**3GPP TSG RAN WG1 #100bis R1-200xxxx**

**e-Meeting, April 20th – 30th, 2020**

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

**Title: Chairman's Notes of AI 7.2.11.6**

**Agenda Item:** **7.2.11.6**

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

1.

#### 7.2.11.6 UE features for eMIMO

[R1-2001868](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001868.zip) Summary on UE features for eMIMO Moderator (AT&T)

**Working Assumption:** For the previous FG 16-3a family use the following as starting point fur more email discussion

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
|  | 16-3a | Regular eType-II | Basic components:1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=1
2. Support of parameter combinations 1-6
3. Support of rank 1,2
4. FFS: CBSR with hard amplitude restriction
 | TBD |  | N/A |  | FFS: Per band or Per band per BC | N | N |  |  | Optional |
|  | 16-3a-1 | Support of PMI sub-bands with R=2 | FFS: {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=2 |  |  |  |  |  |  |  |  |  |  |
|  | 16-3a-2 | Additional parameter combinations | Support of additional parameter combinations other than 1-6 |  |  |  |  |  |  |  |  |  |  |
|  | 16-3a-3 | Support of rank 3,4 | Support of rank 3,4 |  |  |  |  |  |  |  |  |  |  |
|  | 16-3a-4 | CBSR | ALT 1) CBSR with soft amplitude restriction (capture consequence if not supported 🡪 hard amplitude restriction is supported)ALT 2) CBSR |  |  |  |  |  |  |  |  |  |  |
|  | 16-7 | Extension of the maximum number of configured aperiodic CSI report settings | Extension of the maximum number of configured aperiodic CSI report settings for all codebook types |  |  |  |  | [Per band] |  |  |  |  |  |
|  | 16-8 | Mixed codebook types | Support of mixed codebook types |  |  |  |  |  |  |  |  |  |  |

**Agreement:** The baseline for single-DCI based multi-TRP is as follows:

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| 16-2b-0 | Two default beams for single-DCI based multi-TRP | Support of default QCL assumption with two TCI states | 16-2b |  | N/A |  | Per band | TDD only | FR2 only |  |  | TBD |
| 16-2b-1 | Single-DCI based SDM scheme | 1. FFS: Support of DCI indication of ~~of~~ 2 TCI states by a codepoint and DMRS ports within two CDM groups
2. ~~Whether supporting~~ Support of two PTRS ports
3. FFS Support of DMRS entry {0, 2, 3}
 | 16-2b, TBD |  | N/A |  | Per band | N | TBD |  |  | TBD |
| 16-2b-2 | Single-DCI based FDMSchemeA | Support of FDMSchemeA | 16-2b, TBD |  | N/A |  | Per band | N | TBD |  |  | TBD |
| 16-2b-3 | Single-DCI based FDMSchemeB | 1. Support of FDMSchemeB
2. For FDMSchemeB, whether the UE can support CW soft combining
 | 16-2b, TBD |  | N/A |  |  [per FSPC] | N | TBD |  |  | TBD |
| 16-2b-4 | Single-DCI based TDMSchemeA | 1. Support of TDMSchemeA
2. Supported maximum TBS size for TDMSchemeA
 | 16-2b, TBD |  | N/A |  | Per band | N | TBD |  | Component 2 candidate values {10 CBs, TBD} | TBD |
| 16-2b-5 | Single-DCI based inter-slot TDM | 1. Support of MAC CE to activate ~~multiple~~ two TCI states for a TCI codepoint
2. Support of RepNumR16 in PDSCH-TimeDomainResourceAllocation and the maximum value of RepNumR16
3. Supported maximum TBS size according to RepNumR16 in PDSCH-TimeDomainResourceAllocation
4. FFS: TCI state mapping to PDSCH transmission occasions (Cyclical mapping or Sequential mapping)
 | 16-2b, TBD |  | N/A |  | Per band | N | TBD |  | Component 1 candidate values: {8,16}Component 2 candidate values {10 CBs, TBD} | TBD |

**Agreement:**

* Introduce at least one or more new FGs for current basic components (5),(6),(7) “out-of-order operation”
	+ All details of new FGs are FFS incl. prerequisite
* FFS: Introduce one new FG for current basic component (4) “fully/partially time/frequency overlapped”

Agreement: Introduce a new FG 16-2a-1 “Separate CRS rate matching”. The following is the starting point for further discussion by email.

**Alt. 1:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 16-2a-1 | Multi-DCI based multi-TRP CRS rate matching  | Whether the UE shall rate match around configured CRS patterns which is associated with CORESETPoolIndex (if configured) and are applied to the PDSCH scheduled with a DCI detected on a CORESET with the same value of CORESETPoolIndex | 16-2a, TBD |  | N/A |  | TBD [per band / per FSPC] | N | TBD |  |  | TBD |

**Alt. 2:**

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| 16-2a-1 | Multi-DCI based multi-TRP CRS rate matching  | Support of CRS rate matching for Multi-DCI based Multi-TRP operation. “Joint” is mandatory for UE that supports Multi-DCI based Multi-TRP CRS rate matching, but “Separate” is optional * Joint: UE rate match around the union of CRS from both TRPs
* Separate: UE rate match around configured CRS patterns which is associated with CORESETPoolIndex (if not configured, CORESETPoolIndex=0) and are applied to the PDSCH scheduled with a DCI detected on a CORESET with the same value of CORESETPoolIndex
 | 16-2a, TBD |  | N/A |  | TBD [per band / per FSPC] | N | TBD |  |  | TBD |

**Conclusion:** Change the existing FG 16-6a as follows, introduce a new FG 16-6c as follows.

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| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 16-6a | Low PAPR DMRS for PUSCH without transform precoding | For PUSCH without transform precoding | TBD | Y | N/A | Y | FFS: Per band | N/A | N/A |  |  |  FFS: Optional with capability signalling |
| 16-6c | Low PAPR DMRS for PUSCH with transform precoding and with pi/2 BPSK | For PUSCH with transform precoding and with pi/2 BPSK modulation | TBD | Y | N/A | Y | FFS: Per band | N/A | N/A |  |  |  FFS: Optional with capability signalling |

**Working assumption:** Introduce a new FG 16-5a. The following is the starting point for further discussion by email with the intention to replace “mode 0” by the actual RRC parameter name

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| 16-5a | UL full power transmission [mode 0] | Supported UL full power transmission [mode 0] | 2-13, 2-14 | Y | N/A | Y | FFS: Per FS or Per band or Per band per BC | N/A | N/A |  |  | TBD |

* Address Nokia comment “we need to clarify the content better, as mode 0 is not defined in the specifications” and Qualcomm comment “with mode 0 removed it is unclear that this FG is for the whole Rel-16 full power feature”

**Proposal:** Agree number of FGs, continue discussion by email

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| 16-5c | UL full power transmission mode 2 | 1. Supported UL full power transmission mode 2
2. Number of ~~Tx~~ SRS antenna ports to support mode 1: {2~~Tx~~, 4~~Tx, 2Tx\_4Tx~~ }
3. The maximum number of SRS resources in set with different number of ports [for usage set to ‘codebook’]. FFS on details for supported number of Tx.
4. FFS: Maximum number of ports per SRS resource
5. FFS: Maximum number of different spatial relation info for all SRS resources for usage set to ‘codebook’ in a resource set
6. TPMI group which delivers full power. FFS on details for supported number of Tx.

Note: UE indicating mode 2 shall support full power transmission for 1 antenna port | 2-13, 2-14, 16-5b | Y | N/A | Y | FFS: Per FS or Per band or Per band per BC | ~~N~~ N/A | ~~N~~ N/A |  |  | TBD |

**Working assumption:** There will be three FGs for L1-SINR reporting structured similarly to R15 L1-RSRP

* RS related capability
* Number of non-group based L1-SINR reports
* Group-based L1 SINR report

Note: candidate component values and other details to be discussed in second round

**Working assumption:** AssumepreviousFG 16-1b requires three FGs, use Alt. 2 for further email discussion

FFS: maximum component values and all other details FFS

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| 16-1b | TCI state activation and spatial relation update | 1. ~~[~~Support of ~~/ maximum number of lists for]~~ Simultaneous TCI state activation across multiple CCs: PDCCH, PDSCH ~~(FFS whether to be a separate UE feature, e.g. 16-1b)~~
2. ~~[Support of / maximum number of lists for] Simultaneous spatial relation update across multiple CCs: AP-SRS, SP-SRS~~
3. ~~[Support of / The maximum number of] PUCCH resource groups per BWP for simultaneous spatial relation update~~
4. FFS: details on whether/how to indicate band pairs which can share the same DL TCI state
5. ~~FFS: details on whether/how to indicate band pairs which can share the same UL spatial relation info~~
 | Component 1: 2-1, 2-4~~Component 2: 2-59, 2-60~~~~Component 3: 2-53, 2-59, 4-24~~ |  | N/A |  | TBD[Per BC or per band] | N | Y |  |  | TBD |
| 16-1b-2 | Spatial relation update across multiple CCs | 1. Support of Simultaneous spatial relation update across multiple CCs: AP-SRS, SP-SRS
2. FFS: details on whether/how to indicate band pairs which can share the same UL spatial relation info
 | Component 1: 2-59, 2-60 |  | N/A |  | TBD[Per BC or per band] | N | Y |  |  | TBD |
| 16-1b-3 | Spatial relation update for PUCCH group | Support of PUCCH resource groups per BWP for simultaneous spatial relation update | 2-53, 2-59, 4-24 |  | N/A |  | TBD[Per BC or per band] | N | Y |  |  | TBD |

**Working Assumption:** There will be a FG 16-1g. The following is the starting point for further discussions

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| 16-1g | ~~FFS:~~ Resources for beam management, [pathloss measurement, BFD, and BFR] | 1. The maximum number of SSB/CSI-RS/[CSI-IM] resources [within a slot] across all CCs for any of L1-RSRP measurement, L1-SINR measurement, [pathloss measurement, BFD, and new beam identification]
2. FFS: The maximum number of SSB/CSI-RS resources within a slot across all CCs for pathloss measurement
3. FFS: The maximum number of SSB/CSI-RS resources within a slot across all CCs for BFD
4. FFS: The maximum number of SSB/CSI-RS resources across all CCs for new beam identification
 |  |  | N/A |  | TBD | N |  |  |  | TBD |

[R1-2001604](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001604.zip) NR eMIMO UE features ZTE

[R1-2001722](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001722.zip) Discussion on Rel-16 eMIMO UE features vivo

[R1-2001738](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001738.zip) Discussion on Rel-16 eMIMO UE features OPPO

[R1-2001794](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001794.zip) UE features for MIMO China Unicom

[R1-2001829](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001829.zip) Views on Rel-16 UE features for NR eMIMO MediaTek Inc.

[R1-2002020](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002020.zip) UE features for NR eMIMO Intel Corporation

[R1-2002071](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002071.zip) Discussion of UE features for NR MIMO CATT

[R1-2002155](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002155.zip) UE features for eMIMO Samsung

[R1-2002161](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002161.zip) Discussion on RAN1 UE feature for NR eMIMO LG Electronics

[R1-2002274](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002274.zip) Discussions on UE features for eMIMO Spreadtrum Communications

[R1-2002353](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002353.zip) Views on Rel-16 eMIMO UE feature list Apple

[R1-2002476](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002476.zip) On UE features for eMIMO Nokia, Nokia Shanghai Bell

[R1-2002494](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002494.zip) eMIMO UE features Ericsson

[R1-2002499](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002499.zip) Discussion on UE features for eMIMO CMCC

[R1-2002567](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002567.zip) Discussion on eMIMO UE features Qualcomm Incorporated

[R1-2002592](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002592.zip) Rel-16 UE features for MIMO Huawei, HiSilicon

[R1-2002628](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2002628.zip) Discussion on UE capability issues Fraunhofer IIS, Fraunhofer HHI