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

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

**Title:** LS on Rel-16 RAN1 UE features lists for NR

**Response to:** -

**Release:** Rel-16

**Work Items:** NR\_2step\_RACH-Core, NR\_unlic-Core, NR\_IAB-Core, 5G\_V2X\_NRSL-Core, NR\_L1enh\_URLLC-Core, NR\_IIOT-Core, NR\_eMIMO-Core, NR\_UE\_pow\_sav-Core, NR\_pos-Core, NR\_Mob\_enh-Core, LTE\_NR\_DC\_CA\_enh-Core, TEI-16, NR\_CLI\_RIM-Core

**Source:** RAN WG1

**To:** RAN WG2, RAN WG4

**CC:**

**Contact Person:**

#### Name: Hiroki Harada, Ralf Bendlin

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**Attachment:**  R1-20xxxxx.zip (Current intermediate version of RAN1 UE features list for Rel-16 NR)

**1. Overall Description:**

RAN1 has been discussing on Rel-16 RAN1 UE features list for NR. Based on the agreements made at the RAN1#100bis-e meeting, RAN1 agreed to send the current intermediate version of NR UE features list to RAN2 to facilitate their work on defining capability signaling.

Following are some notes regarding the NR features list:

* Attached NR UE features list is still an intermediate version and there are a number of FFS or TBD points and brackets included in the lists. In addition, RAN1 is still discussing on potential additional FGs not captured in the current version. RAN1 will have an email discussion on those points after RAN1#100bis-e meeting. An updated NR features list will be shared at RAN1#101-e meeting. Therefore, RAN1 does not recommend any normative works on UE capability signaling for feature groups with bracket/FFS/TBD on signaling design aspects at this moment.
* For the majority of the FGs RAN1 has not concluded on the type, need for TDD/FDD differentiation, need of FR1/FR2 differentiation, and capability interpretation for mixture of FDD/TDD and/or FR1/FR2. Especially RAN1 couldn’t discuss interpretation on combination of xDD and FRx differentiation bits at all in the RAN1#100bis-e meeting.
* RAN1 intends to list only RAN1 related (i.e., L1) features for RAN2-led WIs in the lists. Nevertheless, some of feature group(s) in the attached features lists may be already defined in RAN2. In addition, some of feature group(s) may be missed in both RAN1 and RAN2 features lists, e.g., feature group not clearly belonging to RAN1. RAN1 kindly would like to ask RAN2 to check if any missing capability for RAN2 led WIs.
* RAN1 agreed to update FG8-1 “Dynamic power sharing for LTE-NR DC” for Rel-16 so that Rel-16 UEs are required to set the capability bit for FG8-1 to 1 i.e., supported. This is applied from Rel-16 (not to Rel-15).
* RAN1 made following agreements regarding UE features for MR-DC/CA enhancements. RAN1 respectfully ask RAN2 to introduce an FG for indicating support of asynchronous NR-DC operation and to discuss whether to introduce an optional FG for indicating supported cell-grouping configurations for a BC where the UE supports NR-DC operation.

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| * RAN1 lists NR-DC power-sharing features as FG18-1/1a/1b. Apart from them, RAN1 see the need of following:
	+ RAN2 to introduce an FG that indicates support of asynchronous operation
		- RAN1 will discuss whether this FG is mandatory or optional
	+ RAN2 to discuss whether or not to introduce an optional FG that indicates supported cell-grouping configurations for a BC where the UE supports NR-DC operation
		- If the UE reports a cell-grouping configuration in which MCG cell(s) and SCG cell(s) are in the same FR, the UE must support FG18-1 (FG18-1a/1b are optional).
* The capability signalling structure is up to RAN2.
* The requirements for sync-DC and async-DC are up to RAN4.
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* For NR\_IAB, the attached feature list includes only L1 features applicable to the IAB-MT function of an IAB node. L1 features applicable to the IAB-DU function of an IAB node were provided to RAN3 via LS in R1-2002968.
* For 5G\_V2X\_NRSL-Core:
	+ For FG 15-19 RAN1 still has to decide whether it is a basic FG.
	+ For FG 15-23 RAN1 still has to decide whether it is also a basic FG for UEs not supporting mode 1.
	+ Support for 256-QAM transmission in an FR should be decided by RAN4.
	+ RAN1 concluded that RAN4 should decide any UE capability related decisions in regard to 256 QAM sidelink reception support in Rel. 16 V2X for both FR1 and FR2
	+ The notes for some RAN1 FGs for NR V2X refer to “a band indicated with only the PC5 interface in 38.101-1 Table 5.2E-1”. These notes use Table 5.2E-1 as example to illustrate how a given FG applies to bands where a UE can be operate according to the terms of the associated note(s). RAN1 kindly asks RAN4 and RAN2 to decide the appropriate manner of referencing such bands in a forward compatible manner that doesn’t require maintenance of specifications when new bands without expected network deployment emerge.
* For NR UE features for 2 step RACH, RAN1 discussed on some possible FGs and RAN1 see the need of RAN2 input on following point.
	+ RAN1 respectfully ask RAN2 to further discuss if msgB payload size could be relatively comparable with msg4, or significantly larger than the max possible payload size of msg2, given that there are Rel-15 UE capabilities for limitation on max # of unicast PDSCHs including msg4 per slot per CC and current RAN1 specification has no limitation on modulation order for PDSCH scheduled by DCI with msgB-RNTI (unlike msg2 PDSCH scheduled by DCI with RA-RNTI). RAN1 may further investigate the need to have such limitation, if the payload size of msgB is typically not large, e.g. similar as msg2.
* For FG 16-5c in the NR UE features list:
	+ RAN1 reached the following agreements in RAN1#98 and RAN1#99 regarding UE capability for the maximum number of SRS resources and TPMI/TPMI groups that deliver full power transmission supported by a UE for full power Mode 2:

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| **Agreement*** For 4 TX UEs, a maximum of 4 SRS resources are supported in Mode 2 for usage set to ‘codebook’ in a set
	+ Depending on UE capability, either up to 2 or 4 SRS resources are supported
* For 2 TX UEs, a maximum of 4 SRS resources are supported in Mode 2 for usage set to ‘codebook’ in a set
	+ Depending on UE capability, either up to 2 or 4 SRS resources are supported
* For mode 2 UEs, up to 2 different spatial relation info can be configured for all SRS resources with usage set to ‘codebook’

Note: it does not mean to support simultaneous transmission of multiple SRS resources *usage* is set to ‘codebook’ |

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| Agreement (RAN1#98)For mode 2, in case of non-coherent with 2 ports, support following TPMI indication for rank 1 which support UL full power transmission:* Rank 1: support {TPMI=0} and {TPMI=1}
* FFS: Details on UE capability signalling

Agreement (RAN1#99)For 2 ports, number of bits to indicate TPMI(s) which can deliver UL full power: * bits (bitmap)
* Whether is this capability reporting is optional or not will be discussed as part of UE capability discussions

AgreementFor 4 ports, number of bits to indicate TPMI(s) which can deliver UL full power:* Non Coherent 2 bits
* Partial coherent 4 bits
	+ Additional entries on top of existing entries may be added to table 1 and table 2
* Whether is this capability reporting is optional or not will be discussed as part of UE capability discussions

Table 1.

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| 4Tx, nonCoherent | 4Tx, partial coherent (4bit) |
| G0 | G0 |
| G1 | G1 |
| G2 | G2 |
| G3 | G3 |
|  | G4 |
|  | G5 |
|  | G6 |
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Definition of G0~G6 can be found in the table below.Table 2. |

* + RAN1 is presently discussing whether feature 16-5c related to UL full power Mode 2 is captured with one or two rows. While component definitions and any interdependence they may have are not yet agreed, as discussed above, Mode 2 UE capability will identify a maximum number of SRS resources supported by the UE and any TPMI(s) supported by the UE with full power within at least one row. If two rows are used, this SRS and TPMI related capability information is split into respective rows. RAN1 is also discussing potential motivations for two rows for 16-5c in the context of UL Tx switching with Option 2.
	+ Therefore, RAN1 respectfully asks RAN2:
		- As RAN2 develop UE capability signaling for UL full power Mode 2, to take into account that the use of one vs. two rows for feature 16-5c is still being discussed in RAN1, and to provide any feedback to RAN1 on the relative merits of one vs. two rows from RAN2’s perspective.

In addition, for uplink Tx switching, In RAN1 #100b-e, the following agreements on inter-band UL CA have been reached:

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| Agreements:For inter-band UL CA, if UE reports via capability signaling to support uplink Tx switching, UE further reports via capability signaling which option (between Option 1 and Option 2) is supported.­        Option 1: If uplink Tx switching is configured, UE is not expected to be scheduled or configured with UL transmission on carrier 2 for case 1.

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|   | Number of **Tx chains** in WID (carrier 1 + carrier 2) | Number of **antenna ports** for UL transmission (carrier 1 + carrier 2) |
| Case 1 | 1T+1T | 1P+0P |
| Case 2 | 0T+2T | 0P+2P, 0P+1P  |

 ­        Option 2: If uplink Tx switching is configured, UE can be scheduled or configured with UL transmission on both carrier 1 and carrier 2 for case 1.o    UE can be scheduled or configured with UL transmission on either carrier 1 or carrier 2.o    UE can be scheduled or configured with UL transmission on both carrier 1 and carrier 2 simultaneously.

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|   | Number of **Tx chains** in WID (carrier 1 + carrier 2) | Number of **antenna ports** for UL transmission (carrier 1 + carrier 2) |
| Case 1 | 1T+1T | 1P+0P, 1P+1P, 0P+1P |
| Case 2 | 0T+2T | 0P+2P, 0P+1P |

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RAN1 respectfully asks RAN2 to take the above information into account.

**2. Actions:**

**To RAN WG2**

**ACTION:** RAN1 kindly would like to ask RAN2 to take into account the list of RAN1 NR UE features for designing corresponding capability signalling in Rel.16.

For MR-DC/CA enhancements, RAN1 respectfully ask RAN2 to introduce an FG for indicating support of asynchronous NR-DC operation and to discuss whether to introduce an optional FG for indicating supported cell-grouping configurations for a BC where the UE supports NR-DC operation.

For 2 step RACH, RAN1 respectfully ask RAN2 to further discuss if msgB payload size could be relatively comparable with msg4, or significantly larger than the max possible payload size of msg2, given that there are Rel-15 UE capabilities for limitation on max # of unicast PDSCHs including msg4 per slot per CC and current RAN1 specification has no limitation on modulation order for PDSCH scheduled by DCI with msgB-RNTI (unlike msg2 PDSCH scheduled by DCI with RA-RNTI).

For FG16-5c for eMIMO, RAN1 respectfully asks RAN2

* + As RAN2 develop UE capability signaling for UL full power Mode 2, to take into account that the use of one vs. two rows for feature 16-5c is still being discussed in RAN1, and to provide any feedback to RAN1 on the relative merits of one vs. two rows from RAN2’s perspective.

**To RAN WG4**

**ACTION:** RAN1 kindly would like to ask RAN4 to decide any UE capability related decisions in regard to 256 QAM sidelink reception support in Rel. 16 V2X for both FR1 and FR2.

**To RAN WG2 and WG4**

**ACTION:** In NR V2X, RAN1 kindly asks RAN4 and RAN2 to decide the appropriate manner of referencing bands without expected network deployment in a forward compatible manner that doesn’t require maintenance of specifications when new bands for NR V2X without expected network deployment emerge.

**3. Date of Next RAN WG1 Meetings:**

TSG-RAN WG1 Meeting #101-e 25th May – 5th June 2020 E-meeting.