**3GPP TSG RAN WG1 #109-e R1-2nnnnn**

**e-Meeting, May 9th – 20th, 2022**

**Source: Ad-Hoc Chair (AT&T)**

**Title: Session Notes of AI 8.16.1**

**Agenda Item:** **8.16.1**

**Document for:** **Endorsement**



#### 8.16.1 UE features for further enhancements on NR-MIMO

[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

**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 | 23-1-1b | 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]:~~ for 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 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 |

* Note: Additional values for component 2 candidate values for FR 2-2 to be discussed in agenda item 8.16.2

**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 | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell ~~[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-cell ~~[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    If a UE supports FG 23-1-1k, the signalled component values [(except component 5)] also apply to inter-cell beam management | 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 |
| 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 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 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 |

**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 | 23-1-2 | 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~~ a ~~[~~pair~~/beam]~~ is 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 | 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: ~~Whether~~ component 4 [and/or 5 are/is] also counted in FG16-1g/16-1g-1~~]~~ | Optional with capability signalling |

**Agreement: Introduce the following new FGs**

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| 23. NR\_FeMIMO | 23-10-1 | 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/ per BWP per CC] 3. The maximum number of configured UL TCI states [across all CC in a band/ per BWP per CC] 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 for 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 | 23-1-1 | 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 |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1b | 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 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 DL TCI states per CC in a band 4. The maximum number of MAC-CE activated UL TCI states per CC in a band |  | Yes |  | 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 is not supported | per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 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 |  | Optional with capability signalling |

**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 | 23-10-1b | 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 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 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- ~~and 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 | If a UE supports FG 23-10-1m, the signalled component values also apply to inter-cell beam management | Optional with capability signalling |
| 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 in PCell [in a band] [in a band combination]]  [3. Support K additional MAC-CE activated UL TCI states per CC in a band [in a band combination]]  [4. Support K additional MAC-CE activated DL TCI states across all CC(s) in a band [in a band combination]]  [5. Support K additional MAC-CE activated UL TCI states across all CC(s) in a band [in a band combination]] | 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 | FFS: a UE that supports FG 23-10-1 must also support this FG | Optional with capability signalling |

**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 | 23-10-1e | 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 | 23-10-1 | 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 | FFS: a UE that supports FG 23-10-1 must also support this FG | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1d | 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 | 23-10-1 | Yes |  |  | per band | n/a | n/a | n/a | FFS: a UE that supports FG 23-10-1 must also support this FG | Optional with capability signalling |

**Agreement: Introduce the following new FG**

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| 23. NR\_FeMIMO | 23-10-1f | Common multi-CC DL/UL-TCI state ID update and activation with separate DL/UL TCI update | Common multi-CC DL/UL-TCI state ID update and activation | 23-10-1 | Yes |  | Common multi-CC DL/UL-TCI state ID update and activation with separate DL/UL TCI update is not supported | per band | n/a | n/a | n/a |  | Optional with capability signalling |

**Working assumption: Introduce the following new FG**

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| 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 | Yes |  | PDCCH repetition with PDCCH  monitoring on any span of up to 3 consecutive OFDM symbols of a slot is not supported |  | Per Band | n/a | FR1 only | n/a | 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 | Yes |  | 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 is not supported |  | Per UE | No | FR1 only | No | 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 | Yes |  | PDCCH repetition for Case 2 PDCCH monitoring with a span gap is not supported |  | Per FS | n/a | n/a | n/a | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 64[, no limit]}  Component 4 candidate values: {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 | Yes |  | PDCCH repetition for Rel-16 PDCCH monitoring is not supported |  | Per FS | n/a | n/a | n/a | 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 |

* Note: Final FG ID set by moderator

**Agreement: Introduce the following new FG**

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| 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 | Yes |  | Updating two Spatial relation or two sets of power control parameters for PUCCH group is not supported |  | Per Band | n/a | n/a | n/a |  | 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 | Yes |  | Maximum number of power control parameter sets configured for multi-TRP PUCCH repetition in FR1 is not supported |  | Per Band | n/a | FR1 only | n/a | Candidate values: {3 to 8} | Optional with capability signalling |

* Note: Final FG ID set by moderator

**Agreement: Introduce the following new FG**

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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 |  | Optional with capability signalling |

* Note: Final FG ID set by moderator

**Agreement: Introduce the following new FG**

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| 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 |

* Note: Final FG ID set by moderator

**Agreement: Introduce the following new FG**

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| 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 |

* Note: Final FG ID set by moderator

**Agreement: Confirm the working assumption to introduce the following new FGs (final FG ID set by moderator)**

* [23-2-1b] “PDCCH repetition with PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot”
* [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”
* [23-2-1d] “PDCCH repetition for Case 2 PDCCH monitoring with a span gap”
* [23-2-1e] “PDCCH repetition for Rel-16 PDCCH monitoring”

**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 | 23-8-3 | 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 are not reported if component 1 is reported as xTyR with x=y valid for the same values of xTyR in component 1 with Rel-15/16 UE capability reporting.~~ | Optional with capability signalling |

**Conclusion:**

* **Inform RAN2 that there is no consensus in RAN1 between interpretation (a) and (b) in R2-2204360 at this time. RAN1 will continue to discuss during RAN1 #109-e and will provide an update in a second LS**

**Agreement: Introduce the following new FG**

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| 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 or 23-10-1f | 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 |

* Note: Final FG ID set by moderator

**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 | 23-1-1 | 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 |  | 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 23-1-1k, the signalled component values ~~[~~(except component 5)~~]~~ apply to intra- and inter-cell beam management jointly  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions | 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 per CC ~~in PSpCell~~ ~~[~~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    Component candidate values for K: {0,1,2,4}  Note: A UE that supports 23-1-1k 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 |

**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 | 23-7-1b | 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 |

**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 | 23-4 | 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 |

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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~~ {2,3,4,8,16,32,64}  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 |

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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: {0~~1~~ to 8}  Component 4: {1 to 16}  Component 5: {1,2}~~]~~ | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-1-4 | ~~MPUE support for UL~~ UE capability value reporting | 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]~~ UE 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~~ | Optional with capability signalling |

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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 [{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 | Optional with capability signalling |

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| 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 | Yes |  | PDCCH repetition for Case 2 PDCCH monitoring with a span gap is not supported | Per FS | n/a | n/a | n/a | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 44, 64~~[~~, no limit~~]~~}  Component 4 candidate values: {4, 8, 16, 32, 44, 64, 128, 256, 512~~[~~, no limit~~]~~}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |
| 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 | Yes |  | PDCCH repetition for Rel-16 PDCCH monitoring is not supported | Per FS | n/a | n/a | n/a | This capability is signalled for SCS 15 kHz and 30 kHz.  Component 2: {intra-span, inter-span, both}  Component 3: {4, 8, 16, 32, 44, 64~~[~~, no limit~~]~~}  Component 4: {4, 8, 16, 32, 44, 64, 128, 256, 512~~[~~, no limit~~]~~}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit X is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-10-1 | 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/~~ per BWP per CC~~]~~ 3. The maximum number of configured UL TCI states ~~[across all CC in a band/~~ per BWP per CC~~]~~ 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 for 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 | 23-1-1 | 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 | Component 2 candidate value {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate value {4, 8, 12, 16, 24, 32, 48, 64}  Component 7 candidate value {1, 2, 4, 8, 16}  Component 8 candidate value {1, 2, 4, 8, 16}  [If a UE supports FG 23-10-1m, the signalled component values (except components 4 and 5) apply to intra- and inter-cell beam management jointly] | Optional with capability signalling |
| 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 ~~in PCell~~ per CC [in a band~~] [in a band combination]]~~  ~~[~~3. Support K additional MAC-CE activated UL TCI states per CC in a band ~~[in a band combination]]~~  ~~[~~4. Support K additional MAC-CE activated DL TCI states across all CC(s) in a band ~~[in a band combination]]~~  ~~[~~5. Support K additional MAC-CE activated UL TCI states across all CC(s) in a band ~~[in a band combination]]~~ | 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 |

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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]]~~ |  | 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 |

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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 |

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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 | 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 |

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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): The number of CPUs for UE can process Y1 NCJT CSI and Y2 sTRP CSI measurement hypothesis simultaneously in a CC]~~ 9. ~~[A list of (X1,X2): The number of CPUs for 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 candidate values: {2,4,6,8,10,12,14,16} The list can have maximum of 16 pairs.~~  ~~- Y1: {1 to 4}~~  ~~- Y2: {1 to 8}]~~  ~~[Component 6 candidate values: {2,4,6,8,…,60,62,64) 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 |

**Working assumption:**

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs | 1. The maximum total number of CPUs for NCJT CSI in a CC 2. The maximum total number of CPUs for NCJT CSI across all CCs | 23-7-1 | Yes |  |  | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values: {2,4,6,8,10,12,14,16}  Component 2 candidate values: {2,4,6,8,…,60,62,64)  Note: This FG is a working assumption | Optional with capability signalling |

* Include in the LS to RAN2 a note that RAN1 will continue discussion whether FG 23-7-1c is needed, RAN1 may decide not to confirm the WA for 23-7-1c

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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 | 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 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 | 23-3-3 | 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  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 (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |

**Agreement:**

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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 |
| 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~~]~~ or 23-6-1-1 | Yes |  | Default UL beam setup for SFN PDCCH is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

**R1-2205383** 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

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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 |
| 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 |

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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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| 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 | 1. 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 |
| 23. NR\_FeMIMO | 23-10-1d | 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 | 23-10-1 | Yes |  |  | per band | n/a | n/a | n/a | ~~FFS: a UE that supports FG 23-10-1 must also support this FG~~ | Optional with capability signalling |

**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 | 23-5-2a | 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 |
| 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 |

**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 | 23-8-3 | 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}  Component 2 and Component 3 are optional. If reported, the reported values for component 2 and component 3 are not valid for the same values of xTyR in component 1 reported with Rel-15/16 UE capability reporting | Optional with capability signalling |

**Agreement: confirm interpretation (b) in R2-2204360**

**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 | 23-1-1 | 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 23-1-1k, 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 transmissions | Optional with capability signalling |

**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 | 23-10-1 | Unified TCI with separate DL/UL TCI update for intra-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 per CC in a band 5. One MAC-CE activated UL TCI state per CC in a band 6. TCI state indication for 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 | 23-1-1 | Yes |  | Unified TCI with separate DL/UL TCI update for intra-cell beam management is not supported | per band | n/a | n/a | n/a | Component 2 candidate value {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate value {4, 8, 12, 16, 24, 32, 48, 64}  Component 7 candidate value {1, 2, 4, 8, 16}  Component 8 candidate value {1, 2, 4, 8, 16}  ~~[~~If a UE supports FG 23-10-1m, the signalled component values (except components ~~4~~7 and ~~5~~8) apply to intra- and inter-cell beam management jointly~~]~~ | Optional with capability signalling |
| 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]~~ 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. The signalled value in component 4 (5) of 23-10-1m plus the signalled value in component 7 (8) of 23-10-1 determine the maximum number of MAC-CE activated DL (UL) TCI states across all CC(s) in a band that are applied to intra and inter-cell beam management jointly. | Optional with capability signalling |

**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 | 23-5-2c | 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 |

**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 | 23-10-1e | 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 |

**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 | 23-1-2 | 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 | 23-1-1~~k~~a | 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 | 23-1-2, 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 | ~~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 23-1-1~~k~~a 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 |

**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 | 23-1-1a | 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 | 23-1-2, 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 | 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. The signalled value in component 3 of 23-1-1a plus the signalled value in component 5 of 23-1-1 determine the maximum number of MAC-CE activated joint TCI states across all CC(s) in a band that are applied to intra and inter-cell beam management jointly. | Optional with capability signalling |

**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 |

**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 measured 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 measured 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 |

**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 |

**Proposal:**

* **Confirm FG 23-7-1c**
* **Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs | 1. The maximum total number of CPUs for NCJT CSI in a CC 2. The maximum total number of CPUs for NCJT CSI across all CCs | 23-7-1 | Yes |  |  | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values: {2,4,6,8,10,12,14,16}  Component 2 candidate values: {2,4,6,8,…,60,62,64)  ~~Note: This FG is a working assumption~~ | Optional with capability signalling |

[R1-2203107](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203107.zip) Rel-17 UE features for further NR MIMO enhancements Huawei, HiSilicon

[R1-2203262](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203262.zip) UE features for feMIMO ZTE

[R1-2203529](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203529.zip) Discussion on UE features for further enhancements on NR-MIMO vivo

[R1-2203777](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203777.zip) Discussion on FeMIMO UE features xiaomi

[R1-2203877](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203877.zip) Views on UE features for Rel-17 NR FeMIMO Samsung

[R1-2203951](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2203951.zip) UE features for further enhancements on NR-MIMO OPPO

[R1-2204032](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204032.zip) Discussion on UE features for FeMIMO Ericsson

[R1-2204140](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204140.zip) Discussion on Rel-17 UE feature for NR FeMIMO LG Electronics

[R1-2204218](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204218.zip) Views on Rel-17 FeMIMO UE features Apple

[R1-2204356](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204356.zip) Discussion on Rel-17 FeMIMO UE features NTT DOCOMO, INC.

[R1-2204586](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204586.zip) On UE features for further enhancements on NR-MIMO Nokia, Nokia Shanghai Bell

[R1-2204690](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204690.zip) UE Features for further enhancements on NR MIMO MediaTek Inc.

[R1-2204779](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204779.zip) UE features for NR feMIMO Intel Corporation

R1-2204849 Summary of UE features for further enhancements on NR-MIMO Moderator (AT&T)

[R1-2204998](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_109-e\Docs\R1-2204998.zip) Discussion on FeMIMO UE features Qualcomm Incorporated