and periodicity of the serving cell PCI, hence case 2 should capture the complementary set of case 1, which is the highlighted part in the following agreement, i.e. “is not according to Case 1”.  |  | | --- | | **Agreement** (in RAN1#106bis-e)  Support two independent X values (X1, X2) are reported as a UE capability for two different assumptions on additional SSB time domain position and periodicity with respect to serving cell SSB.   * X1 (Case 1)= The maximum number of configured additional PCIs when each configuration~~s~~ of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI * X2 (Case 2)= The maximum number of configured additional PCIs when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 * Note: By definition, Case 1 and Case 2 cannot be enabled simultaneously * Supported values for X1 and X2 include~~s~~ at least 0,1,2,3 and 7. FFS on other values * This UE capability has FR1 and FR2 differentiation (FFS : Whether this UE capability is per UE or per band) |  * For the candidate values of component 2 and component 3, in order to keep alignment with the agreement in RAN1#108-e as below, the candidate values {0, 1, 2, 3, 4, 5, 6, 7} need to be captured.  |  | | --- | | **Agreement** (in RAN1#108-e)  From RRC signaling perspective, the number of configured additional PCIs can be {1, 2, 3, 4, 5, 6, 7}. |   According to the above check points, we have the following proposal.  ***Proposal 12:*** *For multi-TRP inter-cell enhancements, the following modification in red is proposed.*   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1~~different with SSB time domain positions and periodicity of the serving cell PCI~~ |  |  |  |  |  |  |  |  | Component 2 candidate values: {~~[~~0,~~]~~1,2,3,~~[~~4,5,6,~~]~~7}  Component 3 candidate values: {0,1,2,3,~~[~~4,5,6,~~]~~7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  FFS: how to count X1 and X2  [Note: case1 and case2 cannot be enabled simultaneously] | |
| Vivo [4] | The FG 23-4 was agreed in RAN1#108-e with some candidate values for component 2 and 3 in square brackets.  In RAN1#106b-e, following agreements were made:  ***Agreement***  *Support two independent X values (X1, X2) are reported as a UE capability for two different assumptions on additional SSB time domain position and periodicity with respect to serving cell SSB.*   * *X1 (Case 1) = The maximum number of configured additional PCIs when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI* * *X2 (Case 2) = The maximum number of configured additional PCIs when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1* * *Note: By definition, Case 1 and Case 2 cannot be enabled simultaneously* * *Supported values for X1 and X2 include at least 0,1,2,3 and 7. FFS on other values* * *This UE capability has FR1 and FR2 differentiation*   And, in RAN1#108-e, further agreement on configurable values of additional PCIs was made:  ***Agreement***  *From RRC signaling perspective, the number of configured additional PCIs can be {1, 2, 3, 4, 5, 6, 7}*  From above agreements, it is clear that the UE reported values for X1 and X2 are limited to 0, 1, 2, 3 and 7; while for the UEs reporting value of 7 the gNB can configure one of the values from 1~7. Furthermore, there is one FFS point on how to count X1 and X2, as there is agreement in RAN1 that Case 1 and Case 2 cannot be enabled simultaneously, that means X1 and X2 are counted independently. And, the note in square bracket regarding restriction on configuration of case 1 and case 2 can be captured in TS 38.306 or in TS 38.331 which is up to RAN2. Hence, we propose following revisions.   1. Support following updates in FG 23-4.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {~~[~~0,~~]~~1,2,3,[~~4,5,6,]~~7}  Component 3 candidate values: {0,1,2,3~~,[4,5,6,]~~7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  ~~FFS: how to count X1 and X2~~  ~~[~~Note: case1 and case2 cannot be enabled simultaneously~~]~~ | |
| Xiaomi [5] |  |
| Samsung [6] | For component 23-4, we do not think it is necessary to report 0 for X1 because 1 as the minimum capability for X1 should be sufficient. Support to confirm 4, 5 and 6 as candidate values for X1 and X2.  **Proposal 14:** Do not support candidate value 0 for X1, support to confirm candidate values 4, 5 and 6 for X1 and X2. |
| OPPO [7] | In RAN1#108 e-meeting, the candidate values for number of additional PCIs for Case 1 and Case 2 were discussed with two remaining issues: whether 0 is supported for X1 and whether 4,5,6 are supported for X1 and X2. For the first issue, considering there is a note saying “UE indicates a non-zero value for at least one of component 2 or component 3”, we think 0 can be included as candidates for X1. For the second issue, considering {4,5,6} neighboring cells are not typical deployment in network, {0,1,2,3,7} seems sufficient for capability reporting.  ***Proposal: The candidate values for both X1 and X2 can be {0,1,2,3,7}.*** |
| Ericsson [8] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 | ~~FFS~~ 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {[0,]1,2,3,[ 4, 5, 6,] 7}  Component 3 candidate values: {0,1,2,3, [ 4, 5, 6,]7}  Note: UE indicates a non-zero value for at least one of component 2 or component 3  FFS: how to count X1 and X2  [Note: case1 and case2 cannot be enabled simultaneously] | Optional with capability signalling |   The Rel-17 Inter-cell mTRP is an extension of Rel-16 Multi-DCI based Multi-TRP functionality. FG 16-2a which indicates UE is capable of CORESETPoolIndex configuration shall be supported as a prerequisite feature group for FG 23-4.   1. On FG 23-4, Add FG16-2a as prerequisite feature group for FG 23-4. Remove candidate values in yellow to avoid fragmented UE capability report. |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {0,1,2,3,4,5,6,7}  Component 3 candidate values: {0,1,2,3,4,5,6,7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  Note: case1 and case2 cannot be enabled simultaneously | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For component 2, the candidate value of 0 is not needed because the deployment scenario in component 2 is important for commercial NW. Hence, case 1 in component 2 could be defined as a default case for inter-cell MTRP operation. We’re open for other candidate values.  Regarding the last note, it is true that case1 and case2 cannot be enabled simultaneously. However, it is related to NW configuration instead of UE feature, thus, the note can be removed.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  ~~[~~2. The maximum number of configured additional PCIs per CC is X1 (case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI~~]~~  ~~[~~3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1~~]~~ | FFS | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | ~~[~~Component 2 candidate values: {0,1,2,3,[ 4, 5, 6,] 7}~~]~~  ~~[~~Component 3 candidate values: {0,1,2,3, [ 4, 5, 6,]7}~~]~~  Note: UE indicates a non-zero value for at least one of component 2 or component 3  FFS: how to count X1 and X2 | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | The following are proposed for inter-cell mTRP UE feature:   * First, all highlighted candidate values should be confirmed. Also, given the note “Note: UE indicates a non-zero value for at least one of component 2 or component 3”, candidate value 0 is needed for component 2. * Regarding “FFS: how to count X1 and X2”, we think it should be deleted as the definition is already clear from components 2 and 3 (“maximum number of configured additional PCIs …”) consistent with the agreement below. * Regarding the last note, we think it is needed and can be further clarified given the agreement below.   **Agreement**  Support two independent X values (X1, X2) are reported as a UE capability for two different assumptions on additional SSB time domain position and periodicity with respect to serving cell SSB.   * X1 (Case 1)= The maximum number of configured additional PCIs when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI * X2 (Case 2)= The maximum number of configured additional PCIs when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 * Note: By definition, Case 1 and Case 2 cannot be enabled simultaneously * Supported values for X1 and X2 include at least 0,1,2,3 and 7. FFS on other values * This UE capability has FR1 and FR2 differentiation (FFS : Whether this UE capability is per UE or per band)   Hence, we have the following proposal:  ***Proposal 6-1: Adopt the following for Rel-17 inter-cell mTRP UE features (modifications in red).***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {~~[~~0,~~]~~1,2,3,~~[~~4,5,6,~~]~~7}  Component 3 candidate values: {0,1,2,3,~~[~~4,5,6,~~]~~7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  ~~FFS: how to count X1 and X2~~  ~~[~~Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2~~]~~ | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | Yes |  | Group based L1-RSRP reporting enhancements are not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: FFS  Component 3 candidate values: FFS  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * Regarding group based report [23-5-1]   + Regarding #. RS for both CMR sets (component-2/3), in FG 2-24, we have the following requirement:  |  | | --- | | 1. The max number of SSB/CSI-RS (1Tx) resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP within a slot shall not exceed MB\_1   * Component-1, candidate value set for MB\_1 is {0, 8, 16, 32, 64}   + On FR2, UE is mandated to signal MB\_1 >=8   + On FR1, MB\_1 >=8 is supported mandatory with capability signaling   1a. The max number of CSI-RS resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP shall not exceed MC\_1   * + Component-1a, candidate value set for MC\_1 is {0, 4, 8, 16, 32, 64}   + For FR1, UE is mandated to report at least 8. |   Therefore, we think that the candidate value {8, 16, 32, 64, 128} and {8, 16, 32, 64, 128} should be considered for component 2 and 3, respectively.   |  |  |  | | --- | --- | --- | | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  🡪 Candidate value comprises {8, 16, 32, 64, 128}.  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs  🡪 Candidate value comprises {8, 16, 32, 64, 128}. | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | For FG 23-5-1, we suggest candidate values for component 2 as {1, 2, 3, 4} and component 3 as {8, 16, 32, 64}.  **Proposal 15:** Support components 2 and 3 in FG 23-5-1 with candidate values {1, 2, 3, 4} and {8, 16, 32, 64} respectively. |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | Yes |  | Group based L1-RSRP reporting enhancements are not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: {1, 2, 3, 4}  Component 3 candidate values: {1, 2, 4, 8, 12, 16, 24, 32, 48, 64}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported BFD-RS resources per set per BWP  3. Supported maximum number of BFD-RS resources across two BFD-RS sets per BWP |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 3 candidate values: {2,3,4} | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | The supported number of RSs for beam measurement/reporting for multi-TRP scenario in Rel-17 were agreed to be counted in FG 16-1g and 16-1g-1 in the last meeting. In addition, we propose the supported number of RSs for beam failure recovery for multi-TRP scenario in Rel-17 should be also be counted in FG 16-1g and 16-1g-1. We propose the following:  ***Proposal 3-6: Support adding the following note in FG 23-5-2: BFD-RS resources and NBI-RS resources for MTRP BFR are counted in FG 16-1g and 16-1g-1.***  To reflect UE processing capability on number of CCs with beam failure recovery running, there needs to be a UE feature on maximum number of CCs on which spCell/SCell/MTRP BFR in Rel-15/16/17 can be configured. We then propose the following:  ***Proposal 3-7: Add a new component in FG 23-5-2 as follows***   * + ***4. The maximum number of CCs configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17), with candidate values {1, 2, 3, 4, 5, 6, 7, 8, 9}***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported BFD-RS resources per set per BWP  3. Supported maximum number of BFD-RS resources across two BFD-RS sets per BWP  4. The maximum number of CCs configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17) |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 3 candidate values: {2,3,4}  Component 4 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}  Note:BFD-RS resources and NBI-RS resources for MTRP BFR are counted in FG 16-1g and 16-1g-1 | Optional with capability signalling | |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * FG 23-5-2, if MAC-CE is introduced to activate BFD-RS resources, the activated BFD-RS resources should be indicated in the FG  |  |  |  |  | | --- | --- | --- | --- | | 23-5-2 | MTRP BFR enhancements | 1. Maximum number of supported active BFD-RS resources per set per BWP  2. Supported maximum number of active BFD-RS resources across two BFD-RS sets per BWP | Per band | |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {1, 2}  [Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * + Regarding 23-5-2a, as for SCell-BFR, PUCCH-SR should be mandatorily supported for a UE, and due to the same reason, we think that at least one PUCCH-SR should be supported as in a basic feature.  |  |  |  | | --- | --- | --- | | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group  Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1 | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | For FG 23-5-2a and FG 23-5-2b, we do not see the need to add the note: a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1.  **Proposal 16:** Delete the note “a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1” in FG 23-5-2a and FG 23-5-2b, which is unnecessary. |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {1, 2} | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For 23-5-2a, one PUCCH-SR for BFR should be baseline, like Rel-16 BFR. Hence, the note should be kept.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group  ~~[2. association between a BFD-RS resource set on SpCell and a PUCCH SR resource (if component candidate value equals 2)]~~ |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {~~[0,~~1~~]~~, 2}  Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1 | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource | 23-5-2a | Yes |  | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource is not supported | Per UE | No | Yes | No | [Note: A UE that supports FG 23-5-2a with candidate value 2 must indicate this FG is supported with at least component candidate value 1] | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * + Regarding 23-5-2b, based on RAN1 already agreement, the association between a BFD-RS resource set on SpCell and a PUCCH SR resource is necessary if supporting 2 PUCCH-SR for cell-group.  |  |  |  | | --- | --- | --- | | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource  Note: A UE that supports FG 23-5-2a with candidate value 2 must indicate this FG is supported ~~with at least component candidate value 1~~ | |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] | For FG 23-5-2a and FG 23-5-2b, we do not see the need to add the note: a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1.  **Proposal 16:** Delete the note “a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1” in FG 23-5-2a and FG 23-5-2b, which is unnecessary. |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource | 23-5-2a | Yes |  | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource is not supported | Per UE | No | Yes | No |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | For 23-5-2b, the note is also supported as this is the main motivation to configure two PUCCH-SR resources.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource | 23-5-2a | Yes |  | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource is not supported | Per UE | No | Yes | No | Note: A UE that supports FG 23-5-2a with candidate value 2 must indicate this FG is supported with at least component candidate value 1 | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] | * FG 23-5-2b – there is no use-case for a UE to support 23-5-2a with candidate value 2 but not 23-5-2b, so the note should be kept. |
| Qualcomm Incorporated [15] | For FG 23-5-2b, suggest to remove the note based on the agreement on UE capability for association   * + The agreement does not say UE must support the association when having 2 PUCCH-SR resources, because the whole agreement assumes 2 PUCCH-SR resources. The highlighted part means the association is optional in case of 2 PUCCH-SR resources   Agreement  Support to configure an association between a BFD-RS set on SpCell and a PUCCH-SR resource / SR configuration for per TRP BFR.  FFS: Configure an association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration for per TRP BFR  A UE capability signaling is introduced for indicating the support of this association. Above applies only for multi-DCI case |

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| 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH |  | Yes |  | SFN scheme A (scheme 1) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***HST multi-TRP deployment***  It is proposed add a component of maximum number of codepoints configured for SFN data to FGs 23-6-1/1b/2/2b, to avoid the complexity of large number of combined TCI states for HST-SFN. Another option can be a new FG to maximal number of PDSCHs per slot. Either option can resolve the problem.   * Option 1: Add the following component to FGs 23-6-1/1b/2/2b   + The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8} * Option 2: Add a new FG for PDSCH processing capability in HST   + Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}   With above analysis, we propose the following:  ***Proposal 3-8: down-select between the following options for HST-SFN FGs:***   * ***Option 1: Add the following component to FGs 23-6-1/1b/2/2b***   + ***The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8}*** * ***Option 2: Add a new FG for PDSCH processing capability in HST***   + ***Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}*** |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | * For SFN scheme A (FG23-6-1/23-6-1-1/23-6-1b) and SFN scheme B (FG23-6-2/23-6-2b), at least one FG for each SFN scheme should be a basic function to avoid market fragmentation. During the RAN1 discussion for Rel.17 HST, the assumption of the basic operation is a combination of “ SFN-PDCCH + SFN-PDSCH” (i.e. FG23-6-1 and FG23-6-2), and some UE vendors claim difficulty of supporting other combinations. Hence, the basic capability of SFN scheme A should be FG23-6-1 and the basic capability of SFN scheme B should be FG23-6-2. We can make pre-requisite feature of FG23-6-1-1/23-6-1b as “FG23-6-1” and pre-requisite feature of FG23-6-2b as “FG23-6-2”. It means UE supporting FG23-6-1-1/23-6-1b must support FG23-6-1, or UE supporting FG23-6-2b must support FG23-6-2. We believe we should clarify that FG23-6-1 or FG23-6-2 is a basic function of each SFN scheme in the UE feature list.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH |  | Yes |  | SFN scheme A (scheme 1) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In the last RAN1 meeting #108e, the number of TCI codepoint configured with SFN PDSCH was discussed. If UE supports N TCI states, this doesn’t mean that UE can support all the combination of TCI pairs. For example, a UE can support 4 TCI states, but can only support single pair TCI states, i.e., one TCI codepoint, for SFN data. This issue is even more pronounced for SFN scheme B as TCI pair {TCI1, TCI2} is not the same for the TCI pair {TCI2, TCI1}. A component of maximum number of codepoints configured for SFN data should be added for UE FGs of SFN scheme A and SFN scheme B.  ***Proposal 8-1: Add component 2 of maximum number of codepoints configured for SFN data with candidate values {1,2,3,4,5,6,7,8} for FG 23-6-1, 23-6-1b, 23-6-2 and 23-6-2b***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme A (scheme 1) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-1-1 | SFN scheme A (scheme 1) for PDCCH only | Support of SFN scheme A for PDCCH scheduling single TRP PDSCH |  | Yes |  | SFN scheme A (scheme 1) for PDCCH only is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1-1 | SFN scheme A (scheme 1) for PDCCH only | Support of SFN scheme A for PDCCH scheduling single TRP PDSCH | 23-6-1 | Yes |  | SFN scheme A (scheme 1) for PDCCH only is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-6-1a | Dynamic switching - scheme A | Support of dynamic switching between single-TRP and PDSCH SFN scheme A by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-1 or 23-6-1b | Yes |  | Dynamic switching - scheme A is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1a | Dynamic switching - scheme A | Support of dynamic switching between single-TRP and PDSCH SFN scheme A by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-1 or 23-6-1b | Yes |  | Dynamic switching - scheme A is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |  1. On 23-6-1a, the prerequisite feature for dynamic switching-scheme A shall be confirmed, which is “23-6-1 or 23-6-1b”. |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-6-1b | SFN scheme A (scheme 1) for PDSCH only | 1. Support of SFN scheme A for PDSCH scheduled by single TRPPDCCH |  | Yes |  | SFN scheme A (scheme 1) for PDSCH only is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | ***HST multi-TRP deployment***  It is proposed add a component of maximum number of codepoints configured for SFN data to FGs 23-6-1/1b/2/2b, to avoid the complexity of large number of combined TCI states for HST-SFN. Another option can be a new FG to maximal number of PDSCHs per slot. Either option can resolve the problem.   * Option 1: Add the following component to FGs 23-6-1/1b/2/2b   + The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8} * Option 2: Add a new FG for PDSCH processing capability in HST   + Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}   With above analysis, we propose the following:  ***Proposal 3-8: down-select between the following options for HST-SFN FGs:***   * ***Option 1: Add the following component to FGs 23-6-1/1b/2/2b***   + ***The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8}*** * ***Option 2: Add a new FG for PDSCH processing capability in HST***   + ***Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}*** |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1b | SFN scheme A (scheme 1) for PDSCH only | 1. Support of SFN scheme A for PDSCH scheduled by single TRPPDCCH | 23-6-1 | Yes |  | SFN scheme A (scheme 1) for PDSCH only is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In the last RAN1 meeting #108e, the number of TCI codepoint configured with SFN PDSCH was discussed. If UE supports N TCI states, this doesn’t mean that UE can support all the combination of TCI pairs. For example, a UE can support 4 TCI states, but can only support single pair TCI states, i.e., one TCI codepoint, for SFN data. This issue is even more pronounced for SFN scheme B as TCI pair {TCI1, TCI2} is not the same for the TCI pair {TCI2, TCI1}. A component of maximum number of codepoints configured for SFN data should be added for UE FGs of SFN scheme A and SFN scheme B.  ***Proposal 8-1: Add component 2 of maximum number of codepoints configured for SFN data with candidate values {1,2,3,4,5,6,7,8} for FG 23-6-1, 23-6-1b, 23-6-2 and 23-6-2b***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-1b | SFN scheme A (scheme 1) for PDSCH only | 1. Support of SFN scheme A for PDSCH scheduled by single TRPPDCCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme A (scheme 1) for PDSCH only is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***HST multi-TRP deployment***  It is proposed add a component of maximum number of codepoints configured for SFN data to FGs 23-6-1/1b/2/2b, to avoid the complexity of large number of combined TCI states for HST-SFN. Another option can be a new FG to maximal number of PDSCHs per slot. Either option can resolve the problem.   * Option 1: Add the following component to FGs 23-6-1/1b/2/2b   + The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8} * Option 2: Add a new FG for PDSCH processing capability in HST   + Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}   With above analysis, we propose the following:  ***Proposal 3-8: down-select between the following options for HST-SFN FGs:***   * ***Option 1: Add the following component to FGs 23-6-1/1b/2/2b***   + ***The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8}*** * ***Option 2: Add a new FG for PDSCH processing capability in HST***   + ***Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}*** |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | * For SFN scheme A (FG23-6-1/23-6-1-1/23-6-1b) and SFN scheme B (FG23-6-2/23-6-2b), at least one FG for each SFN scheme should be a basic function to avoid market fragmentation. During the RAN1 discussion for Rel.17 HST, the assumption of the basic operation is a combination of “ SFN-PDCCH + SFN-PDSCH” (i.e. FG23-6-1 and FG23-6-2), and some UE vendors claim difficulty of supporting other combinations. Hence, the basic capability of SFN scheme A should be FG23-6-1 and the basic capability of SFN scheme B should be FG23-6-2. We can make pre-requisite feature of FG23-6-1-1/23-6-1b as “FG23-6-1” and pre-requisite feature of FG23-6-2b as “FG23-6-2”. It means UE supporting FG23-6-1-1/23-6-1b must support FG23-6-1, or UE supporting FG23-6-2b must support FG23-6-2. We believe we should clarify that FG23-6-1 or FG23-6-2 is a basic function of each SFN scheme in the UE feature list.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In the last RAN1 meeting #108e, the number of TCI codepoint configured with SFN PDSCH was discussed. If UE supports N TCI states, this doesn’t mean that UE can support all the combination of TCI pairs. For example, a UE can support 4 TCI states, but can only support single pair TCI states, i.e., one TCI codepoint, for SFN data. This issue is even more pronounced for SFN scheme B as TCI pair {TCI1, TCI2} is not the same for the TCI pair {TCI2, TCI1}. A component of maximum number of codepoints configured for SFN data should be added for UE FGs of SFN scheme A and SFN scheme B.  ***Proposal 8-1: Add component 2 of maximum number of codepoints configured for SFN data with candidate values {1,2,3,4,5,6,7,8} for FG 23-6-1, 23-6-1b, 23-6-2 and 23-6-2b***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | [23-6-2 or] 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * + - The prerequisite FG 23-6-2 is not needed. In FG 23-6-2, if dynamic switching is supported, this would mean that combination of SFN scheme B for PDCCH and single-TRP PDSCH is supported which is not supported in RAN1 specification.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Apple [10] | * + For FG23-6-2a: pre-requisite can be “23-6-2 or 23-6-2b”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-2 or 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | * For FG 23-6-2a, we agree to remove [] of pre-requisite feature. Similar as FG23-6-1a, pre-requisite feature of 23-6-2a should be “23-6-2 or 23-6-2b”.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-2 or 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 8-2: The prerequisite of FG 23-6-2a should be FG 23-6-2 or FG 23-6-2b.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | ~~[~~23-6-2 or~~]~~ 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-2b | SFN scheme B (TRP based pre-compensation) for PDSCH only | 1. Support of SFN scheme B for PDSCH scheduled by single TRP PDCCH |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH only is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | ***HST multi-TRP deployment***  It is proposed add a component of maximum number of codepoints configured for SFN data to FGs 23-6-1/1b/2/2b, to avoid the complexity of large number of combined TCI states for HST-SFN. Another option can be a new FG to maximal number of PDSCHs per slot. Either option can resolve the problem.   * Option 1: Add the following component to FGs 23-6-1/1b/2/2b   + The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8} * Option 2: Add a new FG for PDSCH processing capability in HST   + Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}   With above analysis, we propose the following:  ***Proposal 3-8: down-select between the following options for HST-SFN FGs:***   * ***Option 1: Add the following component to FGs 23-6-1/1b/2/2b***   + ***The maximal number of codepoints configured for SFN data, with candidate values {1, 2, 3, 4, 5, 6, 7, 8}*** * ***Option 2: Add a new FG for PDSCH processing capability in HST***   + ***Component 1. The maximal number of PDSCHs per slot, with candidate values {1, 2, 3, 4 ,7}*** |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2b | SFN scheme B (TRP based pre-compensation) for PDSCH only | 1. Support of SFN scheme B for PDSCH scheduled by single TRP PDCCH | 23-6-2 | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH only is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In the last RAN1 meeting #108e, the number of TCI codepoint configured with SFN PDSCH was discussed. If UE supports N TCI states, this doesn’t mean that UE can support all the combination of TCI pairs. For example, a UE can support 4 TCI states, but can only support single pair TCI states, i.e., one TCI codepoint, for SFN data. This issue is even more pronounced for SFN scheme B as TCI pair {TCI1, TCI2} is not the same for the TCI pair {TCI2, TCI1}. A component of maximum number of codepoints configured for SFN data should be added for UE FGs of SFN scheme A and SFN scheme B.  ***Proposal 8-1: Add component 2 of maximum number of codepoints configured for SFN data with candidate values {1,2,3,4,5,6,7,8} for FG 23-6-1, 23-6-1b, 23-6-2 and 23-6-2b***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-2b | SFN scheme B (TRP based pre-compensation) for PDSCH only | 1. Support of SFN scheme B for PDSCH scheduled by single TRP PDCCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH only is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] | * + - 23-6-1-1 should be included in the prerequisite.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling | |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | ***Proposal 8-3: The prerequisite of FG 23-6-3 should be FG 23-6-1 or 23-6-2 or 23-6-1-1.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | [23-6-1 or 23-6-2] | Yes |  | Default DL beam setup for SFN is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | [23-6-1 or 23-6-2] | Yes |  | Default DL beam setup for SFN is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |   On 23-6-4, there’s a need to clarify what is the “Default DL beam setup for SFN”. In our understanding the “Default DL beam setup for SFN” refers to the UE behaviour enableTwoDefaultDCI-states is configured.   1. On 23-6-4, clarify the “Default DL beam setup for SFN” as “Default DL beam setup when enableTwoDefaultDCI-states is configured”. |
| LG Electronics [9] |  |
| Apple [10] | * + For FG23-6-4: pre-requisite can be “23-6-1 or 23-6-1b or 23-6-2 or 23-6-2b”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | 23-6-1 or 23-6-1b or 23-6-2 or 23-6-2b | Yes |  | Default DL beam setup for SFN is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | * For FG 23-6-4/23-6-4a, we agree to have pre-requisite feature as FG23-6-1 or FG23-6-2. As we discussed above, FG23-6-1 and FG23-6-2 are basic FGs of SFN schemes. All UE supports SFN schemes shall support either/both of FG23-6-1 or/and FG23-6-2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | 23-6-1 or 23-6-2 | Yes |  | Default DL beam setup for SFN is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | ~~[~~23-6-1 or 23-6-2~~]~~ | Yes |  | Default DL beam setup for SFN is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | [23-6-1 or 23-6-2] | Yes |  | Default UL beam setup for SFN is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | * + For FG23-6-4a: pre-requisite can be “23-6-1 or 23-6-1b or 23-6-2 or 23-6-2b”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | 23-6-1 or 23-6-1b or 23-6-2 or 23-6-2b | Yes |  | Default UL beam setup for SFN is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] | * For FG 23-6-4/23-6-4a, we agree to have pre-requisite feature as FG23-6-1 or FG23-6-2. As we discussed above, FG23-6-1 and FG23-6-2 are basic FGs of SFN schemes. All UE supports SFN schemes shall support either/both of FG23-6-1 or/and FG23-6-2.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | 23-6-1 or 23-6-2 | Yes |  | Default UL beam setup for SFN is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | ~~[~~23-6-1 or 23-6-2~~]~~ | Yes |  | Default UL beam setup for SFN is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. [A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC] 9. [A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs] |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   [Component 5: The list can have maximum of 16 pairs.  - Y1: {1 to 4}  - Y2: {1 to 8}]  [Component 6: The list can have maximum of 16 pairs.  - X1: {1 to 16}  - X2: {1 to 32}]  Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | Since the number of CMRs associated with CMR pair for NCJT measurement is always even, it is unnecessary to include the odd candidate values for Component 4 c) of FG 23-7-1,.  ***Proposal: 5.1: Delate the odd candidate values for Component 4 c) of FG 23-7-1.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. [A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC] 9. [A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs] |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2~~,3,4 …~~ : 2: 64} 3. {2,3,4, …, 256}   [Component 5: The list can have maximum of 16 pairs.  - Y1: {1 to 4}  - Y2: {1 to 8}]  [Component 6: The list can have maximum of 16 pairs.  - X1: {1 to 16}  - X2: {1 to 32}]  Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214 | Optional with capability signalling | |
| ZTE [3] | * In FG 23-7-1, for component-5 and 6, we have already increased the number of occupied CPU(s) compared with s-TRP CSI calculation, and therefore the legacy UE capability report for CPU(s) should be sufficient.  |  |  |  | | --- | --- | --- | | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. ~~[A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC]~~ 9. ~~[A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs]~~ | |
| Vivo [4] |  |
| Xiaomi [5] | There are some remained issues on two FG 23-7-1 and FG 23-7-1b. It will be disccuesed whether both Component 5 and Componet 6 for FG 23-7-1 is retained or not. It was agreed that UE can report NCJT CSI and sTRP CSI simultaneously. In addition, the PMI search complexity is different for NJCT CSI and sTRP CSI. This implies that it cannot infer the UE capabiltity by just reporting the processing capability of NCJT CSI or sTRP CSI. Hence, the two components should be kept to indicate the processing capabiltiliy of UE when NJCT CSI and sTRP CSI are reported together.  It was also agreed that UE does not report sTRP CSI, i.e., X=0, and only NCJT CSI is fedback for NCJT. For NCJT CSI reporting, only Type I codebook is supported. Howerever, the PMI computation complexity for NCJT CSI and sTRP CSI even if both them adopt Type I codebook to report CSI. Therefore, codebook combinations on codebook1 should include NCJT and NCJT with Type 1 SP, repespectively, for Component 1 of FG 23-7-1b. According to above discussion, we provide the following proposal.  Proposal 10-1: Adopt the following for Rel-17 mTRP CSI UE feature (highlighted in blue).   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. ~~[~~A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC~~]~~ 9. ~~[~~A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs~~]~~ |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   ~~[~~Component 5: The list can have maximum of 16 pairs.  - Y1: {1 to 4}  - Y2: {1 to 8}~~]~~  ~~[~~Component 6: The list can have maximum of 16 pairs.  - X1: {1 to 16}  - X2: {1 to 32}~~]~~  Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214 | Optional with capability signalling | |
| Samsung [6] | Before Rel-17, when we only consider single-TRP CSI measurement hypothesis, there are UE capability signalling FG 2-35 including Component 8 meaning that UE can process Y CSI report(s) simultaneously in a CC and Component 9 meaning that UE can process X CSI report(s) simultaneously across all CCs. Component 8 of FG 2-35 can have a candidate value from 1 to 8, and Component 9 of FG 2-35 can have a candidate value from 5 to 32.  In RAN1#108-e, FG 23-7-1 has been agreed with 6 Components including the extended version of Components 8 and 9 in FG 2-35 considering NCJT CSI as well. Among those, based on Component 5, UE can report a list of (Y1, Y2) meaning that UE can process Y1 NCJT CSI and Y2 single-TRP CSI measurement hypothesis simultaneously in a CC. The possible list of candidate values can be 16 pairs of (Y1,Y2) where Y1 can be from 1 to 4 and Y2 can be from 1 to 8. Also, based on Component 6, UE can report a list of (X1, X2) meaning that UE can process X1 NCJT CSI and X2 single-TRP CSI measurement hypothesis simultaneously across all CCs. The possible list of candidate values can be 16 pairs of (X1,X2) where X1 can be from 1 to 16 and X2 can be from 1 to 32.  Therefore, comparing Component 8 of FG 2-35 with Component 5 of FG 23-7-1, if a Rel-17 UE reports (Y1,Y2) as (4,8) which is the combination of the maximum values for both Y1 and Y2, then the maximum capability is increased from 8 to 12. Similarly, comparing Component 9 of FG 2-35 with Component 6 of FG 23-7-1, if a Rel-17 UE reports (X1,X2) as (16,32) which is the combination of the maximum values for both X1 and X2, then the maximum capability is increased from 32 to 48. These increased maximum values would be significant burden for UE to calculate both single-TRP and NCJT CSI measurement hypothesis. Hence, we would like to propose the limitation of the value Y1+Y2 as 8 and X1+X2 as 32, respectively, which is aligned with the maximum capability of current UE.  **Proposal 18:** *Regarding Component 5 and 6 in FG 23-7-1, support Y1+Y2≤8 and X1+X2≤32.* |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] | * Remove component 5 and 6.   The question is whether CPUs for MTRP CSI should be counted in different CPU pools, separately from all other CSI calculations, or the same CPU pool should be used, whose size is indicated by *simultaneousCSI-ReportsPerCC* and *simultaneousCSI-ReportsAllCC*, per CC and across all CCs, respectively. These two capability components were introduced in Rel-15 FG 2-35 for all CSI calculations. In our view, introducing two new CPU pools, for single-TRP and NCJT CSI calculations, respectively, only for MTRP CSI reporting is unnecessary and complicates the CPU occupancy count, because it requires adding two new separate counters with corresponding rules for not updating certain CSIs when the calculation exceeds the maximum capability of the corresponding CPU pool.   * Remove Note. This note is not needed as ‘NCJT’ is also used in the RRC parameters description |
| MediaTek Inc. [13] | The current capability signalling design leads to underreporting of UE’s capability of processing single-TRP CSI. Therefore, the listed Component 5 and Component 6 are preferable as UE can inform gNB about its processing capability in the tradeoff between NCJT CSI measurement hypotheses and single-TRP CSI measurement hypotheses. Furthermore, the listed candidate values make sense.  **Proposal 24:** **Support Component 5 and Component 6 in FG 23-7-1 and their candidate values.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. ~~[~~A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC~~]~~ 9. ~~[~~A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs~~]~~ |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   ~~[~~Component 5: The list can have maximum of 16 pairs.  - Y1: {1 to 4}  - Y2: {1 to 8}~~]~~  ~~[~~Component 6: The list can have maximum of 16 pairs.  - X1: {1 to 16}  - X2: {1 to 32}~~]~~  Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214 | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | The following are proposed for mTRP CSI UE features:   * In FG 23-7-1:   + A component 7 should be added to FG 23-7-1, which is to indicate the supported codebook mode for NCJT CSI. Note that for sTRP Type1 SP, UE reports the supported codebook mode through component 2 of FG 2-36.   + Components 5 and 6 are needed but they can be simplified given the compromise in the previous meeting. That is, components 5 and 6 can be changed to report one value for NCJT only (instead of a list for both NCJT and sTRP), which is the same as component 4 for reporting triplets for NCJT only for CMRs/ports.     - In the previous meeting, some companies argued that components 5 and 6 even in the simplified form suggested above will result in many changes to 38.214. However, we do not think that is the case. In Rel-15, number of CPUs is reported per CC and across all CCs (by *simultaneousCSI-ReportsPerCC* and *simultaneousCSI-ReportsAllCC*). However, the priority rule for “not updating the remaining CSI reports” when CPU limit is exceeded is not jointly specified for the per CC limit and across all CCs limits. Hence, the same principle should be followed for the CPU budget for NCJT without the need for any joint consideration.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. ~~[A list of (Y1,Y2):~~ UE can process Y~~1~~ NCJT CSI ~~and Y2 sTRP CSI~~ measurement hypothesis simultaneously in a CC~~]~~ 9. ~~[A list of (X1,X2):~~ UE can process X~~1~~ NCJT CSI ~~and X2 sTRP CSI~~ measurement hypothesis simultaneously across all CCs~~]~~ 10. Supported codebook modes for NCJT CSI |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   ~~[~~Component 5: ~~The list can have maximum of 16 pairs.~~  - Y~~1~~: {1 to 4}  ~~- Y2: {1 to 8}]~~  ~~[~~Component 6: ~~The list can have maximum of 16 pairs.~~  - X~~1~~: {1 to 16}  ~~- X2: {1 to 32}]~~  Component 7 candidate values: {mode 1, both mode 1 and mode 2}  Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214 | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  | [Active CSI-RS resources and ports in the presence of multi-TRP CSI is not supported] | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {[‘NCJT’,] NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] | * In FG 23-7-1b, for component-1, we think ‘NCJT’-only case should be captured in codebook-1 for covering the case that only NCJT mode is configured per band.  |  |  |  | | --- | --- | --- | | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  🡪 Component 1 candidate values:  Codebook 1 = {~~[~~‘NCJT’,~~]~~ NCJT+Type 1 SP (for sTRP)}  🡪 {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | |
| Vivo [4] |  |
| Xiaomi [5] | There are some remained issues on two FG 23-7-1 and FG 23-7-1b. It will be disccuesed whether both Component 5 and Componet 6 for FG 23-7-1 is retained or not. It was agreed that UE can report NCJT CSI and sTRP CSI simultaneously. In addition, the PMI search complexity is different for NJCT CSI and sTRP CSI. This implies that it cannot infer the UE capabiltity by just reporting the processing capability of NCJT CSI or sTRP CSI. Hence, the two components should be kept to indicate the processing capabiltiliy of UE when NJCT CSI and sTRP CSI are reported together.  It was also agreed that UE does not report sTRP CSI, i.e., X=0, and only NCJT CSI is fedback for NCJT. For NCJT CSI reporting, only Type I codebook is supported. Howerever, the PMI computation complexity for NCJT CSI and sTRP CSI even if both them adopt Type I codebook to report CSI. Therefore, codebook combinations on codebook1 should include NCJT and NCJT with Type 1 SP, repespectively, for Component 1 of FG 23-7-1b. According to above discussion, we provide the following proposal.  Proposal 10-1: Adopt the following for Rel-17 mTRP CSI UE feature (highlighted in blue).   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  | ~~[~~Active CSI-RS resources and ports in the presence of multi-TRP CSI is not supported~~]~~ | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {~~[~~‘NCJT’,~~]~~ NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling | |
| Samsung [6] | In RAN1#107b-e there was a discussion on how to incorporate UE capability reporting on the supported mixed codebook types pertinent to NCJT CSI reporting. In order to keep the structure of the legacy UE capability reporting for mixed codebook types in FG 16-8 while limiting the new capability reporting to CSI reporting for NCJT, we support a separate mixed codebook types capability reporting for NCJT as FG 23-7-1b.  **Proposal 19:** *Support FG 23-7-1b for mixed codebook reporting for NCJT with reporting structure {Codebook 1, Codebook 2, Codebook 3}*   * *NCJT + Type 1 SP (for sTRP) as a candidate value for Codebook 1.* * *Support a candidate value {Codebook 2, Codebook 3}={Null, Null}.* |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  |  | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {‘NCJT’, NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] | * + - “Consequence if the feature is not supported by a UE”.   We suggest the wording “**Active CSI-RS resources and ports in the presence of multi-TRP CSI with mode 1 and X>0 or mode 2 is not supported**”. When 23-7-1b is absent the max number of active resources/ports when both NCJT and single-TRP measurements are configured is not defined, hence mode 1 with X>0 and mode 2 reporting cannot be configured for MTRP CSI. For mode 1 with X=0, only NCJT measurements are needed, hence the triplets in component 4 of 23-7-1 are needed.   * + - Remove brackets from ‘NCJT’ in component 1 candidate values.   If NCJT is not included in the candidate values and mode 1, with X=0 is configured together with any of Rel16/17 combinations, it is not clear how many resources/ports can be active.   * + - Add a Note: the codebook combination {‘NCJT’,NULL,NULL} is indicated in component 4 of 23-7-1 |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | * In FG 23-7-1b:   + In codebook 1 of component 1 candidate values, ‘NCJT’ can be deleted as the existing FG 23-7-1 is to report capability for NCJT only (i.e., in the absence of sTRP CSI). Furthermore, the case that for Type1 SP codebook, network only configures NCJT CSI without any sTRP CSI is not practical or useful.   + Consequence if not supported can be “Combination of multi-TRP CSI and sTRP CSI (with Type 1 SP codebook or other codebooks) is not supported.”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  | ~~[Active CSI-RS resources and ports in the presence of multi-TRP CSI is not supported]~~  Combination of multi-TRP CSI and sTRP CSI (with Type 1 SP codebook or other codebooks) is not supported. | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {~~[‘NCJT’,]~~ NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-7-1a | Additional CSI report mode 1 | Maximum value of numberOfSingleTRP-CSI-Mode1 | 23-7-1 | Yes |  | CSI report mode 1 with X=1, or X=2 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate value set: { X=1, X=2} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] | In FG 23-7-1, there is a component for “CSI report mode selection of mode 1 with X=0 and/or mode 2” with candidates of {mode 1 with X=0, mode 2, both}. In FG 23-7-1a, there is additional FG for CSI report mode 1 saying “Maximum value of numberOfSingleTRP-CSI-Mode1” with candidate values of {X=1, X=2}. In our understanding, mode 1 with X=0 should be pre-requisite of mode 1 with X=1 and X=2. If UE cannot support mode 1 with X=0, it is impossible to support mode 1 with X=1 and X=2. That is, UE can report FG 23-7-1a only when it reports“mode 1 with X=0” or “both” for component 3 of FG 23-7-1.  ***Proposal: Add a note for FG 23-7-1a (Additional CSI report mode 1 selection): UE reports this capability only when UE reports “mode 1 with X=0” or “both” for component 3 of FG 23-7-1.*** |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-7-4 | Support of Nmax=2 for Multi-TRP CSI | Support of maximum number of CMR pairs Nmax=2 configured in NZP-CSI-RS-ResourceSet for a given CSI report setting | 23-7-1 | Yes |  | Nmax=2 for Multi-TRP CSI is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] |  |
| ZTE [3] |  |
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| Xiaomi [5] |  |
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| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-7-5 | CMR sharing | Support a NZP CSI-RS resource referred by both a CMR pair configured for Rel-17 Multi-TRP CSI enhancement and a single CMR configured for Single-TRP measurement in a CSI reporting setting | 23-7-1 | Yes |  | CMR sharing is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| Company | Summary |
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| Samsung [6] |  |
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| 23. NR\_FeMIMO | 23-8-1 | SRS triggering offset enhancement | The maximum number of configured available slots offsets for determining aperiodic SRS location based on available slot | 2-52 | Yes |  | SRS triggering offset enhancement is not supported | Per band | n/a | n/a | n/a | Candidate 1 component values: {1, 2, 4} | Optional with capability signalling |

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| Company | Summary |
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| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
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| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-8-2 | Triggering SRS only in DCI 0\_1/0\_2 | Support of triggering SRS in DCI 0\_1/0\_2 without data and without CSI | 2-52 | Yes |  | Triggering SRS only in DCI 0\_1/0\_2 is not supported | per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
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| 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>4  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}  Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest y  Component 2 candidate values: {1 to 32}  Component 3 candidate values: {1 to 32}  Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y. | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [2] | For 23-8-3, the candidate value of component 1 is “a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}”, which means it can indicate 4R antenna switching configuration. Notice that Rel-15/16 capability also can indicate 4R antenna switching configuration, then how to deal with the situation where Rel-15/16 capability and Rel-17 capability indicating same value for component 1 (e.g., 1t4r) and different value for component 2/3 should be further clarified. Therefore we propose to add the note below.  ***Proposal 4-2: Add following note for 23-8-3 to clarify the rule of dealing with the situation where Rel-15/16 capability and Rel-17 capability indicating same value for component 1 and different values for component 2/3:***  ***Note: For the xTyR antenna switching configurations that are both reported here and in Rel-15/16 SRS antenna switching feature (2-55 and 14-4), the component 2 and 3 of this feature apply.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>4  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}  Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest y  Component 2 candidate values: {1 to 32}  Component 3 candidate values: {1 to 32}  Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y.  Note: For the xTyR antenna switching configurations that are both reported here and in Rel-15/16 SRS antenna switching feature (2-55 and 14-4), the component 2 and 3 of this feature apply. | Optional with capability signalling | |
| ZTE [3] |  |
| Vivo [4] |  |
| Xiaomi [5] |  |
| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>4  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}  Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest y  Component 2 candidate values: {1 to 32}  Component 3 candidate values: {1 to 32} | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] | In 23-8-3 note, it has “Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y”. However, component 1 can report a combination with multiple values, it is not clear which xTyR is considered.  Furthermore, FG 23-8-3 should be reported only when the largest y>4, so it never has x=y for the most capable xTyR.  **Proposal 27: remove or review the need of “Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y”.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>4  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | Yes |  | SRS Antenna switching for >4Rx is not supported | Per FS | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}  Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest y  Component 2 candidate values: {1 to 32}  Component 3 candidate values: {1 to 32}  ~~Note: Component 2 and component 3 is not reported if component 1 is reported as xTyR with x=y.~~ | Optional with capability signalling | |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-8-4 | Maximum 2 SP and 1 periodic SRS sets for antenna switching | Support of maximum 2 SP SRS resource sets and maximum 1 periodic SRS resource set for antenna switching | 2-53 | Yes |  | Maximum 2 SP and 1 periodic SRS sets for antenna switching is not supported | Per FS | n/a | n/a | n/a | Note1:   * Applies for all supported xTyR where y<=8 * For xTyR where y>4, 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 * For xTyR where y<=4, if UE does not support this feature, follow Rel-15 on the number of resource sets for periodic and semi-persistent SRS * The two SP-SRS resource sets are not activated at the same time | Optional with capability signalling |

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| Company | Summary |
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| 23. NR\_FeMIMO | 23-8-5 | Increased repetition for SRS | Support of increased repetition patterns (8, 10, 12, 14 symbols) for SRS resource | 10-11, 2-52 | Yes |  | Increased repetition for SRS is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS | 2-52 | Yes |  | Partial frequency sounding of SRS is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
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| Samsung [6] |  |
| OPPO [7] |  |
| Ericsson [8] |  |
| LG Electronics [9] |  |
| Apple [10] |  |
| NTT DOCOMO, INC. [11] | For FG23-8-6, the following agreement in the last e-meeting should be captured. In other words, this FG should be divided into two, one for FH case, and the others for non-FH case.   |  | | --- | | **Agreement**  RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS with frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS with frequency hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-8-6a | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS without frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS without frequency hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In RAN1 meeting #108e, it was agreed to support RPFS for non-frequency hopping case as optional UE feature.   |  | | --- | | **Agreement**  RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS. |   To implement this agreement, the description of FG 23-8-6 should be updated to include only frequency hopping scenario. In addition, a new FG should be added for UE support of RPFS for non-FH case.  ***Proposal 9-1: Update the description of FG 23-8-6 as following “Support of partial frequency sounding for SRS frequency hopping”,***  ***Proposal 9-2: Add new FG 23-8-6-1 for the support of partial frequency sounding for SRS non frequency hopping.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS frequency hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-8-6-1 | Partial frequency sounding for SRS non-frequency hopping case | Support of partial frequency sounding for SRS non frequency hopping case |  |  |  | Partial frequency sounding of SRS non-FH is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-8-7 | Start RB location hopping for partial frequency SRS | Support of start RB location hopping in partial frequency SRS transmission across different SRS frequency hopping periods for periodic/semi-persistent/aperiodoc SRS | 23-8-6 | Yes |  | Start RB location hopping for partial frequency SRS is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-8-8 | Comb-8 SRS | Support of comb-8 for SRS other than for positioning |  | Yes |  | comb-8 for SRS other than for positioning is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R is not supported | Per FS | N/A | N/A | N/A | [Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports] | Optional with capability signalling |

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| Company | Summary |
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| NTT DOCOMO, INC. [11] | For FG23-8-9, whether to have a note “Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports” is FFS. We are fine with having this note as it is.  We also believe the following should be reflected by introducing a new FG, as we suggest as FG23-8-10 below. Note that since this FG is to be similar to FG23-8-9, we think it may be necessary to update FG23-8-9 as well, so that the difference between them is clarified enough, as suggested on the table below.   |  | | --- | | **Agreement (#108-e)**  FL Proposal 3-1: Support N = 1 for aperiodic SRS configuration for 1T4R   * This new configuration is UE optional. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-9 | Support of 4 aperiodic SRS resource sets for 1T4R, and 2 aperiodic resource sets for 1T2R and 2T4R | Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R. | 2-53, 2-55 | Yes |  | SRS antenna switching with 4 aperiodic SRS resource sets for 1T4R, and 2 aperiodic SRS resource sets for 1T2R and 2T4R are not supported | Per FS | N/A | N/A | N/A | Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports | Optional with capability signalling | | 23. NR\_FeMIMO | 23-8-9 | Support of 1 aperiodic SRS resource set for 1T4R | Support of 1 aperiodic SRS resource set for 1T4R | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration with 1 aperiodic SRS resource set for 1T4R is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling | |
| Nokia/Nokia Shanghai Bell [12] |  |
| MediaTek Inc. [13] |  |
| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] | In RAN1 meeting #108-e, it was agreed to extend 1T4R SRS sets/resource configuration and support single SRS set with 4 SRS resource with 1 port per resource as UE optional feature. The description of FG 23-8-9 should be updated to include a second component for such SRS configuration. This is a better option than creating a new UE feature. In addition, it is aligned with the editor 38.214 CR.   |  | | --- | | **Agreement**  Support single SRS resource set for aperiodic SRS configuration for 1T4R with 4 SRS resources, 1 port each.   * This new configuration is UE optional |   ***Proposal 9-3: For 23-8-9, add component 2 for the support single SRS resource set for aperiodic SRS configuration for 1T4R with 4 SRS resources, 1 port each.***   * ***Remove the square brackets for the note which is needed to clarify that this FG is applicable for subset of FG 2-55.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | 1. Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R.  2. Support single SRS resource set for aperiodic SRS configuration for 1T4R with 4 SRS resources, 1 port each. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R is not supported | Per FS | N/A | N/A | N/A | ~~[~~Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports~~]~~ | Optional with capability signalling | |

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| 23. NR\_FeMIMO | 23-9-1 | Basic Features of Further Enhanced Port-Selection Type II Codebook (FeType-II) | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=1 and R=1 2. Support rank 1,2 3. Support parameter combinations with M=1 | 2-35 | Yes |  | Further Enhanced Port-Selection Type II Codebook (FeType-II) is not suported | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64}   Max # total ports: {4 to 256} | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-9-5 | Active CSI-RS resources and ports for mixed codebook types in any slot | 1. List of codebook combinations   List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-9-1, 16-3a, 2-36, 2-40, 2-41, 23-9-2, 23-9-4 | Yes |  | Active CSI-RS resources and ports for mixed codebook types in any slot is not suported | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {Type I SP, Type I MP}  {Codebook 2, Codebook 3} = {{FeType II PS M=1, NULL},{FeType II PS M=2 R=1, NULL}, {FeType II PS M=2 R=2, NULL}, {Type II, FeType II PS M=1}, {Type II, FeType II PS M=2 R=1} ,{eType II R=1, FeType II PS M=1},{eType II R=1, FeType II PS M=2 R=1}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1：if a UE reports one or more codebook combinations in 23-9-5, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note 2: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8, 23-9-5 and per-codebook capability 2-36/40/41, 16-3a, and 23-9-1/23-9-2/23-9-4  Note 3: Up to 4 combinations for component 1 | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-9-2 | Support of M=2 and R=1 for FeType-II | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=2 and R=1  2. Support parameter combinations with M=2 | 23-9-1 | Yes |  | M=2 and R=1 for FeType-II is not suported | per band and per BC | n/a | n/a | n/a | Component 1 candidate values  - Maximum 8 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signalling |

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| Company | Summary |
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| Intel Corporation [14] |  |
| Qualcomm Incorporated [15] |  |

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| 23. NR\_FeMIMO | 23-9-3 | Support of rank 3, 4 for FeType-II | Support of rank 3, 4 for FeType-II | 23-9-1 | Yes |  | Rank 3, 4 for FeType-II is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-9-4 | Support of R = 2 for FeType-II | 1. Support of R = 2 for FeType-II  2. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=2 and R=2 | 23-9-2 | Yes |  | R = 2 for FeType-II is not suported | per band and per BC | n/a | n/a | n/a | Component 2 candidate values:  • Maximum 8 triplets  • Max # of Tx ports in one resource: {4,8,12,16,24,32}  • Max # resources: {1 to 64}  • Max # total ports: {4 to 256} | Optional with capability signalling |

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

**Others**

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | The following agreement has been agreed, but not captured yet.  **Agreement**  To handle UE complexity / memory requirements for linked PDCCH candidates, address the issue by UE capability, where UE indicates a limit (X) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span.   * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * The limit X is indicated per CC and also across all CCs * Note: “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate.   Above is applicable at least for the inter-span case (FFS: intra-span case)  The value X related to AL was introduced to report the memory limit supported by UE at least for inter-span case. The remaining issue of whether the limit X can be applied for intra-span case is discussed in [2]. Therefore, we propose to add the new FG 23-2-3 and a candidate value for X indicated by UE.  ***Proposal 3-2: Add a new FG 23-2-3 as follows,***  ***FG 23-2-3 UE memory requirements for linked PDCCH candidates***   * ***1. Support a limit (X) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span.*** * ***2. The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16.*** * ***3. The limit X is indicated per CC and also across all CCs*** * ***The FG is applicable for the inter-span case and intra-span case.***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-3 | UE memory requirements for linked PDCCH candidates | 1.Support a limit (X) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span.2.The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16.  3.The limit X is indicated per CC and also across all CCs  The FG is applicable for the inter-span case and intra-span case. | 23-2-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component 1 candidate value: {FFS} | Optional with capability signalling |   ***Beam Management for multi-TRP***  A UE need simultaneous two panel activation to receive the simultaneous measurement on two CMR resource sets with two different QCL-TypeD in FR2, which would result in high UE implementation complexity. So we propose,  ***Proposal 3-5: Add a new FG 23-5-1b as follows,***  ***FG 23-5-1b Two QCL TypeD for group based L1-RSRP reporting enhancement***   * + ***Simultaneous reception of CSI-RS/SSB across two CMR sets with different QCL Type-D***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-1b | Two QCL TypeD for group based L1-RSRP reporting enhancements | 1. Simultaneous reception of CSI-RS/SSB across two CMR sets with different Type-D |  |  |  |  |  |  |  | FR2 only |  | Optional with capability signalling |   In order to limit the UE implementation complexity in tracking activated TCI, similar to FG 2-4 in Rel-15 and FG 16-2a-7, the maximum number of activated TCI states should also be added in HST scenarios  ***Proposal 3-9: Support adding a new FG 23-6-5 for TCI tracking capability in HST as follow,***   * + ***FG 23-6-5: Component 1. The maximal total number of activated TCI states per BWP per CC including data and control, with candidate values {1, 2, 4, 8 ,16};***   + ***FG 23-6-5: Component 2. The maximal total number of activated TCI states all BWPs all CCs including data and control, with candidate values {1, 2, 4, 8 ,16, 32};***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-5 | Maximum number of activated TCI states for HST/[URLLC] | 1. The maximal number of activated TCI states per BWP per CC including data and control  2. The maximal number of activated TCI states all BWPs all CCs including data and control |  |  |  |  |  |  |  |  | Candidate values for Component 1: {1,2,4,8,16}  Candidate values for Component 2: {1,2,4,8,16, 32} |  | | 23. NR\_FeMIMO | 23-6-6 | PDSCH processing capability for HST/[URLLC] | 1. The maximal number of PDSCH per slot |  |  |  |  |  |  |  |  | Candidate values for Component 1: {1,2,3,4,7} |  |   In last meeting, 1 aperiodic SRS resource set was supported for 1T4R, which is UE optional.  Agreement  Support N = 1 for aperiodic SRS configuration for 1T4R   * This new configuration is UE optional.   According to the agreement, a new UE capability should be added for the new feature. Therefore, we propose  ***Proposal 4-1: Add a new FG 23-8-10 for 1 aperiodic SRS resource set for 1T4R.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-10 | 1 aperiodic SRS resource set for 1T4R | Support of 1 aperiodic SRS resource sets for 1T4R. | 10-11, 2-55 | Yes |  | 1 aperiodic SRS resource set for 1T4R is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling |   For partial sounding, following agreement was achieved in last meeting:  Agreement  RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS.  According to the agreement, a new UE feature is needed for RPFS for the non-frequency hopping cases. Therefore, we propose  ***Proposal 4-2: Add a new FG 23-8-11 for RPFS for non-FH case.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-11 | Partial frequency sounding of SRS for non-frequency hopping case | Support of partial frequency sounding for SRS for non-frequency hopping case. | 23-8-6 | Yes |  | Partial frequency sounding of SRS for non-frequency hopping case is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |   The UE is not mandated to support simultaneous reception with different QCL-TypeD for Rel-16 NCJT operation. Therefore UE FG 16-2c *simultaneousReceptionDiffTypeD-r16* is used to indicate whether UE supports simultaneous reception with different QCL-TypeD reference signal, as 38.306.  However it is unclear whether *simultaneousReceptionDiffTypeD-r16* can be applied CSI-IM resources, since one may argue that CSI-IM is not reference signal. Therefore if *simultaneousReceptionDiffTypeD-r16* reports “not support” (i.e. such an IE is not reported by UE), NW may be able to configuretwo CMRs with different QCL-TypeD with a TDM manner, e.g., over different symbols in a slot.  Then according to following agreement in RAN1 #104bis-e:  **Agreement**  The UE may assume that QCL-Type D of CMRs associated with a NCJT measurement hypothesis are applied to the corresponding CSI-IM resource.  The UE still have to apply two different QCL-Type D of CMRs associated with a NCJT measurement hypothesis over the corresponding CSI-IM resource simultaneously. Therefore the UE needs to support two receive beams simultaneously which is contradictive to the spirit of FG 16-2c to report “not support”.  So we have the following proposal:  **Proposal 5.2: Add a new FG 23-7-6 to i*ndicate whether UE supports simultaneous reception with different QCL-TypeD for CSI-IM resource associated with NCJT measurement hypothesis.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-6 | Simultaneous reception of CSI-IM with different Type-D | Supports simultaneous reception with different QCL Type-D over CSI-IM resources for Multi-TRP CSI | 23-7-1 |  |  |  | Per UE |  | FR2 only |  |  | Optional with capability signalling | |
| ZTE [3] | Besides joint TCI state, we need to additionally introduce a FG for separate TCI for intra- and inter-cell beam management. The approved FG structure for joint TCI state can be reused as a baseline, except that we have separate components for DL and UL TCI states. Based on this principle we have the following proposal.  ***Proposal 8:*** *For separate TCI for intra- and inter-cell beam management, the following should be introduced.*   |  |  |  | | --- | --- | --- | | 23-5-1 | Unified TCI with separate DL/UL TCI update for intra- and inter-cell beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured DL TCI states across all CC in a band 3. The maximum number of configured UL TCI states across all CC in a band 4. One MAC-CE activated DL TCI state per CC in a band 5. One MAC-CE activated UL TCI state per CC in a band 6. TCI state indication mode: update and activationa) MAC CE based TCI state indication for one active DL/UL TCI state 7. The maximum number of MAC-CE activated DL TCI states across all CC(s) in a band 8. The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band | | 23-5-1b | Unified TCI with separate DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated separate TCI state per CC | 1. TCI state indication mode: update and activation b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS 3. The maximum number of MAC-CE activated DL TCI states per CC in a band 4. The maximum number of MAC-CE activated UL TCI states per CC in a band | | 23-5-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework | | 23-5-1d | Per BWP DL/UL-TCI state pool configuration for CA mode | 1. Support of DL/UL TCI state pool configuration per BWP for CA mode | | 23-5-1e | TCI state pool configuration with DL/UL-TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC 2. The maximum number of configured DL TCI state pools across all BWPs and all CCs in a band 3. The maximum number of configured UL TCI state pools across all BWPs and all CCs in a band | | 23-5-1f | Common multi-CC DL/UL-TCI state ID update and activation | Common multi-CC DL/UL-TCI state ID update and activation | | 23-5-1g | Beam misalignment between the DL source RS in the UL TCI state | Beam misalignment between the DL source RS in the UL TCI state to provide spatial relation indication and the PL-RS | | 23-5-1h | Association between UL-TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between UL-TCI state and UL PC settings except for PL RS | | 23-5-1i | Indication/configuration of R17 DL-TCI states for aperiodic CSI-RS, PDCCH, PDSCH and SRS | Support of indication/configuration of R17 DL TCI states for aperiodic CSI-RS, PDCCH, PDSCH (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s); | | 23-5-1j | Indication/configuration of R17 UL-TCI states for SRS | Support of indication/configuration of R17 UL TCI states for SRS reusing the Rel-15/16 signaling/configuration design(s); |   In addition, given that inter-span PDCCH repetition was agreed as a UE optional feature in RAN1#106bis-e meeting as below, we think a new FG should be introduced to capture it.   |  | | --- | | **Agreement** (in RAN1#106bis-e)  When 3 BDs are counted for two linked candidates   * The third BD is counted in the later span for inter-span PDCCH repetition when r16monitoringcapablity is configured. * Note: Inter-span repetition is UE optional |   According to the above check points, we have the following proposal.  ***Proposal 9:*** *For multi-TRP PDCCH enhancements, the following modification in red is proposed.*   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23-2-3 | Inter-span PDCCH repetition | Support of inter-span PDCCH repetition |  |  |  |  |  |  |  |  |  | |
| Vivo [4] | A separate FG should be added for mTRP UL full power transmission *fullpowerMode2.*   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | XXX | Multi-TRP PUSCH repetition for *fullpowerMode2* | 1. Support multi-TRP PUSCH repetition for fullpowerMode2  2. Supported number of SRS resources in one SRS resource set | 16-5c，23-3-1 | Yes |  |  | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~4~~} | Optional with capability signalling | |
| Xiaomi [5] | There is an agreement about supporting a UE feature on how many physical cell IDs can be associated with the activated TCI states as following [6]:   |  | | --- | | **Agreement**  On Rel.17 beam indication enhancements for inter-cell beam management, for the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation):   * Support a UE feature on how many physical cell IDs (including that of the serving cell) can be associated with the activated TCI states   + FFS: If UE is configured for only one physical cell ID, decide between the following two options:     - Opt1: the NW can activate TCI states associated with either the same physical cell ID as that of the serving cell or a different physical cell ID from that of the serving cell     - Opt2: the NW can only activate TCI states associated with the same physical cell ID as that of the serving cell   Note: The above does not necessarily mean that more than 1 physical cell ID that is not serving cell in RRC |   Until now, we have discussed the maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement in FG 23-1-2, however this UE feature has not been discussed in any FG. Therefore, it is better to add a new feature group to deal with it which is related to beam indication for inter-cell beam management.  ***Proposal 2-1: Add a new feature group as follows (highlighted in blue).***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-1-1k | beam indication for inter-cell BM | 1. The number of MAC-CE activated PCI(s) different from serving cell PCI for beam indication. | 23-1-1 |  |  |  |  |  |  |  |  |  |   The following has been agreed for SRS enhancement in RAN1#108 meeting.  **Agreement**  RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS.  RPFS for non-FH case also requires new UE capability.  Proposal 9-1: Add FG23-8-10 to support the RPFS for non-FH.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-10 | Partial frequency sounding of SRS | Support of non-frequncy hopping for partial frequency sounding of SRS | 2-52 | Yes |  | RPFS for non-FH is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling | |
| Samsung [6] | Also, FG 23-1-1, FG 23-1-1b, and FG 23-1-2 should be basic features for Rel-17 TCI framework. For such features, we would like to propose the signalling granularity as per band based on two reasons. First reason is that based on working assumption in RAN1#107-e, the UE is not expected to be configured with Rel-15/Rel-16 TCI/*SpatialRelationInfo* if the UE is configured with Rel-17 TCI in any CC in a band. Second reason is that according to RAN2 guidance, the UE features which have “per-band combination” or “per-band per band combination” should be minimized. Hence, “per band” granularity is quite natural starting point to consider for those basic features.  **Proposal 8:** SupportFG 23-1-1, FG 23-1-1b, and FG 23-1-2 as basic features and per-band granularity.  In RAN1#107-e, there was an agreement to handle UE complexity / memory requirements for linked PDCCH candidates as follows.   |  | | --- | | **Agreement**  To handle UE complexity / memory requirements for linked PDCCH candidates, address the issue by UE capability, where UE indicates a limit (X) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span.   * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * The limit X is indicated per CC and also across all CCs * Note: “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * Above is applicable at least for the inter-span case (FFS: intra-span case) |   Since it has not been discussed during UE feature discussion for Rel-17 FeMIMO, we propose to support a new FG (e.g., FG 23-2-5) including the appropriate contents of the above agreement.   * Name: UE complexity / Memory requirements for PDCCH repetition * Component 1: A limit (X1) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span per CC. * Component 2: A limit (X2) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span across all CCs. * Pre-requisite: FG 23-2-1 * Reporting granularity: per band and per BC * Candidate values for each component: FFS * Note: For component 1 and 2, X1 and X2 is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. This is applied for the inter-span case.   **Proposal 12:** Support FG 23-2-5 as a new FG handling UE complexity / memory requirements for PDCCH repetition.  Based on the discussion in RAN1#108-e, the latest version of FGs (23-6-1, 23-6-1-1, 23-6-1a, 23-6-1b, 23-6-2, 23-6-2b, 23-6-3, 23-6-4, 23-6-4a) have been agreed for HST-SFN.  In order to identify two QCL-TypeD properties to receive SFNed PDCCH, since FG 23-2-2 is used for PDCCH repetition, a separate FG supporting to identify two QCL-TypeD properties for SFNed PDCCH which two TCIs have been activated on a CORESET should be needed.  **Proposal 17:** Support separate FG as identifying two QCL-TypeD properties for SFNed PDCCH. |
| OPPO [7] |  |
| Ericsson [8] | The work in the multi-beam agenda targets to develop a more efficient TCI framework. Unnecessary flexible configurations are removed, and the signalling mechanisms for the critical parts are streamlined. However, this work has led to that some Rel-15/16 functionality has been replicated, and based on this replicated functionality, enhancements have been added.  It may be tempting to define a basic level of functionality that contains only the replicated functionality. This would bring the Rel-17 TCI framework on par with the Rel-15/16 functionality and would lead to a functional feature. However, there is no incentive for an operator to deploy only the replicated functionality, and there is no incentive for a NW vendor to implement only the replicated functionality:   1. There is no incentive for a NW vendor to implement only the parts of the Rel-17 TCI framework that replicated the Rel-15/16 functionality.   Based on Observation 1, we conclude that a UE that supports the Rel-17 TCI framework must also support enhancements on top of the replicated functionality:   1. A UE that supports the Rel-17 TCI framework must support enhancements relative the Rel-15/16 TCI framework: it is not sufficient to support only the replicated functionality.   To reiterate: no NW will implement *only* the duplicated functionality. There is no point that a UE only implements and advertises support for the replicated functionality. This would be a useless paper product.  A UE that supports the Rel-17 TCI framework would thus have to also support enhancements. Overall, the Rel-17 TCI framework supports two main performance enhancements:   * DCI-based TCI state update for all channels * Inter-cell beam management   To make the Rel-17 TCI framework attractive for an operator to deploy and attractive for a NW vendor to implement, the basic level of UE support should include both DCI-based TCI state update and inter-cell beam management:   1. A UE that supports the Rel-17 TCI framework should support both DCI-based TCI state update and inter-cell beam management.   The support described in Proposal 1 could be on a minimum level: for example, DCI-based TCI state update requires that the UE supports two active TCI states – but not more than that. Inter-cell beam management would require that the UE can measure on SSBs associated with one PCI different from the serving cell PCI – but not more than one. More advanced UEs could then advertise larger values for these capabilities.  No components have been agreed for separate UL/DL TCI. The assumption is FG 23-1-1 can be used as a starting point to define such components.  Since it is unlikely that separate UL/DL TCI is implemented early, it would make sense that separate UL/DL TCI is a separate FG, to facilitate IODT:   1. Separate DL/UL TCI is a separate FG, and joint DL/UL TCI is a prerequisite FG.   A straightforward extension of component 1 is to replace “joint” with “separate”. However, one additional modification would make sense. Note that SRS is a valid source RS for UL TCI, and that SRS cannot be used as a PL RS. Defining beam alignment between SRS and a DL RS is non-trivial, since in the most realistic case, the SRS is configured without any relation to a DL RS. Based on this argument, we assume that a UE that supports separate DL/UL TCI would have to also support an arbitrary PL RS:   1. The basic component for ‘separate DL/UL TCI’ would be: “Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals, support for beam misalignment)”   Some of the components discussed in subsection 2.1.1 are related to the number of TCI states, both configured and activated.  Since joint DL/UL TCI is a prerequisite FG for the separate DL/UL TCI, and a joint DL/UL TCI is identical to a DL TCI state from a configuration point of view, we propose   1. A UE that supports separate UL/DL TCI states supports the same number of configured DL TCI states as configured joint TCI states.   Of course, there is no need to introduce a separate component – the number reported under FG 23-1-1 can be reused. However, it is required that the UE reports how many configured *UL* TCI states it supports in addition to the joint UL/DL TCI states:   1. A UE that supports separate UL/DL TCI states reports how many configured UL TCI states it supports in addition to the number of joint/DL TCI states.   Note that the number of configured TCI states that are needed is not reduced with the introduction of separate DL/UL TCI. The same is true for the activated TCI states: the number of activated DL TCI states that are needed is not reduced with the introduction of UL TCI states. Hence, we have the corresponding proposals for the activated TCI states:   1. A UE that supports separate DL/UL TCI states supports the same number of activated DL TCI states as activated joint TCI states. 2. A UE that supports separate DL/UL TCI states reports how many activated UL TCI states it supports in addition to the number of activated joint TCI states.   The UL TCI states are now defined in the UL BWP. It would thus make sense to define UE features for the maximum number of UL TCI states per BWP and the total maximum number of UL TCI states across all CCs:   1. Introduce components for the maximum number of TCI states per BWP and across all CCs.   Regarding the beam application time, there is no need for a separate component for separate DL/UL TCI states – the value from FG 23-1-1b is reused.  Also, there is no need for a counterpart of FG 23-1-1c, since SCell BFR is not related to UL TCI states. The same is true for FG 23-1-1j.  Based on a cleaned-up version of the table in section 2.1.1, we propose the following FGs for separate DL/UL TCI:   |  |  |  | | --- | --- | --- | | 23-1-5 | Unified TCI with separate DL/UL TCI update for intra- and inter-cell beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals, support for beam misalignment) 2. The maximum number of configured UL TCI states per BWP per CC 3. One MAC-CE activated UL TCI state per CC 4. TCI state indication: update and activationa) MAC CE based TCI state indication 5. The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band | | 23-1-5b | Unified TCI with separate DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication: update and activation  b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The maximum number of MAC-CE activated UL TCI states per CC | | 23-1-5d | Per BWP UL TCI state pool configuration for CA mode | 1. Support of UL TCI state pool configuration per BWP for CA mode | | 23-1-5e | UL TCI state pool configuration with UL TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference UL TCI state pool shared by a set of BWP/CC  2. The maximum number of configured UL TCI state pools across all BWPs and all CCs in a band | | 23-1-5f | Common multi-CC UL TCI state ID update and activation | Common multi-CC TCI state ID update and activation | | 23-1-5h | Association between UL TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | | 23-1-5i | Indication/configuration of R17 UL TCI states for SRS | Support of indication/configuration of R17 TCI states for SRS reusing the Rel-15/16 signaling/configuration design(s) | |
| LG Electronics [9] | **Additional FGs for separate DL/UL TCI update:** FG23-1-1 and 23-1-1b are for ‘joint DL/UL TCI update’. Similarly, there should be other FGs for ‘separate DL/UL TCI update’.  **Proposal 1: Support the following two FGs for separate DL/UL TCI update to be aligned with FG23-1-1 and FG23-1-1b**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1k | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management | 1. Support of unified TCI with separate DL/UL TCI update for intra- [and inter-] cell beam management 2. WA: The maximum number of configured DL TCI states [per BWP per CC] [in a band] [in a band combination] 3. WA: The maximum number of configured UL TCI states [per BWP per CC] [in a band] [in a band combination] 4. One MAC-CE activated separate TCI state per CC [in a band] [in a band combination] 5. TCI state indication [mode]: update and activation [in case of updates] a) MAC CE based TCI state indication respectively [for one active TCI state] 6. [The maximum number of MAC-CE activated separate TCI states for DL/UL across all CC(s) in a band] |  | Yes |  | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-1-1l | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS 3. The maximum number of MAC-CE activated separate TCI states for DL/UL per CC [in a band] [in a band combination] | 23-1-1k | Yes |  | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |  * + - Regarding the following agreement, a FFS point should be clarified for the maintenance. In our perspective, a new UE capability for X=2 should be introduced. This is because the value of X can impact the UE implementation. For example, for two CMRs for NCJT CSI calculation, when X=2, it is necessary to occupy the memory for a longer time than when X=1. Furthermore, the value of X also can impact CSI accuracy and latency. So, it is preferred to report UE’s capability about the value of X.   **Agreement @106b-e**  For CSI measurement associated with a *CSI-ReportingConfig* for NCJT, support two CMRs within the same CMR pair configured for NCJT measurement hypothesis to be restricted within X continuous slot(s) without DL/UL switch between two CMRs   * X=1, 2   + whereas X=1 implying the same slot and X=2 implying two adjacent slots * FFS other restrictions for FR2   FFS whether UE capability is needed for X=2  **Proposal 8: Support a new FG to indicate whether to support 2 continuous slots without DL/UL switch between two CMRs..** |
| Apple [10] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1-2 | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured DL TCI states in a band 3. The maximum number of configured UL TCI states in a band 4. The maximum number of configured DL+UL TCI states in a band 5. One MAC-CE activated DL+UL TCI state pair per CC in a band 6. TCI state indication mode: update and activation a) MAC CE based TCI state indication 7. The maximum number of MAC-CE activated DL TCI states across all CC(s) in a band 8. The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band 9. The maximum number of MAC-CE activated DL+UL TCI states across all CC(s) in a band 10. The maximum number of configured DL TCI state pools across all BWPs and all CCs in a band   The maximum number of configured UL TCI state pools across all BWPs and all CCs in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a | Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 3 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 4 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 7 candidate value {1, 2, 4, 8}  Component 8 candidate value {1, 2, 4, 8}  Component 9 candidate value {1, 2, 4, 8}  Component 10 candidate value {1, 2, 4, unlimited (one TCI pool per BWP)}  Component 11 candidate value {1, 2, 4, unlimited (one TCI pool per BWP)}  The TCI states are counted as 1 if the reference signals for TCI states are the same or share the same QCL property. | Optional with capability signalling | | 23. NR\_FeMIMO | 23-1-1-3 | Unified TCI with separate DL/UL TCI update for inter-cell beam management | 1. Support of SSB associated with a PCI different from serving cell PCI to be configured as QCL source in DL and UL TCI state 2. Support of activation of DL and UL TCI states to be QCLed with SSB associated with different PCIs 3. Support of a CORESET associated with at least a Type3 CSS/USS and at least a Type 0/0a/1/2 CSS 4. Support of a PDSCH scheduled by PDCCH in Type3 CSS or USS with scheduling offset smaller than threshold reported in FG 2-2   Support of aperiodic CSI-RS with scheduling offset smaller than threshold reported in FG 2-28 | 23-1-1-2 | Yes |  | Unified TCI with separate DL/UL TCI update for inter-cell beam management is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |  * We propose to introduce a new FG on maximum number of CC lists to reflect the following agreement in RAN1 #108.  |  | | --- | | **Agreement**  On Rel-17 MAC-CE-based and DCI-based beam indication, regarding the CC list for common TCI state ID update and activation, the maximum number of CC lists can be configured is 4 per cell group   * The maximum number of CC lists for a UE to support is subject to its UE capability |  * We also proposed to have the following two new FGs   + FG 23-6-5: Support of implicit configuration of RS(s) with two TCI states for beam failure detection   + FG 23-6-6: QCL-TypeD collision handling with CORESET with 2 TCI states. This is to implement the following agreement  |  | | --- | | **Agreement**  When a CORESET is activated with two TCI states which overlaps with another CORESET, support extension of Rel-15 prioritization rule for PDCCH monitoring of PDCCH candidates in overlapping monitoring occasions with different QCL-TypeD   * FFS: Prioritization rule considers CORESETs indicated with 1 and/or 2 TCI states * Supports identifying two QCL-TypeD properties for multiple overlapping CORESETs   + UE capability is introduced |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-5 | Support implicit/explicit configuration of RS(s) with two TCI states for beam failure detection | Support RS(s) with two TCI states configured, either implicitly or explicitly, for beam failure detection enhancement for HST |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-6-6 | QCL-TypeD collision handling with CORESET with 2 TCI states | Support of identifying two QCL-TypeD properties for multiple overlapping CORESETs When a CORESET is activated with two TCI states which overlaps with another CORESET. |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling |  * We propose to introduce FG23-7-6 for the support of CSI-IMR  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-6 | Support of CSI-IM for CSI enhancement for Multi-TRP | Support CSI-IM for CSI enhancement for Multi-TRP | 23-7-1 | Yes |  |  | Per UE | n/a | Yes | n/a |  | Optional with capability signalling |  * We propose to introduce FG23-8-10 for the following agreement made in the last RAN1 meeting  |  | | --- | | Agreement  Support N = 1 for aperiodic SRS configuration for 1T4R   * This new configuration is UE optional. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-10 | Extension of aperiodic SRS configuration for 1T4R | Support of 1 aperiodic SRS resource sets for 1T4R. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling |  * We propose to introduce FG23-8-6a for the following agreement made in the last RAN1 meeting  |  | | --- | | Agreement   * RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-8-6a | Partial frequency sounding of SRS for non-frequency hopping | Support of partial frequency sounding for SRS for non-frequency hopping case | 23-8-6 | Yes |  | Partial frequency sounding of SRS for non-frequency hopping case is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling | |
| NTT DOCOMO, INC. [11] |  |
| Nokia/Nokia Shanghai Bell [12] | One major controversial point on FeMIMO UE features is the arrangement of FGs related to unified TCI framework. While RAN1#108-e managed to mature a basic set of FGs for unified TCI framework for **joint TCI updates**, we still need to consider how to define the FGs for separate TCI updates and inter-cell operation.  Before getting into the details of the components mentioned above, it is useful to have a short review on what are the main elements of unified TCI framework, so that one can ensure that the FGs are meaningful and correspond to implementable features in the end, both in UE and network sides.  Basic unified TCI state operation is described below, and illustrated in Figure 1:   * RRC configures set of joint and/or separate TCI states   + Different needs, e.g. to address MPE issue, beam resource allocation flexibility at gNB * MAC activation of up to 8 joint or separate TCI states * DCI indicates one of the activated TCI states/codepoints to be the indicated TCI state ( = common TCI state)   + Before first indication, the first activated TCI state is the current indicated TCI state   + DCI format 1\_1/1\_2 with and without DL assignment   + Indication confirmed by HARQ-ACK by UE   + Application time of the beam indication   + One beam application time (BAT) for a given SCS     Figure 1: Basic operation of unified TCI states  Another essential functionality of unified TCI states is the support for common cross-CC TCI update, described briefly below and exemplified in Figure 2:   * Two cases   1. **RRC-configured TCI state pool(s) can be configured in the PDSCH configuration (PDSCH-Config) for each BWP/CC** as in Rel-15/16      + Source RS in each CC to provide a reference signal for the quasi-colocation for DM-RS of PDSCH, DM-RS of PDCCH and CSI-RS in the CC, and a reference, if applicable, for determining UL TX spatial filter for dynamic-grant and configured-grant based PUSCH and SRS in the CC is associated to source RS of the *indicated* TCI-State   2. RRC-configured TCI state pool(s) can be absent in the PDSCH configuration (PDSCH-Config) for each BWP/CC, and replaced with a reference to **RRC-configured TCI state pool(s) in a reference BWP/CC**      + Source RS of the *indicated* TCI-State provides a reference signal for the quasi-colocation for DM-RS of PDSCH, DM-RS of PDCCH and CSI-RS in the set of configured CCs, and a reference, if applicable, for determining UL TX spatial filter for dynamic-grant and configured-grant based PUSCH and SRS in the set of configured CCs  |  | | --- | |  | | (a) | |  | | (b) |   Figure 2: Cross-CC TCI state update: (a) RRC-configured TCI state pool(s) for each BWP/CC and (b) RRC-configured TCI state pool(s) in a reference BWP/CC.  Finally, UL power control is another key aspect of unified TCI state operation, briefly described below:   * A PL-RS (configured for path-loss calculation) is either included in UL TCI state or (if applicable) joint TCI state or associated with UL TCI state of (if applicable) joint TCI state * For each of PUSCH and PUCCH and SRS, the UL control parameters can be associated with UL TCI state or (if applicable) joint TCI state per BWP   In addition, while it is true that joint TCI state update provides optimized signaling and room for extra TCI states, all use cases for joint TCI state updates can be provided by separate TCI state updates directly (by indicating both UL and DL TCI state in the MAC CE for the corresponding DCI codepoint). Hence, separate TCI states should be considered as a baseline.  **Proposal: Consider separate TCI state updates as baseline to be supported by UEs supporting Rel-17 unified TCI framework.**  **Proposal: For separate UL/DL TCI state update, the following principles should be followed:**   * **Maximise utilization of FGs defined for joint TCI update case as pre-requisites whenever applicable** * **Support at least one DL and one UL TCI state needs to be ensured if UE supports separate TCI state updates**   Hence, we propose the following FGs are introduced for separate TCI updates.   |  |  |  |  | | --- | --- | --- | --- | | Index | Feature group | Components | Prerequisite feature groups | | 23-1-1k | Unified TCI with **separate** DL/UL TCI update for intra- [and inter-cell] beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. WA: The maximum number of configured separate TCI states [per BWP per CC] [in a band] [in a band combination] 3. One MAC-CE activated joint TCI state per CC [in a band] [in a band combination] 4. TCI state indication [mode]: update and activation [in case of updates]a) MAC CE based TCI state indication [for one active TCI state] 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | | 23-1-1l | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated separate TCI state per CC | 1. TCI state indication [mode]: update and activation [in case of updates] b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. [The minimum beam application time between PUCCH of ACK and the first slot in Y symbols per SCS] 3. The maximum number of MAC-CE activated joint TCI states per CC [in a band] [in a band combination], where at least 1 DL and 1 UL TCI activated states need to be supported 4. [The minimum time gap between the beam indication PDCCH and first slot where beam is applied] | 23-1-1 | | 23-1-1m | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured separate TCI state pools across all BWPs and all CCs in a band | 23-1-1 |   Please note that the following FGs can be common for joint and separate TCI updates, and hence only the pre-requisites need to be updated:   |  |  |  |  | | --- | --- | --- | --- | | Index | Feature group | Components | Prerequisite feature groups | | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  [2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR] | 23-1-1 or 23-1-1k | | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 or 23-1-1k | | 23-1-1f | Common multi-CC TCI state ID update and activation | Common multi-CC TCI state ID update and activation | 23-1-1 or 23-1-1k | | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 or 23-1-1k | | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 or 23-1-1k | | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH [, and SRS] (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 or 23-1-1k | | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 or 23-1-1k |   For inter-cell TCI state update, the structures above can be used as baseline one they are stable. In addition the following principles need to be followed for better organization of the FGs and to avoid complexity on network and UEs alike:  **Proposal:**   * **Intra-cell operation be pre-requisite to inter-cell, as it is not sensible to imagine UEs that can support Rel-17 TCI state updates only for inter-cell scenarios.** * **Counting to be done consistently for both intra- and inter-cell cases, e.g. N TCI states type of features** |
| MediaTek Inc. [13] | On FGs for separate DL/UL TCI update, it can be modified from 23-1-1 and remove the redundant component (e.g., component 4 in 23-1-1 and component 1 & 2 in 23-1-1b).  **Proposal 7: Introduce the following new FG:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1l | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured DL TCI states per BWP per CC 3. The maximum number of configured UL TCI states per BWP per CC 4. One MAC-CE activated DL TCI state and one MAC-CE activated UL TCI state per CC 5. The maximum number of MAC-CE activated DL TCI states across all CC(s) in a band 6. The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band | 23-1-1 | Yes |  | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management is not supported | Per band | n/a | n/a | n/a | Note: The MAC-CE activated DL TCI state(s) should include the activated DL TCI states for all PDCCH/PDSCH receptions | Optional with capability signalling |   **Proposal 8: Introduce the following new FG:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1m | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated DL and UL TCI states per CC | 1. The maximum number of MAC-CE activated DL TCI states per CC 2. The maximum number of MAC-CE activated UL TCI states per CC | 23-1-1 | Yes |  | Unified TCI with separate DL/UL TCI update for intra- [and inter-cell] beam management with more than one MAC-CE activated DL and TCI states per CC is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: [{2, …}]  Component 2 candidate values: [{2, …}]  Note: The maximum numbers of MAC-CE activated DL and UL TCI states across all CC(s) in a band for more than one MAC-CE activated DL and UL TCI states are signaled in 23-1-1l, components 5 and 6, respectively  Note: The MAC-CE activated DL TCI state(s) should include the activated DL TCI states for all PDCCH/PDSCH receptions | Optional with capability signalling |   Add the new optional FG 23-3-4 to capture the following agreement reached in RAN1 #106 bis-e:  **Agreement**  When 3 BDs are counted for two linked candidates   * The third BD is counted in the later span for inter-span PDCCH repetition when *r16monitoringcapablity* is configured. * Note: Inter-span repetition is UE optional   **Proposal 14: Add optional UE feature, FG 23-2-5 to indicate support for inter-span PDCCH repetition**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-5 | Inter-span PDCCH repetition | Support of Inter-span repetition for PDCCH | 23-2-1 |  |  |  |  |  |  |  | {Supported, Not supported} | Optional with capability signalling |   We propose to add a new FG, 23-6-5 to capture the following agreement reach in RAN1 #106 bis-e  **Agreement**  Support combination of Rel-17 SFN PDCCH scheme 1 and single-TRP PDSCH   * This is optional UE feature * Note: The support of such combination scheme is for URLLC use-case only.   **Proposal 23: Add the optional UE feature FG 23-6-5 to indicate support combination of Rel-17 SFN PDCCH scheme 1 and single-TRP PDSCH**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-5 | Support of Rel-17 SFN PDCCH scheme 1 and single-TRP PDSCH combination | Support combination of Rel-17 SFN PDCCH scheme 1 and single-TRP PDSCH |  |  |  |  |  |  |  |  | {Supported, Not supported} | Optional with capability signalling |   New FG: Support of maximum slot offset X=2 for two resources in a resource pair  In the RAN1#106bis-e meeting, we have the following agreement:   |  | | --- | | Agreement  **For CSI measurement associated with a *CSI-ReportingConfig* for NCJT, support two CMRs within the same CMR pair configured for NCJT measurement hypothesis to be restricted within X continuous slot(s) without DL/UL switch between two CMRs**   * **X=1, 2**   + **whereas X=1 implying the same slot and X=2 implying two adjacent slots** * **FFS other restrictions for FR2** * **FFS whether UE capability is needed for X=2** |   We propose to add a new optional UE FG to indicate support of two resources in a resource pair configured within two adjacent slots. The reasons are two-fold: First, maintaining phase coherency across two slots increases UE implementation complexity. Second, awake for an additional slot consumes extra power.  **Proposal 25: Add FG to indicate support of maximum slot offset X=2 for two** **resources in a resource pair.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-6 | Slot offset of CMRs in a CMR pair | Support of two CMRs in a CMR pair transmitted in two contiguous slots | 23-7-1 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |   New FG: Support of Type I codebookMode 'Mode2’ for multi-TRP CSI  We propose to add a new optional UE FG to indicate support for Codebook type I Mode 2 in Multi-TRP CSI.  **Proposal 26: Add a new FG to indicate support for Codebook type I Mode 2 in Multi-TRP CSI.**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-7-7 | Codebook type I Mode 2 in Multi-TRP CSI | Support for Codebook type I Mode 2 in Multi-TRP CSI | 23-7-1 |  |  |  | Per band |  |  |  |  | Optional with capability signalling | |
| Intel Corporation [14] | * FG 23-2-X, for corresponding inter-span PDCCH monitoring add support of PDCCH repetition and restriction on the total number of linked candidates  |  |  |  |  | | --- | --- | --- | --- | | 23-2-X | PDCCH inter-span repetition | 1. Support of PDCCH repetition  2. The total number of linked candidates of which the first candidate is received and the second one has not been received at any given span (X1 per CC, X2 across CCs) | 23-2-1 |   Add a new UE feature group FG 23-3-1-x. Since the M-TRP PUSCH repetition Type A is based on Rel-16, only consecutive slots are considered. However, for Rel-17 coverage enhancement, non-consecutive slots can be also used for PUSCH repetition type A, where the counting is based on available slots. The related coverage enhancement UE feature group is FG 30-2. Thus, if a UE has Rel-17 coverage enhancement capability and can also support M-TRP PUSCH repetition Type A, additional UE capability to support non-consecutive slot-based M-TRP PUSCH repetition Type A is beneficial. We propose to add FG 23-3-1-x to support non-consecutive slot-based M-TRP PUSCH repetition Type A, where prerequisite feature groups include FG 23-3-1, FG 23-3-1-2, and FG 30-2.     |  |  |  |  | | --- | --- | --- | --- | | 23-3-1-x | non-consecutive slot based PUSCH repetition Type A | Support non-consecutive slot based M-TRP PUSCH repetition Type A | Prerequisite feature groups includes FG 23-3-1, FG 23-3-1-2, and FG 30-2 |   In RAN1 #108-e meeting, the below agreements were reached on SRS. Since the agreed operation is UE optional, two new FGs should be introduced accordingly.   |  | | --- | | **Agreement**  RPFS is applicable for both frequency hopping and non-frequency hopping cases, where support of RPFS for non-FH case is an optional UE feature for UEs supporting RPFS.  **Agreement**  FL Proposal 3-1: Support N = 1 for aperiodic SRS configuration for 1T4R   * This new configuration is UE optional. |   The proposed modifications of the FGs for SRS enhancement are summarized as below.   |  |  |  |  | | --- | --- | --- | --- | | **Index** | **Feature group** | **Components** | **Candidate values** | | 23-8-10 | Partial frequency sounding of SRS for non-frequency hopping | Support of partial frequency sounding for SRS for non-frequency hopping case |  | | 23-8-11 | Support 1 aperiodic SRS resource set for 1T4R | Support of 1 aperiodic SRS resource set for 1T4R antenna switching |  | |
| Qualcomm Incorporated [15] | In RAN1 #108e, the following agreement was made to have maximum number of configured CC lists as UE capability for common TCI state ID update and activation. Therefore, corresponding UE capability should be captured as a new FG  **Agreement**  On Rel-17 MAC-CE-based and DCI-based beam indication, regarding the CC list for common TCI state ID update and activation, the maximum number of CC lists can be configured is 4 per cell group   * The maximum number of CC lists for a UE to support is subject to its UE capability   ***Proposal 2-1***: Introduce a new row FG 23-1-1k to capture UE capability on maximum number of configured CC lists for common multi-CC TCI state ID update and activation   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-1-1k | Maximum number of configured CC lists | Maximum number of configured CC lists per cell group for common multi-CC TCI state ID update and activation | 23-1-1f | Yes |  | Common multi-CC TCI state ID update and activation is not supported | Per UE | n/a | n/a | n/a | Component candidate values: {1,2,3,4} | Optional with capability signaling |   In Rel-15, PDCCH monitoring capability is defined for different cases including Case 1-1 for basic capability (FG 3-1), Case 1-2 for single occasion monitoring (FG 3-2), restricted Case 1-2 introduced for Rel-16 (FG 22-12), and Case 2 for PDCCH monitoring with span gap (FG 3-5b). Furthermore, Rel-16 introduced additional capabilities (FG 11-2 family). The support of Rel-17 mTRP PDCCH repetition should be separately indicated for each of these PDCCH monitoring capabilities given that PDCCH repetition can significantly increase the UE complexity and some of the advanced PDCCH monitoring features that the UE is able to support in the absence of PDCCH repetition need a separate capability when combined with PDCCH repetition. This enables a UE to support an advance PDCCH monitoring capability in absence of PDCCH repetition while support a more basic PDCCH monitoring capability in the presence of PDCCH repetition.  In RAN1 #108-e, the following note was agreed for FG 23-2-1: “Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot”. This means that the basic FG for Rel-17 mTRP PDCCH repetition should only include the basic PDCCH monitoring capability.  Furthermore, for the proposed FGs 23-2-1c and 23-2-1d, UE should be able to indicate the supported mode of PDCCH repetition wrt intra-span versus inter-span. In fact, such capability is already agreed:  **Agreement**  When 3 BDs are counted for two linked candidates   * The third BD is counted in the later span for inter-span PDCCH repetition when r16monitoringcapablityis configured. * Note: Inter-span repetition is UE optional   Additionally, in RAN1 #107-e, the following was agreed to handle the UE complexity / memory requirement, which needs to be captured entirely by UE capability spec (since the editor of 38.213 clarified that this agreement can be completely taken care of by UE capability spec instead of by 38.213), and is specific to inter-span PDCCH repetition  **Agreement**  To handle UE complexity / memory requirements for linked PDCCH candidates, address the issue by UE capability, where UE indicates a limit (X) associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span.   * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * The limit X is indicated per CC and also across all CCs * Note: “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * Above is applicable at least for the inter-span case (FFS: intra-span case)   Based on the discussions above, and the agreements during the WI mentioned above, and given the fact that existing FG 23-2-1 only includes the basic PDCCH monitoring capability, we propose the following:  ***Proposal 3-1: PDCCH repetition for more advanced PDCCH monitoring capabilities need a separate capability for each of the following***   * ***Add FG 23-2-1b for “PDCCH repetition with PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot”*** * ***Add FG 23-2-1c for “PDCCH repetition with PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot”*** * ***Add FG 23-2-1d for “PDCCH repetition for Case 2 PDCCH monitoring with a span gap”***   + ***Add a component for “Supported mode of PDCCH repetition” with candidate values {intra-span, inter-span, both}***   + ***Add a component for “X per CC” and “X across all CCs”, where X is defined in the agreement above applicable to inter-span PDCCH repetition*** * ***Add FG 23-2-1e for “PDCCH repetition for Rel-16 PDCCH monitoring”***   + ***Add a component for “Supported mode of PDCCH repetition” with candidate values {intra-span, inter-span, both}***   + ***Add a component for “X per CC” and “X across all CCs”, where X is defined in the agreement above applicable to inter-span PDCCH repetition***  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-2-1b | PDCCH repetition with PDCCH  monitoring on any span of up to 3 consecutive OFDM symbols of a slot | Support of PDCCH repetition for PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot | 3-2  23-2-1 |  |  |  | Per Band |  |  | FR1 only | Applicable to 15KHz SCS only | Optional with capability signalling | | 23. NR\_FeMIMO | 23-2-1c | PDCCH repetition with PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot | Support of PDCCH repetition for PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot | 22-12  23-2-1 |  |  |  | Per UE |  |  | FR1 only | Applicable to 15KHz SCS only | Optional with capability signalling | | 23. NR\_FeMIMO | 23-2-1d | PDCCH repetition for Case 2 PDCCH monitoring with a span gap | 1. Support of PDCCH repetition for PDCCH monitoring of any occasions with span gap as defined in FG 3-5b.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 3-5b  23-2-1 |  |  |  | Per FS |  |  |  | This capability is necessary for each SCS.  Component2: {intra-span, inter-span, both}  Component3: {4, 8, 16, 32, 64, no limit}  Component 4: {4, 8, 16, 32, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. | Optional with capability signalling | | 23. NR\_FeMIMO | 23-2-1e | PDCCH repetition for Rel-16 PDCCH monitoring | 1. Support of PDCCH repetition with Rel-16 PDCCH monitoring capability as defined in FG 11-2 family.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 11-2  23-2-1 |  |  |  | Per FS |  |  |  | This capability is signalled for SCS 15 kHz and 30 kHz.  Component2: {intra-span, inter-span, both}  Component3: {4, 8, 16, 32, 64, no limit}  Component 4: {4, 8, 16, 32, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit X is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. | Optional with capability signalling |  * Updating two beams / power control parameters for a group of PUCCH resources requires a UE capability (similar to the Rel-16 feature in the case of one beam, i.e., FG 16-1b-3). FG 23-3-d below is needed for this purpose. * An FG is needed for max number of power control parameter sets configured for multi-PUCCH in FR1 when max number is larger than 2. Note that the following was agreed in the previous meeting in LS response to RAN2: “The maximum number of power control parameter sets is 8, which is subjected to UE capability.”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-3-2d | Updating two Spatial relation or two sets of power control parameters for PUCCH group | Support of updating two Spatial Relation Info’s / two sets of power control parameters for a group of PUCCH resources in a CC by MAC-CE | 23-3-2 |  |  |  | Per Band |  |  |  |  | Optional with capability signalling | | 23. NR\_FeMIMO | 23-3-2e | Maximum number of power control parameter sets configured for multi-TRP PUCCH repetition in FR1 | Maximum number of power control parameter sets configured for multi-TRP PUCCH repetition in FR1 | 23-3-2 |  |  |  | Per Band |  | FR1 only |  | Candidate values: {3 to 8} | Optional with capability signalling |   In RAN1 #108e, the following feature is agreed to support MAC-CE to dynamically update the explicit BFD-RS for mTRP BFR. In addition, in LS response to RAN2, RAN1 also agreed that the maximum configured candidate BFD-RS for MAC-CE to down select is up to 64 and is further subject to UE capability. Therefore, corresponding UE capability should be captured as a new row under FG 23-5-2.  **Agreement**  Support to configure/update explicit BFD -RS set by RRC signalling and MAC CE signalling  **R1-2202720**  **Question 2.4:** Please inform how to implement beam failure detection RS sets for mTRP. Also what is the maximum number of detection resources to be configured per UE per cell or per TRP? What is the maximum number of recovery resources to be configured per UE per cell or per TRP?  **Answer 2.4:**  RAN1 agreed to support both explicit and implicit beam failure detection (BFD) RS sets configurations for mTRP, and the implicit BFD RS sets can only be configured for mDCI based mTRP (i.e., when PDCCH-Config contains two different values of coresetPoolIndex). The two beam failure detection RS sets are to be configured per DL BWP (BWP-DonwlinkDedicated).  For implicit configuration, the UE determines the two BFD RS sets including periodic CSI-RS resource configuration indexes having the same values as the source RS indexes in the TCI states for the CORESETs associated with respective pool indexes 0 and 1.  Details on explicit configuration (RRC, MAC-CE or RRC+MAC-CE) are still under discussion in RAN1. RAN1 will notify RAN2 after RAN1 reach any consensus.  The maximum number of detection resources per set per CC is 64, which is subject to UE capability.  ***Proposal 7-1***: Introduce a new row FG 23-5-2c to capture UE capability on MAC-CE update of explicit BFD-RS for mTRP BFR and maximum configured candidate BFD-RS for MAC-CE down selection   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-5-2c | MAC-CE based update of explicit BFD-RS | 1. Support of MAC-CE based update of explicit BFD-RS for mTRP BFR 2. Maximum number of configured candidate BFD-RS per BWP for MAC-CE based update | 23-5-2 | Yes |  | MAC-CE based update of explicit BFD-RS is not supported | Per UE | No | Yes | No |  |   There is missing FG for the UE capability of supporting of two QCL TypeD prosperities for multiple overlapping CORESETs when a CORESET is activated with two TCI as per RAN1-agreement below   |  | | --- | | **Agreement**  When a CORESET is activated with two TCI states which overlaps with another CORESET, support extension of Rel-15 prioritization rule for PDCCH monitoring of PDCCH candidates in overlapping monitoring occasions with different QCL-TypeD   * FFS: Prioritization rule considers CORESETs indicated with 1 and/or 2 TCI states * Supports identifying two QCL-TypeD properties for multiple overlapping CORESETs   + UE capability is introduced * FFS other details * FFS: Strive to have same / similar solution as discussed under AI 8.1.2.1 |   ***Proposal 8-4: Add FG 23-6-4b for the indication of Two QCL TypeD properties determination for overlapping CORESETs.***   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 23. NR\_FeMIMO | 23-6-4b | Two QCL TypeD properties for SFN PDCCH | Supports identifying two QCL-TypeD properties for multiple overlapping CORESETs when a CORESET is activated with two TCI states. |  | Yes |  |  | Per Band |  | FR2 only |  |  | Optional with capability signalling | |

# Discussion/Approval Items during RAN1 #109-e — First Checkpoint

After review of contributions submitted to RAN1 #109-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #109-e.

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG 23-1-1 and 23-1-1k

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. ~~WA:~~ The maximum number of configured joint TCI states ~~[~~per BWP per CC~~] [~~in a band~~] [in a band combination]~~ 3. One MAC-CE activated joint TCI state per CC ~~[~~in a band~~] [in a band combination]~~ 4. TCI state indication ~~[mode]:~~ for update and activation ~~[in case of updates]~~ a) MAC CE based TCI state indication ~~[~~for one active TCI state~~]~~ 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band in a band combination 6. The maximum number of configured joint TCI states across all BWPs and all CCs in a band in a band combination 7. The maximum number of MAC-CE activated joint TCI states per CC in a band in a band combination |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra-cell beam management is not supported | Per band | n/a | n/a | n/a | Component 2 candidate value {8, 12, 16, 24, 32, 48, 64}  Component 5 candidate value {1, 2, 4, 8}  FFS: how to count the MAC-CE activated joint TCI    If a UE supports FG 23-1-1k, the signalled component values ~~[~~(except component 5)~~]~~ also apply to inter-cell beam management  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1k | Unified TCI with joint DL/UL TCI update for inter-cell beam management | 1. Support of unified TCI with joint DL/UL TCI update for inter-cell beam management  ~~[~~2. Support K additional MAC-CE indicated joint TCI states in PCell ~~[~~in a band~~] [in a band combination]]~~  ~~[~~3. Support K additional MAC-CE activated joint TCI states across all CC(s) in a band~~]~~ |  | Yes |  | Unified TCI with joint DL/UL TCI update for inter-cell beam management is not supported | Per band | n/a | n/a | n/a | FFS: a UE that supports FG 23-1-1 must also support this FG | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | 23-1-1:  Do not support the addition of a “in a band combination” in component 5. Do not support component 6 and 7. Since 23-1-1 is reported per band, it does not really make sense. Any feature that is signalled per band combination is very difficult to process in the NW: under normal circumstances, a UE advertises support for hundreds of band combinations, since the CA arrangement affects this.  Add “transmissions” at the end of the note.  23-1-1k: OK with editorial:  ~~[~~2. Support K additional MAC-CE indicated joint TCI states in ~~P~~SpCell ~~[~~in a band~~] [in a band combination]]~~ |
| QC | For FG 23-1-1   * For component 5, prefer to delete the red text “in a band combination” * For component 6 and 7, prefer to delete * Include component 7 in the following note   + If a UE supports FG 23-1-1k, the signaled component values (except component 5 and 7) also apply to inter-cell beam management * Add 128 as candidate value for component 2   + Component 2 candidate value {8, 12, 16, 24, 32, 48, 64, 128}   For FG 23-1-k   * For component 2   + Prefer to change MAC-CE “indicated” to “activated”   + Prefer to change “PCell” to “per CC”, since all CCs in the same band typically have same set of active TCIs, which can be used by gNB * For component 3, fine with the wording * The yellow FFS should be deleted, given the agreed note in 23-1-1, which says “if a UE supports FG 23-1-k”   Add dependency to FG 23-1-1 |
| LG | 23-1-1   * Regarding component 6/7, it should be removed according to the agreement in GTW session.   23-1-1k   * Regarding component 2/3, the bracket should be kept unless the necessity of K additional MAC-CE is clarified |
| Huawei, Hisilicon | 23-1-1K:  We prefer to remove the Note with FFS.  Regarding component 2 and 3, we think the wording of the components needs some changes:   * For component 2, we are not sure why K “additional” MAC-CE indicated TCI states are only in “PCell”. We don’t have a parallel component in 23-1-1 for intra-cell case. * Also, we are not sure why both values in components 2 and 3 are “K”. Does it mean that the same value of “K” corresponds to both components?   We also think that the number of joint TCI states in component 2 and 3 should be shared for both inter-cell and intra-cell beam management. This resource sharing is important for a flexible UE implementation otherwise UE should always dedicate/reserve processing resources for inter-cell for a cell center UE. Similarly, UE cannot use the dedicated processing resources for intra-cell for a cell edge UE. |
| ZTE2 | For FG 23-1-1   * For candidate values for component-2, it should further include ‘128, 192’ at least. * For candidate values for component-5, it should further include ‘10, 12, 14, 16, 20, 24, 28, 32, 36, 40, 44, 48, 64’. * For component 5, ‘in a band combination’ should be removed. * For component 6&7. We do not identify the motivation of them. Some further clarification is needed.   For FG 23-1-k   * For component 2   + Prefer to change MAC-CE “indicated” to “activated”   Then, we may use ‘K1’ for component 2 and ‘K2’ for component 3, for the sake of presentation. |

# Issue 2: FG 23-1-1b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- and inter-cellbeam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication for update and activation  b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time in Y symbols per SCS 3. The maximum number of MAC-CE activated joint TCI states per CC in a band 4. The maximum number of configured joint TCI states across all CCs in a band | 23-1-1 | Yes |  | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336}, where {84, 98, 112, 224, 336 } only can be indicated in FR2  Component 3 candidate values: {2,3,4,5,6,7,8}  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | Do not support component 4 – already discussed and discarded. |
| QC | Support to keep the component 4  Suggest to put “and inter-cell” in yellow, which should be added as separate row as FG 23-1-k |
| MediaTek | In RAN1, an agreement has been made as follows. However, this capability has not been captured in any of Rel-17 FGs. Thus, we see if inter-cell BM is separate from FG 23-1-1b, this capability need to be captured in the corresponding FG as well.  For example:   * The maximum number of PCIs (including that of the serving cell) associated with the MAC-CE activated joint TCI states [per CC][across all CCs] in a band  |  | | --- | | Agreement from RAN1#106  On Rel.17 beam indication enhancements for inter-cell beam management, for the supported Rel-17 MAC-CE-based and/or DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation):   * Support a UE feature on how many physical cell IDs (including that of the serving cell) can be associated with the activated TCI states   + FFS: If UE is configured for only one physical cell ID, decide between the following two options:     - Opt1: the NW can activate TCI states associated with either the same physical cell ID as that of the serving cell or a different physical cell ID from that of the serving cell     - Opt2: the NW can only activate TCI states associated with the same physical cell ID as that of the serving cell   Note: The above does not necessarily mean that more than 1 physical cell ID that is not serving cell in RRC | |
| DOCOMO | We agree with Ericsson. |
| LG | Regarding component 4, it should be removed as Ericsson mentioned. |
| Huawei, Hisilicon | We support component 4. |
| ZTE2 | Share the same views with E///. |

# Issue 3: FG 23-1-1c

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework  ~~[~~2. Maximum number of CCs configured with SCell BFR with unified TCI framework [in a band with SpCell BFR~~]~~ |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {0, 1, 2, 4} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Do not support component 2. The following capabilities can be used instead:  ***maxNumberCSI-RS-BFD***  Indicates maximal number of CSI-RS resources across all CCs, and across MCG and SCG in case of NR-DC, for UE to monitor PDCCH quality. In this release, the maximum value that can be signalled is 16. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. It is mandatory with capability signalling for FR2 and optional for FR1.  ***maxNumberSSB-BFD***  Defines maximal number of different SSBs across all CCs, and across MCG and SCG in case of NR-DC, for UE to monitor PDCCH quality. In this release, the maximum value that can be signalled is 16. If the UE includes the field in an FR1 band, it shall set the same value in all FR1 bands. If the UE includes the field in an FR2 band, it shall set the same value in all FR2 bands. The UE supports a total number of resources equal to the maximum of the FR1 and FR2 value, but no more than the FR1 value across all FR1 serving cells and no more than the FR2 value across all FR2 serving cells. It is mandatory with capability signalling for FR2 and optional for FR1.  ***maxNumberSCellBFR-r16***  Defines the maximum number of SCells configured for SCell beam failure recovery simultaneously. The UE indicating support of this also indicates the capabilities of *maxNumberCSI-RS-BFD, maxNumberSSB-BFD* and *maxNumberCSI-RS-SSB-CBD.*  Note that ***maxNumberCSI-RS-BFD*** and ***maxNumberSSB-BFD*** are counted across all serving cells. |
| QC | Fine to keep component 2 and remove the black bracket |
| DOCOMO | We are fine with the component 2. |
| LG | Remove the component 2. the necessity of this component is unclear since we have already specified the FGs for SCell and PCell-BFR |
| Huawei, Hisilicon | We are fine with removing brackets from component 2. OK with the proposed values. |
| ZTE2 | Support E///’s suggestion. In our views, the current component2 is not complete one, even if approved. So reusing legacy one does make sense. |

# Issue 4: FG 23-1-1d

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 | Yes |  | Per BWP TCI state pool configuration for CA mode is not supported | Per band | n/a | n/a | n/a | ~~FFS:~~ A UE that supports 23-1-1 together with CA must indicate this FG is supported] | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Support |
| QC | Fine for deleting the red “FFS” |
| DOCOMO | We are ok, as long as either FG23-1-1d or 23-1-1e are basic feature for UE supporting CA. |
| LG | Support and it is considered as a basic FG. |
| Huawei, Hisilicon | We are fine with removing FFS |
| ZTE2 | Support. BTW, the last ‘]’ should be removed together. |

# Issue 5: FG 23-1-1e

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: ~~FFS~~ {1, 2, 4, 8}  ~~FFS: A UE that supports 23-1-1 together with CA must support this FG]~~ | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Support |
| QC | Fine for deleting the whole FFS |
| DOCOMO | We are ok, as long as either FG23-1-1d or 23-1-1e are basic feature for UE supporting CA. |
| ZTE2 | Why only [1,2,4,8]? For accommodating different CA case, [1,2,3,4,5,6,7,8] makes sense. |

# Issue 6: FG 23-1-1g

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a | ~~FFS:~~ FR2 only | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Support |
| QC | Fine for deleting the red “FFS” |
| DOCOMO | Support. |
| LG | Support |
| ZTE2 | Okay |

# Issue 7: FG 23-1-1h

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | Yes |  | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS is not supported | Per band | n/a | n/a | n/a | ~~[Note: A UE that supports FG 23-1-1 must indicate this FG is supported]~~ | Optional with capability signaling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Support |
| QC | Fine for deleting the whole FFS |
| DOCOMO | We prefer to keep the note. |
| LG | We prefer to keep the note. |
| ZTE2 | Not support. In our views, this association is essential. How about ‘Note: A UE that supports FG 23-1-1 much indicate this FG is supported in FR2’. |

# Issue 8: FG 23-1-1i

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH ~~[, and SRS]~~ reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication  ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1m | Indication/configuration of R17 TCI states for SRS | Support of indication/configuration of R17 TCI states for SRS (except for periodic/semi-persistent SRS for BM) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Indication/configuration of R17 TCI states for SRS reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | 23-1-1-i: Support  23-1-1m: not sure if this is needed, based on discussions in maintenance. |
| QC | Fine for both 23-1-1i and 23-1-1m |
| DOCOMO | Fine with either keeping SRS in FG23-1-1i or separate SRS into FG23-1-1m. |
| LG | Support |
| ZTE2 | Not support. Why we need to have a separate FG for SRS. We prefer the original version (just remove the bracket and keep ‘, and SRS’) |

# Issue 9: FG 23-1-1j

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Support |
| Qualcomm | Fine for deleting the Note. 23-1-1 is now for intra-cell BM only |
| DOCOMO | Fine. |
| LG | Support |
| ZTE2 | Okay |

# Issue 10: FG 23-1-2

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC  ~~[5. The max number of SSB resources configured to measure L1-RSRP with PCI(s) same as or different from serving cell PCI [across all CC]]~~  6. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  7. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to *maxNumberNonGroupBeamReporting*  Note: component 4 ~~[and/or 5 are/~~is~~]~~ also counted in FG16-1g/16-1g-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Do not support component 6 and 7. The UE can advertise this limitation using component 4 (max number of RRC-configured PCIs). |
| QC | Fine to keep component 6 and 7. They are beneficial for both inter-cell BM and mTRP, although not tightly related to measurement |
| DOCOMO | We agree with Ericsson. |
| LG | Regarding 6/7, component 3 is sufficient for the maximum number of PCI(s) and no need to specify in this FG. Also, the corresponding capabilities are included in FG23-4 (i.e. FG for inter-cell MTRP operation). |
| Huawei, Hisilicon | 1. Component 6/7: Support.   If a UE support inter-cell beam management but does not support inter-cell MTRP operation, UE still needs to report the value of X1 and X2. Hence, we suggest introducing the two dedicated components in 23-1-2.   1. Component 5: We do not support removing this component   Component 5 is to restrict the UE memory usage. Also, the total number of resources used for all kinds of DL measurements, including beam management, pathloss measurement, BFD, RLM and new beam identification is reported with UE capability FG 16-1g/16-1g-1. As inter-cell beam management is also a DL measurement, we suggest to add a note that component 5 is also counted towards FG 16-1g/16-1g-1. |
| Intel | Not support component 6,7. These are not related to measurement but for rate matching. |
| ZTE2 | Same views with E///. This issue has been discussed last meeting. Then, we just need one FG for inter-cell beam management and inter-cell mTRP. |

# Issue 11: FG 23-1-3

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced ~~[~~PHR~~]~~ reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | ~~[MPE mitigation is not supported]~~ Enhanced PHR reporting is not supported | Per Band | n/a | n/a | n/a | 2. Candidate value of {1,2,3, 4}  3. Candidate value [{8, 12, 16, 28, 32, 48, 64}~~]~~  Note: FR2 only  Note: Component 3 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | It would be preferable to also change the name of the component to describe what it means. |
| QC | Fine for the red text |
| DOCOMO | Support |
| LG | Support |
| Huawei, Hisilicon | Propose to add the following note in FG 23-1-3:   |  | | --- | | Note: The candidate RS(s) configured in a RRC pool for MPE mitigation are from the SSB/CSI-RS resources configured for a L1-RSRP or L1-SINR measurement. |   MPE mitigation is based on beam measurement with candidate RSs in the pool configured by RRC. To improve the RSs ultilization efficiency for NR system and reduce the unnecessary memory consumption/computing complexity for a UE, the proposed note is useful. |
| ZTE2 | Support |

# Issue 12: FG 23-1-4

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-1-4 | MPUE support for UL | 1. Supported UE capability value ~~[sets]~~ and corresponding max number of SRS ports for each UE capability value ~~[set]~~  2. Support reportQuantity-r17  3. Time domain behaviour for capability index report |  | Yes |  | ~~[MPUE support for UL is not supported]~~ Capability value reporting is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value ~~[sets]~~ each with one value of {~~[0,]~~1,2,4}  Component 3 candidate values: {aperiodic, aperiodic+periodic, aperiodic+semi-persistent, aperiodic+periodic+semi-persistent}  Note: the reported list contains only unique value ~~[sets]~~  ~~This FG is a working assumption~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | It would be preferable to also change the name of the component to describe what it means.  Do not support component 3: 2-35 should be a prerequisite, as would 2-24 and 16-1-x. This should be enough. |
| QC | For component 1 candidate value, still prefer to add “0” to indicate DL only panel. Otherwise, only panels capable of both DL and UL can be considered in the report. |
| DOCOMO | Support |
| LG | Regarding component 3, the candidate values are to be discussed further where the support of AP/SP reporting is optional as agreed |
| ZTE2 | Regarding component-2, it is exactly the same as component-1, and should be removed.  Then for component-3, we share the same views with E///. |

# Issue 13: FG 23-2-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3,5,10,20,40 ~~FFS more~~}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2.  Note: This FG is applicable to Multi-TRP Scenarios only | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support all changes except the last note. The last note “Note: This FG is applicable to Multi-TRP Scenarios only” is unnecessary in our view. The feature is motivated by Multi-TRP, but does not need to be limited to multi-TRP. We had similar discussions in Rel-16, where some of the developed features can be used even for sTRP (e.g., TDM scheme 4 with one TCI state). |
| DOCOMO | Similar view with QC that this feature is not limited to M-TRP. |
| LG | Support the proposal |
| ZTE | For component 1, it is proper to reserve the wording “with non-SFN scheme TDM and FDM” to distinguish FG23-6 family. |
| Huawei, Hisilicon | Support the first note. |
| Intel | Not support the last note. All other changes are ok. |

# Issue 14: FG 23-2-1a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | ~~[~~23-2-1~~]~~ | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. |
| DOCOMO | Support |
| LG | Support the proposal |
| ZTE | Support. |
| Intel | Support. |

# Issue 15: FG 23-2-2

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | 1. Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~  2. Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition with non-SFN FDM sheme | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Component 2 is not needed. “non-SFN FDM scheme” is undefined. |
| DOCOMO | We share similar view with QC that component 2 is not needed. |
| LG | We wonder the intention of defineing two components, which looks the same. |
| ZTE | We share similar view with QC and DOCOMO. |
| Intel | Component 2 is not needed. |

# Issue 16: FG 23-2-4

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-4 | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | Support of simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | 23-2-1, 16-2a | Yes |  | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP is not supported | Per FS | n/a | n/a | n/a | Note: Two linked PDCCH candidates are not expected to be associated with different CORESETPoolIndex values | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Ok, but this is already captured in 38.213:  “For CORESET associated with the search space set and for CORESET associated with the search space set , the UE is either not provided coresetPoolIndex value of 1 for any of the two CORESETs, or is provided coresetPoolIndex value of 1 for both CORESETs. “ |
| DOCOMO | Support |
| LG | Support the proposal |
| ZTE | Support. |
| Intel | Agree with QC, no need for note. |

# Issue 17: FG 23-3-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | ~~FFS~~ 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~[~~,4~~]~~} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Suggest adding a note to clarify that candidate value 4 is for UL full power: “Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c.” |
| DOCOMO | Support |
| LG | Support the proposal |
| ZTE | We can be fine to adopt candidate value 4, plus the note recommend by QC is needed. |
| Ericsson | Support. Ok with suggestion from QC as well. |
| Intel | Support. |

# Issue 18: FG 23-3-1-2b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | Yes |  | CSI-RS processing framework for SRS with two associated CSI-RS resources is not supported | Per Band | n/a | n/a | n/a | ~~[~~Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {1 to 8}  Component 4: {1 to 16}  Component 5: {1,2}~~]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Component 3 should be {0 to 8} as SP-SRS is optional. |
| DOCOMO | Agree with QC |
| ZTE | For components 1/2/3 in FG 23-3-2b, given that Rel-17 MTRP PUSCH is based on TDM scheme, only one CSI-RS is associated with a SRS resource set in a transmission occasion (as the legacy in Rel-15/16). Therefore, components 1/2/3 should be the maximum number of P/SP/A SRS resources associated with one (the first or the second) CSI-RS per BWP, rather than two CSI-RSs (the first one and the second one) simultaneously. Consequently, the candidate values of components 1/2/3 should be {1 to 4}. Likewise, component 4 should be the UE can process Y SRS resources associated with one (the first and second) CSI-RS, and its candidate values should be {1 to 8}. |
| Ericsson | Similar comment as QC. |
| Intel | Agree with QC and DOCOMO, component 3 value should be {0 to 8} |

# Issue 19: FG 23-3-1c

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | 1. Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.)  2. The maximum number of PHR reporting across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Ok, but candidate values for component 2 seem to be missing. |
| DOCOMO | Support |
| ZTE | Component 2 should be removed, which is not aligned with any agreements so far in FeMIMO session. |
| Ericsson | agree with ZTE that there is no corresponding agreement in feMIMO session for component 2. So, we suggest to remove component 2. |
| Huawei, Hisilicon | Support component 2. The component can resolve the complexity for a UE for the PHR calculation and report in mixed MTRP and CA scenarios. With this component, a UE can implement MTRP PHR calculation and report via reducing the capability of per CC PHR calculation and report. For the candidate value, the CC configured with STRP is counted as 1 and the CC configured with MTRP is counted as 2. For example, if the component is reported with 8, a UE can support X STRP CCs PHR calculation/report and Y MTRP CCs PHR calculation and report in a CA case, where X\*1+Y\*2 = 8.  Without this capability, UE has to not support two PHR for bands that is in any band combinations with PHR number larger than UE capability. It’s a loss for the multi-TRP PUSCH feature. |
| Intel | We are OK with this proposal. |

# Issue 20: FG 23-3-1g

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1~~-1~~ or 23-3-1-2 | Yes |  | CG PUSCH transmission towards M-TRPs using a single CG configuration is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Ok. |
| DOCOMO | Support |
| LG | Support the proposal |
| ZTE | Support. |
| Ericsson | ok |
| Intel | Support. |

# Issue 21: FG 23-3-1-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[,4]~~} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Prerequisite is Ok. For candidate value, it should be same as 23-3-1 (candidate value 4 should be kept with an added note). |
| DOCOMO | Candidate value 4 should be kept. |
| LG | Support 4 as a candidate value given that 4 is already supported in Rel-16. |
| ZTE | Okay with the suggestion from QC and DOCOMO. |
| Ericsson | Agree with comment from QC. |
| Intel | Candidate value 4 should be kept. |

# Issue 22: FG 23-3-1-3

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Non-codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Prerequisite should be 2-15 (not 2-14). |
| MediaTek | Prerequisite FG 2-14 should be replaced by FG 2-15. |
| DOCOMO | Same view as QC/MTK |
| LG | Support the proposal |
| ZTE | Same view to QC/MTK/DOCOMO. |
| Ericsson | similar comment as QC/DCM. |
| Intel | Same view to QC/MTK/DOCOMO/ZTE/Ericsson. |

# Issue 23: FG 23-3-2

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. |
| MediaTek | The term “Scheme 1” is only used in the RAN1 discussions. We prefer to use “slot-based repetition” for Scheme 1.  1. Rename FG 23-3-2 as “Multi-TRP PUCCH repetition - slot based”.  2. The description of Component 1 in FG 23-3-2 is modified as “Support of multi-TRP PUCCH slot-based repetition”. |
| DOCOMO | Support |
| ZTE | Ok. |
| Ericsson | ok |
| Intel | Support |

# Issue 24: FG 23-3-2b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-2b | Cyclic mapping for multi-TRP PUCCH repetition | Support of cyclic mapping for beam mapping/power control parameter set mapping for PUCCH repetitions scheme 1 and/or 3 when the number of repetitions is larger than 2 | 23-3-2 | Yes |  | Cyclic mapping for multi-TRP PUCCH repetition is not supported | Per band | n/a | n/a | n/a | Component candidate values: {4, 8} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Candidate value is not needed as the description is “support of …” |
| DOCOMO | Similar view with QC. |
| LG | Support the proposal |
| ZTE | Support, and candidate values is needed for clarification. |
| Ericson | Not sure candate values make sense here. What is the component here? Is it hmber of repetitions? |
| Intel | We can remove the candidate values. |

# Issue 25

Void

# Issue 26: FG 23-3-3

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | 1. Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 3 (intra-slot repetition) is not supported | Per FS | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. The first note should be a copy-paste from 23-3-1. |
| MediaTek | The term “Scheme 3” is only used in the RAN1 discussions. Besides, “intra-slot” can have different implementations, so we prefer to use “subslot-based repetition” for Scheme 3.  1. Rename FG 23-3-3 as “Multi-TRP PUCCH repetition - subslot based”.  2. The description of Component 1 in FG 23-3-3 is modified as “Support of multi-TRP PUCCH subslot-based repetition”. |
| DOCOMO | Support |
| LG | Support the proposal |
| ZTE | Similar view to QC. |
| Ericsson | ok |
| Intel | Support. |

# Issue 27: FG 23-4

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 ~~different with SSB time domain positions and periodicity of the serving cell PCI~~ | 16-2a | Yes |  | IntCell-mTRP is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: {~~[~~0,~~]~~1,2,3,~~[~~4,5,6,~~]~~7}  Component 3 candidate values: {0,1,2,3,~~[~~4,5,6,~~]~~7}    Note: UE indicates a non-zero value for at least one of component 2 or component 3  ~~FFS: how to count X1 and X2~~  ~~[~~Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2~~]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. |
| MediaTek | Support |
| DOCOMO | We prefer to delete candidate value of ‘0’ for component 2. |
| LG | Support the proposal |
| ZTE | Support. |
| ZTE | Agree with DOCOMO, component 2 is not needed. |
| Ericsson | We prefer to avoid too many candidate values that fragments the network implementation, delete candicate values [4,5,6] from component 2 and 3. |
| Huawei, Hisilicon | Support candidate value {0, 1, 2, 3, 4, 5, 6, 7} to align with RRC configuration which support {1, 2, 3, 4, 5, 6, 7}.  Since a large value 7 has already been supported, we don’t find any problem for UE to support 4, 5, 6. |
| Intel | Support. The modification of note is not necessary. |

# Issue 28: FG 23-5-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | Yes |  | Group based L1-RSRP reporting enhancements are not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: ~~FFS~~ {1,2,3,4}  Component 3 candidate values: ~~FFS~~ {8, 16, 32, 64, 128}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Fine for the red candidate values |
| Ericsson | Component 2 is the max number of SSBs and CSI-RS resources in both resource sets. So having a component value of 1 is a bit strange (i.e., the same SSB and CSI-RS cannot be in two CMR sets as the two CMR sets are to be transmitted from different TRPs). So we suggest to remove candidate value of 1 from compoenent 2. |
| Intel | Agree with Ericsson. |
| ZTE2 | * + Regarding #. RS for both CMR sets (component-2/3), in FG 2-24, we have the following requirement:  |  | | --- | | 1. The max number of SSB/CSI-RS (1Tx) resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP within a slot shall not exceed MB\_1   * Component-1, candidate value set for MB\_1 is {0, 8, 16, 32, 64}   + On FR2, UE is mandated to signal MB\_1 >=8   + On FR1, MB\_1 >=8 is supported mandatory with capability signaling   1a. The max number of CSI-RS resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP shall not exceed MC\_1   * + Component-1a, candidate value set for MC\_1 is {0, 4, 8, 16, 32, 64}   + For FR1, UE is mandated to report at least 8. |   Therefore, for component-2, besides that 1 should be removed firstly, we also think that the candidate value {8, 16, 32, 64, 128} should be added for component 2. |

# Issue 29: FG 23-5-2

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported active BFD-RS resources per set per BWP  2. The maximum number of CCs configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17)  3. Supported maximum number of active BFD-RS resources across two BFD-RS sets per BWP |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}  Component 3 candidate values: {2,3,4}  Note:BFD-RS resources and NBI-RS resources for MTRP BFR are counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Fine for the red text |
| LG | Regarding component 2, there was no relavant discussion/agreement in RAN1. We don’t think it is necessary. |
| Ericsson | Similar view as LG. |
| Huawei, Hisilicon | 1. Support to have the note “BFD-RS resources and NBI-RS resources for MTRP BFR are counted in FG 16-1g and 16-1g-1”, since FG 16-1g and FG 16-1g-1 are used to count the total number of RS for all kind of DL measurement including BFD. In addition, such kind of notes have already been introduced in FG 23-5-1, FG 23-1-3, FG 23-1-2 and should also be introduce here.  2. In R16, there is a UE feature on the maximum number of CCs configured with Scell BFR. Similarly, there should be corresponding UE feature to avoid UE being configured with MTRP BFR in too much CCs. Instead of introducing a dedicate UE feature on the maximum number of CCs configured with MTRP BFR, we more prefere to introcude a general UE feature on the maximum number of CCs configured with any kind with BFR (SpCell/Scell/MTRP BFR), because this is more flexible for gNB implementation. For example, if UE report that the maximum number of CCs configured with any kind with BFR is 8, it is free for the gNB to configured BFR in these 8 CCs. The 8 CCs can be all configured with MTRP BFR, or all configured with Scell BFR, or part of the CC configured with MTRP BFR and part of the CC configured with Scell BFR. |
| Intel | Agree with Ericsson and LG that component 2 is not necessary. |
| ZTE2 | We share the same views with E///, LG and Intel. |

# Issue 30: FG 23-5-2a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {1, 2}  ~~[Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Fine for deleting the red text. RACH can be used if no PUCCH-SR |
| DOCOMO | The note should be kept. One PUCCH-SR for BFR has been supported in Rel-16. It is not reasonable to make it optional in Rel-17. |
| LG | Suggest to keep the note. Note that PUCCH-SR is mandatory for all UEs in Rel-15/16, and that was reason to mandate PUCCH-SR for BFRQ in Rel-16 as well. From RAN2 spec perspective, PUCCH-SR is just one of SR configuration which can be shared for other SR purposes, so RAN2 has not considered any UE that does not support PUCCH SR. |
| Intel | Agree with Docomo and LG to keep the note. |
| ZTE2 | Agree with Intel, Docomo and LG to keep the note. |

# Issue 31: FG 23-5-2b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource | 23-5-2a | Yes |  | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource is not supported | Per UE | No | Yes | No | ~~[Note: A UE that supports FG 23-5-2a with candidate value 2 must indicate this FG is supported with at least component candidate value 1]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support to delete the red text  The highlighted agreement part is clear to our understanding. It does not say UE must support the association when having 2 PUCCH-SR resources, because the whole agreement assumes 2 PUCCH-SR resources. The highlighted part means the association is optional in case of 2 PUCCH-SR resources  Agreement  Support to configure an association between a BFD-RS set on SpCell and a PUCCH-SR resource / SR configuration for per TRP BFR.  FFS: Configure an association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration for per TRP BFR  A UE capability signaling is introduced for indicating the support of this association. Above applies only for multi-DCI case |
| LG | Suggest to keep the note. Otherwise, it would have impact on RAN1 and RAN2 specification at this very late stage w.r.t. how to support two PUCCH SR without any association. |
| Intel | Agree with LG. gNB does not need to know if UE implements two PUCCH SR resources but does not support association. |
| ZTE2 | Support to have the note. |

# Issue 32: FG 23-6-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme A (scheme 1) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8}  Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| QC | Support component 2 on the maximum number of SFN codepoint and suggested candidate values.  On the Note, we think it is not necessary and should be deleted. UE can support either FG 23-6-1 or 23-6-2. We shouldn’t mandate the UE to support both FGs. |
| DOCOMO | Not support the component 2. Component 2 intends to report the potential UE complexity of supporting all “TCI1”, “TCI2”, and “TCI#1+TCI#2” for UE supporting 2 active TCI states. However, we already have FG23-6-1a/23-6-2a (Dynamic switching). If UE does not support FG23-6-1a/23-6-2a, UE can be only configured with “TCI#1+TCI#2”. So, we think FG23-6-1a/23-6-2a is useful to handle the UE complexity.   If UE does not support FG23-6-1a/23-6-2a, the possible combinations of two active TCI states are:   * For UE supporting 2 active TCI state: min (2C2, 8) = 1 * For UE supporting 4 active TCI state: min (4C2, 8) = 6 * For UE supporting 8 active TCI state: min (8C2, 8) = 8    If UE supports FG23-6-1a/23-6-2a, the possible combinations of one or two active TCI states are:   * For UE supporting 2 active TCI state: min (2C2 + 2, 8)  = 3 * For UE supporting 4 active TCI state: min (4C2 + 4, 8)  = 8 * For UE supporting 8 active TCI state: min (8C2 + 8 , 8) = 8    Since the maximum number of TCI codepoint is 8, UE should measure up to 8 combinations including one or two TCI states. So, we don’t think there is too many combinations that UE should track.  Also, we believe UE supporting SFN should have (at least a little) higher complexity than S-TRP.  On the other hand, we can support the note to clarify the basic UE capability for SFN. |
| LG | The note should be removed. |
| ZTE | Agree with DOCOMO and LG to remove component 2. |
| Ericsson | We prefer to remove component 2. |
| Huawei, Hisilicon | (a) Support component 2. There are many different combinations of TCI states (single TCI and/or TCI pair) for SFN scheme, which would result in high processing complexity for a UE. So a component is needed to limit the processing complexity.  (b) In addition, we also propose to add two features to limit the TF/beam tracking capability. Propose to add the following components:  Component 3. The maximal total number of activated TCI states per BWP per CC including data and control, with candidate values {1, 2, 4, 8 ,16};  Component 4. The maximal total number of activated TCI states all BWPs all CCs including data and control, with candidate values {1, 2, 4, 8 ,16, 32};  Without component 2, UEs cannot support the number of combination has to report a smaller number of TCI states for single-TRP normal PDSCH, which degrades the performance of normal PDSCH, we don’t see any reason to pay the price of more regular cases. |

# Issue 33: FG 23-6-1-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-1-1 | SFN scheme A (scheme 1) for PDCCH only | Support of SFN scheme A for PDCCH scheduling single TRP PDSCH | 23-6-1 | Yes |  | SFN scheme A (scheme 1) for PDCCH only is not supported | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | This feature was introduced mainly for SFN PDCCH (non-HST). We don’t think that is should be perquisite on FG 23-6-1 which is mainly for HST. |
| DOCOMO | Support the proposal to clarify FG 23-6-1 is a basic capability for SFN scheme A. Re Qualcomm’s comment, we agree the pre-requisite may be not necessary for URLLC use case. But for HST, we believe FG 23-6-1 is a basic capability and FG23-6-1-1 is an optional UE capability. |
| LG | The prerequisite should be removed. |
| ZTE | Support. |
| Ericsson | Support. |

# Issue 34: FG 23-6-1b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-1b | SFN scheme A (scheme 1) for PDSCH only | 1. Support of SFN scheme A for PDSCH scheduled by single TRPPDCCH  2. The maximal number of codepoints configured for SFN data | 23-6-1 | Yes |  | SFN scheme A (scheme 1) for PDSCH only is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. Prerequire 23-6-1 may not be needed. |
| DOCOMO | Not support the component2, with the same reason as our comment to FG 23-6-1.  Support to clarify the pre-requisite feature. |
| LG | The prerequisite should be removed. |
| ZTE | Agree with DOCOMO to remove component 2. |
| Ericsson | We prefer to remove the compoenent 2. |
| Huawei, Hisilicon | (a) Support component 2. There are many different combinations of TCI states (single TCI and/or TCI pair) for SFN scheme, which would result in high processing complexity for a UE. So a component is needed to limit the processing complexity.  (b) In addition, we also propose to add two features to limit the TF/beam tracking capability. Propose to add the following components:  Component 3. The maximal total number of activated TCI states per BWP per CC including data and control, with candidate values {1, 2, 4, 8 ,16};  Component 4. The maximal total number of activated TCI states all BWPs all CCs including data and control, with candidate values {1, 2, 4, 8 ,16, 32}; |

# Issue 35: FG 23-6-2

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH  2. The maximal number of codepoints configured for SFN data |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8}  Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support component 2 on the maximum number of SFN codepoint and suggested candidate values.  On the Note, we think it is not necessary and should be deleted. UE can support either FG 23-6-2 or 23-6-2b. We shouldn’t mandate the UE to support both FGs |
| DOCOMO | Not support the component2, with the same reason as our comment to FG 23-6-1.  On the other hand, we can support the note to clarify the basic UE capability for SFN. |
| LG | The note should be removed. |
| ZTE | Agree with DOCOMO to remove component 2. |
| Ericsson | We prefer to remove the component 2. |
| Huawei, Hisilicon | (a) Support component 2. There are many different combinations of TCI states (single TCI and/or TCI pair) for SFN scheme, which would result in high processing complexity for a UE. So a component is needed to limit the processing complexity.  (b) In addition, we also propose to add two features to limit the TF/beam tracking capability. Propose to add the following components:  Component 3. The maximal total number of activated TCI states per BWP per CC including data and control, with candidate values {1, 2, 4, 8 ,16};  Component 4. The maximal total number of activated TCI states all BWPs all CCs including data and control, with candidate values {1, 2, 4, 8 ,16, 32}; |

# Issue 36: FG 23-6-2a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-2a | Dynamic switching – scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | ~~[~~23-6-2 or~~]~~ 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. |
| DOCOMO | Support |
| ZTE | Support. |
| Ericsson | Support. |

# Issue 37: FG 23-6-2b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-2b | SFN scheme B (TRP based pre-compensation) for PDSCH only | 1. Support of SFN scheme B for PDSCH scheduled by single TRP PDCCH  2. The maximal number of codepoints configured for SFN data | 23-6-2 | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH only is not supported | per FS | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8} | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support. Prerequire 23-6-2 may not be needed. |
| DOCOMO | Not support the component2, with the same reason as our comment to FG 23-6-1.  Support to clarify the pre-requisite feature. |
| LG | The prerequisite should be removed. |
| ZTE | Agree with DOCOMO to remove component 2. |
| Ericsson | We prefer to remove the component 2. |
| Huawei, Hisilicon | (a) Support component 2. There are many different combinations of TCI states (single TCI and/or TCI pair) for SFN scheme, which would result in high processing complexity for a UE. So a component is needed to limit the processing complexity.  (b) In addition, we also propose to add two features to limit the TF/beam tracking capability. Propose to add the following components:  Component 3. The maximal total number of activated TCI states per BWP per CC including data and control, with candidate values {1, 2, 4, 8 ,16};  Component 4. The maximal total number of activated TCI states all BWPs all CCs including data and control, with candidate values {1, 2, 4, 8 ,16, 32}; |

# Issue 38: FG 23-6-3

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support |
| DOCOMO | Support |
| ZTE | Support. |
| Ericsson | Support |

# Issue 39: FG 23-6-4

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | ~~[~~23-6-1 or 23-6-2~~]~~ | Yes |  | Default DL beam setup for SFN ~~when enableTwoDefaultDCI-states is configured~~ is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support removing the bracket and editorial change. In addition, 23-6-1b or 23-6-2b should be added to the pre-requisite options. |
| DOCOMO | Not support the change of “the consequence if not supported”. The component 2 should be mandatory supported. Otherwise, DCI format 1\_0 (without TCI state field) cannot be used in SFN if FG23-6-4 is not reported. If we adopt the change, we must to clarify the component 2 is for DCI format 1\_1/1\_2 only.   1. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI format 1\_1/1\_2 when PDSCH is scheduled with offset equal or larger than the threshold, if applicable   For the pre-requisite, we support to remove [ ]. Re Qualcomm’s comment, since we believe FG23-6-1 or FG23-6-2 is a basic feature, there is no need to add other optional FGs as pre-requisite feature. |
| ZTE | Ok. |
| Ericsson | OK to support. |

# Issue 40: FG 23-6-4a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | ~~[~~23-6-1 or 23-6-2~~]~~ | Yes |  | Default UL beam setup for SFN is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support removing the bracket and editorial change. In addition, 23-6-1-1 should be added where SFN PDCCH is configured. |
| DOCOMO | We support to remove [ ]. Re Qualcomm’s comment, since we believe FG23-6-1 or FG23-6-2 is a basic feature, there is no need to add other optional FGs as pre-requisite feature. |
| ZTE | Ok. |
| Ericsson | We would like to clarify in FG name “Default UL beam setup for SFN PDCCH”, and the consequence “Default UL beam setup for SFN PDCCH is not supported”. If there’s not SFN PDCCH being configured, there’s no need for the default UL beam for SFN. |

# Issue 41: FG 23-7-1

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1 2. Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max 3. CSI report mode selection of mode 1 with X=0 and/or mode 2 4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is 5. Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis 6. Maximum total number of CMRs for NCJT measurement 7. Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses 8. ~~[~~A list of (Y1,Y2): UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC~~]~~ 9. ~~[~~A list of (X1,X2): UE can process X1 NCJT CSI and X2 sTRP CSI measurement hypothesis simultaneously across all CCs~~]~~ 10. Supported codebook modes for NCJT CSI |  | Yes |  | CSI Enhancement for Multi-TRP is not supported | Per band and per BC | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: { mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   ~~[~~Component 5: The list can have maximum of 16 pairs.  - Y1: {1 to 4}  - Y2: {1 to 8}~~]~~  ~~[~~Component 6: The list can have maximum of 16 pairs.  - X1: {1 to 16}  - X2: {1 to 32}~~]~~  Component 7 candidate values: {mode 1, both mode 1 and mode 2}  ~~Note: ‘NCJT’ is not used in RAN1 specifications and will be aligned with 38.214~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| QC | Support component 7. For components 5 and 6, removing the brackets should be fine. If there is a concern with that, we can simplify as follows (similar to what we did for component 4):   1. ~~[A list of (Y1,Y2):~~ UE can process Y~~1~~ NCJT CSI ~~and Y2 sTRP CSI~~ measurement hypothesis simultaneously in a CC~~]~~ 2. ~~[A list of (X1,X2):~~ UE can process X~~1~~ NCJT CSI ~~and X2 sTRP CSI~~ measurement hypothesis simultaneously across all CCs~~]~~   ~~[~~Component 5: ~~The list can have maximum of 16 pairs.~~  - Y~~1~~: {1 to 4}  ~~- Y2: {1 to 8}]~~  ~~[~~Component 6: ~~The list can have maximum of 16 pairs.~~  - X~~1~~: {1 to 16}  ~~- X2: {1 to 32}]~~ |
| MediaTek | Agree with QC’s comment |
| HW, Hisilicon | Do not support Component 5 and Component 6 in FG 23-7-1. In Rel-15/16, the CPU does not distinguish codebook type although the measurement complexity of different codebook types are vastly different. Thus, there is no need to distinguish NCJT and sTRP in Rel-17 since NCJT CSI has double counted CPU in RAN1 spec already, like the concept of CPU counting over a resource set.  Suport Component 7 in FG 23-7-1. |
| ZTE2 | Do not support 5, 6. We are open to have component-7. |

# Issue 42: FG 23-7-1b

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  | ~~[Active CSI-RS resources and ports in the presence of multi-TRP CSI is not supported]~~ Combination of multi-TRP CSI and sTRP CSI (with Type 1 SP codebook or other codebooks) is not supported. | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {~~[~~‘NCJT’,~~]~~ NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Support the first change. For the component 1 candidate value, ‘NCJT’ should be removed as the existing FG 23-7-1 is to report capability for NCJT only (i.e., in the absence of sTRP CSI). |
| Ericsson | Agree with QC. |
| HW, Hisilicon | Support to remove brackets.  The consequence of not supported shall be rephrased as 23-7-1, i.e. “CSI Enhancement for Multi-TRP is not supported”. 23-7-1b is basic in order to inform NW about preference of component 1 and 2. |
| ZTE2 | If all companies share the same views that the existing FG 23-7-1 is to report capability for NCJT only. We are fine to remove the whole bracketof ‘[NCJT]’ |

# Issue 43: FG 23-7-1a

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-7-1a | Additional CSI report mode 1 | Maximum value of numberOfSingleTRP-CSI-Mode1 | 23-7-1 | Yes |  | CSI report mode 1 with X=1, or X=2 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate value set: { X=1, X=2}  Note: UE reports this capability only when UE reports “mode 1 with X=0” or “both” for component 3 of FG 23-7-1 | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Ok |
| Ericsson | ok |

# Issue 44: FG 23-8-3

Proposals for FG 23-8-3 are discussed in agenda item 8.16, email discussion [109-e-R17-UE-features]

# Issue 45: FG 23-8-6

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS with frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS with frequency hopping is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-6a | Partial frequency sounding of SRS | Support of partial frequency sounding for SRS without frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS without frequency hopping is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| QC | Support.  The names of both FGs are the same. It may be better to clarify as follow:   |  |  | | --- | --- | | 23-8-6 | Partial frequency sounding of SRS for frequency hopping | | 23-8-6a | Partial frequency sounding of SRS for non-frequency hopping. | |
| DOCOMO | Support. And agree with QC. |
| LG | OK |
| Intel | Fine with Moderator’s proposal. |
| ZTE | Okay |

# Issue 46: FG 23-8-9

After review of contributions submitted to RAN1 #109-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

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

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| 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | 1. Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R.  2. Support single SRS resource set for aperiodic SRS configuration for 1T4R with 4 SRS resources, 1 port each. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R is not supported | Per FS | N/A | N/A | N/A | ~~[~~Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports~~]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| QC | Having a separate FG (23-8-9a) for single set with 4 resources is a better approach than adding a 2nd component unless UE can indicate support of each component independently. |
| DOCOMO | Ok with the proposal. Having a separate FG for single set with 4 resources is also fine. |
| LG | OK |
| Intel | Fine with Moderator’s proposal |
| ZTE | Okay |

# Discussion/Approval Items during RAN1 #109-e — Second Checkpoint

Based on the comments/questions/suggestions received by the first checkpoint, the following are the revised proposals and/or proposed agreements by the moderator.

# Issue 1

Void

# Issue 2

Void

# Issue 3

Void

# Issue 4

Void

# Issue 5: FG 23-1-1e

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

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| 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: ~~FFS~~ {1, 2, 4, 8}  FFS: A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling |

# Issue 6: FG 23-1-1g

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a | ~~FFS:~~ FR2 only | Optional with capability signaling |

# Issue 7

Void

# Issue 8

Void

# Issue 9: FG 23-1-1j

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling |

# Issue 10

Void

# Issue 11

Void

# Issue 12

Void

# Issue 13: FG 23-2-1

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3,5,10,20,40 ~~FFS more~~}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2. | Optional with capability signalling |

# Issue 14: FG 23-2-1a

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | ~~[~~23-2-1~~]~~ | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

# Issue 15: FG 23-2-2

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~ | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

# Issue 16: FG 23-2-4

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

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| 23. NR\_FeMIMO | 23-2-4 | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | Support of simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | 23-2-1, 16-2a | Yes |  | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP is not supported | Per FS | n/a | n/a | n/a | Note: Two linked PDCCH candidates are not expected to be associated with different CORESETPoolIndex values | Optional with capability signalling |

# Issue 17: FG 23-3-1

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | ~~FFS~~ 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~[~~,4~~]~~}  Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

# Issue 18

Void

# Issue 19

Void

# Issue 20: FG 23-3-1g

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1~~-1~~ or 23-3-1-2 | Yes |  | CG PUSCH transmission towards M-TRPs using a single CG configuration is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

# Issue 21: FG 23-3-1-1

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[~~,4~~]~~} | Optional with capability signalling |

# Issue 22: FG 23-3-1-3

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

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| 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set | 2-15, 11-5 | Yes |  | Non-codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling |

# Issue 23: FG 23-3-2

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

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| 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

# Issue 24

Void

# Issue 25

Void

# Issue 26

Void

# Issue 27

Void

# Issue 28

Void

# Issue 29

Void

# Issue 30

Void

# Issue 31

Void

# Issue 32

Void

# Issue 33

Void

# Issue 34

Void

# Issue 35

Void

# Issue 36: FG 23-6-2a

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

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| 23. NR\_FeMIMO | 23-6-2a | Dynamic switching – scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | ~~[~~23-6-2 or~~]~~ 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

# Issue 37

Void

# Issue 38: FG 23-6-3

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

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| 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling |

# Issue 39: FG 23-6-4

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | [23-6-1 or 23-6-2] | Yes |  | Default DL beam setup for SFN when enableTwoDefaultDCI-states is configured is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |

# Issue 40: FG 23-6-4a

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

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| 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN PDCCH | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | [23-6-1 or 23-6-2] | Yes |  | Default UL beam setup for SFN PDCCH is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

# Issue 41

Void

# Issue 42

Void

# Issue 43: FG 23-7-1a

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

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| 23. NR\_FeMIMO | 23-7-1a | Additional CSI report mode 1 | Maximum value of numberOfSingleTRP-CSI-Mode1 | 23-7-1 | Yes |  | CSI report mode 1 with X=1, or X=2 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate value set: { X=1, X=2}  Note: UE reports this capability only when UE reports “mode 1 with X=0” or “both” for component 3 of FG 23-7-1 | Optional with capability signalling |

# Issue 44

Void

# Issue 45: FG 23-8-6

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

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| 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS with frequency hopping | Support of partial frequency sounding for SRS with frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS with frequency hopping is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

# Issue 46: FG 23-8-9

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

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R is not supported | Per FS | N/A | N/A | N/A | ~~[~~Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports~~]~~ | Optional with capability signalling |

# Discussion/Approval Items during RAN1 #109-e — Third Checkpoint

Based on the comments/questions/suggestions received by the second checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 4 will not be considered]***

**General comments**

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 1: FG 23-1-1

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals) 2. The maximum number of configured joint TCI states per BWP per CC in a band 3. One MAC-CE activated joint TCI state per CC in a band 4. TCI state indication for update and activationa) MAC CE based TCI state indication for one active TCI state 5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for intra-cell beam management is not supported | Per band | n/a | n/a | n/a | Component 2 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 5 candidate value {1, 2, 4, 8, 16}  FFS: how to count the MAC-CE activated joint TCI  If a UE supports FG 23-1-1a, the signalled component values (except component 5) also apply to inter-cell beam management  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions | Optional with capability signalling |

Question from RAN2 spec editor: What is the difference between component 3 and component 4?

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| Company | Comments/Questions/Suggestions |
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# Issue 2: FGs 23-1-1a/c

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-1a | Unified TCI with joint DL/UL TCI update for inter-cell beam management | 1. Support of unified TCI with joint DL/UL TCI update for inter-cell beam management  2. Support K additional MAC-CE indicated joint TCI states per CC in a band  3. Support K additional MAC-CE activated joint TCI states across all CC(s) in a band |  | Yes |  | Unified TCI with joint DL/UL TCI update for inter-cell beam management is not supported | Per band | n/a | n/a | n/a | FFS: a UE that supports FG 23-1-1 must also support this FG    Component candidate values for K: {0,1,2,4}  Note: A UE that supports 23-1-1a supports K additional MAC-CE activated joint TCI states across all CC(s) in a band in addition to the maximum number of MAC-CE activated joint TCI states across all CC(s) in a band signalled in FG 23-1-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework |  | Yes |  | SCell BFR with unified TCI framework is not supported | Per band | n/a | n/a | n/a | The maximum number of CCs configured with SCell BFR with unified TCI framework in a band with SpCell BFR is given by FG 16-1f, in this case FG 16-1f includes SpCell | Optional with capability signalling |

Question from RAN2 spec editor: Do we need to have a pre-requisite feature (23-1-1)?

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| Company | Comments/Questions/Suggestions |
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# Issue 3: FGs 23-1-2 and 23-5-1

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | Yes |  | Group based L1-RSRP reporting enhancements are not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: {2,3,4,8,16,32,64}  Component 3 candidate values: {8, 16, 32, 64, 128}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

Question from RAN2 spec editor: What is the meaning of “Note: component 4 is also counted in FG16-1g/16-1g-1”?

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| Company | Comments/Questions/Suggestions |
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# Issue 4: FG 23-1-4

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-4 | UE capability value reporting | 1. Supported UE capability value and corresponding max number of SRS ports for each UE capability value |  | Yes |  | UE capability value reporting is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value each with one value of {1,2,4}  Note: the reported list contains only unique value | Optional with capability signalling |

Question from RAN2 spec editor: What does “capability” mean?

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| Company | Comments/Questions/Suggestions |
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# Issue 5: FG 23-7-1b

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| 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | Yes |  |  | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {‘NCJT’, NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling |

Question from RAN2 spec editor: What does “{Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}” mean? Do you mean total 14 combinations?

* FG-23-5: {Codebook 2, Codebook 3} = {{FeType II PS M=1, NULL},{FeType II PS M=2 R=1, NULL},  {FeType II PS M=2 R=2, NULL}, {Type II, FeType II PS M=1}, {Type II, FeType II PS M=2 R=1} ,{eType II R=1, FeType II PS M=1},{eType II R=1, FeType II PS M=2 R=1}}
* FG 16-8:  (Codebook 2, Codebook 3) = {(Type II, NULL), (Type II PS, NULL), (eType II R=1, NULL), (eType II R=2, NULL), (eType II PS R=1, NULL), (eType II PS R=2, NULL), (Type II, Type II PS)}

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| Company | Comments/Questions/Suggestions |
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# Issue 6: FG 23-10-1b

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| 23. NR\_FeMIMO | 23-10-1b | Unified TCI with separate DL/UL TCI update for intra-cell beam management with more than one MAC-CE activated separate TCI state per CC | 1. TCI state indication for update and activation b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment) 2. The minimum beam application time in Y symbols per SCS 3. The maximum number of MAC-CE activated DL TCI states per CC in a band 4. The maximum number of MAC-CE activated UL TCI states per CC in a band | 23-10-1 | Yes |  | Unified TCI with separate DL/UL TCI update for intra-cell beam management with more than one MAC-CE activated separate TCI state per CC is not supported | per band | n/a | n/a | n/a | If a UE supports FG 23-10-1m, the signalled component values also apply to inter-cell beam management | Optional with capability signalling |

Question from RAN2 spec editor:

* There is no value for candidate. Is it the same as 23-1-1b?
* In 23-1-1b, component 4 is removed, while 23-10-1b still keep component 4?

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| Company | Comments/Questions/Suggestions |
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# Issue 7: FG 23-10-1m

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| 23. NR\_FeMIMO | 23-10-1m | Unified TCI with separate DL/UL TCI update for inter-cell beam management with more than one MAC-CE activated separate TCI state per CC | Support of unified TCI with separate DL/UL TCI update for inter-cell beam management with more than one MAC-CE activated separate TCI state per CC  2. Support K additional MAC-CE activated DL TCI states per CC in a band  3. Support K additional MAC-CE activated UL TCI states per CC in a band  4. Support K additional MAC-CE activated DL TCI states across all CC(s) in a band  5. Support K additional MAC-CE activated UL TCI states across all CC(s) in a band | 23-10-1 | Yes |  | Unified TCI with separate DL/UL TCI update for inter-cell beam management with more than one MAC-CE activated separate TCI state per CC is not supported | per band | n/a | n/a | n/a | Component candidate values for K: {0,1,2,4}  [Note: A UE that supports 23-10-1m supports K additional MAC-CE activated DL and K additional MAC-CE activated UL TCI states across all CC(s) in a band in addition to the maximum number of MAC-CE activated DL and UL TCI states across all CC(s) in a band signalled in FG 23-10-1]  FFS: a UE that supports FG 23-10-1 must also support this FG | Optional with capability signalling |

Question from RAN2 spec editor: Component candidate values for K: {0,1,2,4} – Is this value “K” applicable to all components (components 2-5) or we need to signal value K for each component separately?

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| Company | Comments/Questions/Suggestions |
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# Issue 8: FG 23-1-3

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

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| 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced PHR reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | Yes |  | Enhanced PHR reporting is not supported | Per Band | n/a | n/a | n/a | Component 2 candidate values: {1,2,3, 4}  Component 3 candidate values: {1, 2, 4, 8, 12, 16, 28, 32, 48, 64}  Note: FR2 only  Note: Component 3 is also counted in FG16-1g/16-1g-1  Note: The candidate RS(s) configured in a RRC pool for MPE mitigation are from the SSB/CSI-RS resources configured for a L1-RSRP or L1-SINR measurement | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 9: FG 23-5-2c

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

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| 23. NR\_FeMIMO | 23-5-2c | MAC-CE based update of explicit BFD-RS | 1. Support of MAC-CE based update of explicit BFD-RS for mTRP BFR 2. Maximum number of configured candidate BFD-RS per BWP for MAC-CE based update | 23-5-2 | Yes |  | MAC-CE based update of explicit BFD-RS is not supported | Per UE | No | Yes | No | Component 2 candidate values: {4, 8, 12, 16, 32, 48, 64} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 10: FG 23-10-1e

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

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| 23. NR\_FeMIMO | 23-10-1e | TCI state pool configuration with DL/UL-TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC 2. The maximum number of configured DL TCI state pools across all BWPs and all CCs in a band 3. The maximum number of configured UL TCI state pools across all BWPs and all CCs in a band |  | Yes |  | TCI state pool configuration with DL/UL-TCI pool sharing for CA mode is not supported | per band | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8}  Component 3 candidate values: {1, 2, 4, 8} | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 11: FG 23-1-4a

**Proposal: Introduce the following new FG**

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| 23. NR\_FeMIMO | 23-1-4a | Semi-persistent/aperiodic capability index report | 1. Support of Semi-persistent/aperiodic capability index report | 23-1-4,  2-22 or 2-23 or 2-23a  or 16-1a-1 or 16-1a-4 or 16-1a-5 | Yes |  | Semi-persistent/aperiodic capability index report is not supported | Per band | n/a | n/a | n/a | Note: UE that supports this FG, supports capability index reporting together with the AP/SP L1-RSRP/L1-SINR reporting(s) that UE supports in Rel-15/16, reported by FG2-22. FG2-23, FG2-23a, FG16-1a-1, FG16-1a-4 and FG16-1a-5 | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
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# Issue 12: FG 23-5-2

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

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| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported active BFD-RS resources per set per BWP  2. The maximum number of CCs configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17)  3. Supported maximum number of active BFD-RS resources across two BFD-RS sets per BWP |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}  Component 3 candidate values: {2,3,4}  Note: BFD-RS resources and NBI-RS resources for MTRP BFR are counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 13: FG 23-3-1c

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

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| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | 1. Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.)  2. The maximum number of PHR reporting across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8,12,16,20,32,48,64}  Note: for the candidate value, the CC configured with STRP is counted as 1 and the CC configured with MTRP is counted as 2. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 14: FG 23-6-1/2

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

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| 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH |  | Yes |  | SFN scheme A (scheme 1) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH |  | Yes |  | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH is not supported | per FS | n/a | n/a | n/a | Note: UE supporting SFN scheme(s) shall indicate either/both of FG23-6-1 or/and FG23-6-2. | Optional with capability signalling |

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# Summary of Final Proposals for Agreements

This Section summarizes the final proposals for agreement in RAN1 #109-e by email. There are no tables for comments.

***[All comments must be directly made on the RAN1 email reflector]***

Companies can continue to update their comments in the previous Sections, however, these are no longer monitored by the moderator. Any such comments will be for archival purposes only and will not influence the outcome of this email discussion. Any objection to any of the proposals in this Section must be voiced directly on the RAN1 email reflector.

## Final Proposals for Agreement by the First Check Point

Based on the comments/questions/suggestions received by the first checkpoint, the following are the revised proposals and/or proposed agreements by the moderator.

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

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| 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | Yes |  | TCI state pool configuration with TCI pool sharing for CA mode is not supported | Per band | n/a | n/a | n/a | Component 2 candidate values: ~~FFS~~ {1, 2, 4, 8}  FFS: A UE that supports 23-1-1 together with CA must support this FG] | Optional with capability signaling |

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

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| 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | Yes |  | Beam misalignment between the DL source RS in the TCI state is not supported | Per band | n/a | n/a | n/a | ~~FFS:~~ FR2 only | Optional with capability signaling |

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

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| 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | Yes |  | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) is not supported | Per band | n/a | n/a | n/a | ~~[A UE that supports 23-1-1 must indicate this FG is supported]~~ | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs ~~[with [non-SFN scheme] TDM and FDM (except FDM based PDCCH repetition for FR2)]~~ including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | Yes |  | PDCCH repetition is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3,5,10,20,40 ~~FFS more~~}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2. | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | ~~[~~23-2-1~~]~~ | Yes |  | Monitoring of individual candidates is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition ~~[with non-SFN TDM and/or FDM sheme]~~ | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-2-4 | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | Support of simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | 23-2-1, 16-2a | Yes |  | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP is not supported | Per FS | n/a | n/a | n/a | Note: Two linked PDCCH candidates are not expected to be associated with different CORESETPoolIndex values | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  3. Support of two SRS resource sets with usage set to 'codebook'  4. Supported number of SRS resources in one SRS resource set | ~~FFS~~ 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ~~[~~,4~~]~~}  Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1~~-1~~ or 23-3-1-2 | Yes |  | CG PUSCH transmission towards M-TRPs using a single CG configuration is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2~~[~~,4~~]~~} | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set | 2-15, 11-5 | Yes |  | Non-codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme | ~~FFS~~ | Yes |  | PUCCH repetition scheme 1 (inter-slot repetition) is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-6-2a | Dynamic switching – scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | ~~[~~23-6-2 or~~]~~ 23-6-2b | Yes |  | Dynamic switching – scheme B is not supported | per FS | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Simultaneous activation of two TCI states for PDCCH across multiple CCs is not supported | Per UE | No | Yes | No |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | [23-6-1 or 23-6-2] | Yes |  | Default DL beam setup for SFN when enableTwoDefaultDCI-states is configured is not supported | Per band | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN PDCCH | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | [23-6-1 or 23-6-2] | Yes |  | Default UL beam setup for SFN PDCCH is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-7-1a | Additional CSI report mode 1 | Maximum value of numberOfSingleTRP-CSI-Mode1 | 23-7-1 | Yes |  | CSI report mode 1 with X=1, or X=2 is not supported | Per Band | n/a | n/a | n/a | Component 1 candidate value set: { X=1, X=2}  Note: UE reports this capability only when UE reports “mode 1 with X=0” or “both” for component 3 of FG 23-7-1 | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS with frequency hopping | Support of partial frequency sounding for SRS with frequency hopping | 2-52 | Yes |  | Partial frequency sounding of SRS with frequency hopping is not suported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |

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

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| 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R. | 2-53, 2-55 | Yes |  | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R is not supported | Per FS | N/A | N/A | N/A | ~~[~~Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports~~]~~ | Optional with capability signalling |

## Final Proposals for Agreement by the Second Check Point

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

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# Conclusion

In addition to the agreements in Section 6, that were reached by email during RAN1 #109-e, the following was agreed by GTW during RAN1 #109-e:

# References

1. R1-2202929, Updated RAN1 UE features list for Rel-17 NR after RAN1 #108-e including remaining RAN1 issues, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2203107 Rel-17 UE features for further NR MIMO enhancements, Huawei/HiSilicon
3. R1-2203262 UE features for feMIMO, ZTE
4. R1-2203529 Discussion on UE features for further enhancements on NR-MIMO, vivo
5. R1-2203777 Discussion on FeMIMO UE features, xiaomi
6. R1-2203877 Views on UE features for Rel-17 NR FeMIMO, Samsung
7. R1-2203951 UE features for further enhancements on NR-MIMO, OPPO
8. R1-2204032 Discussion on UE features for FeMIMO, Ericsson
9. R1-2204140 Discussion on Rel-17 UE feature for NR FeMIMO, LG Electronics
10. R1-2204218 Views on Rel-17 FeMIMO UE features, Apple
11. R1-2204356 Discussion on Rel-17 FeMIMO UE features, NTT DOCOMO, INC.
12. R1-2204586 On UE features for further enhancements on NR-MIMO, Nokia/Nokia Shanghai Bell
13. R1-2204690 UE Features for further enhancements on NR MIMO, MediaTek Inc.
14. R1-2204779 UE features for NR feMIMO, Intel Corporation
15. R1-2204998 Discussion on FeMIMO UE features, Qualcomm Incorporated
16. R1-2205098 Proposal on UE Feature for Rel-17 Unified TCI, Samsung/Ericsson/Nokia/NSB/ZTE/Intel/MediaTek/Verizon/AT&T/KDDI,/NTT DOCOMO/LG Uplus/KT Corporation/SKT