**3GPP TSG RAN WG2#109bis-e R2-2004253**

**Online meeting, 20th-30th April, 2020**

**3GPP TSG RAN WG1 #100bis R1-2002900**

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

Title: Reply LS on CSI-RS capabilities (FG 2-33/36/40/41/43)

Response to: LS (R1-2001519) on Discussion over UE capabilities of FG2-33/36/40/41/43 from RAN2

Release: Release 16

Work Item: TEI16, NR\_newRAT-Core

Source: RAN WG1

To: RAN WG2

Cc: -

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**1. Overall Description:**

RAN1 would like to thank RAN2 for their LS on reply and questions for CSI-RS capabilities (FG 2-33/36/40/41/43). The LS had three questions addressed to RAN1, and RAN1 would like to provide answers to those three questions in this response.

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| Q1: Definition of CSI-RS ports/resources configured for the TDM case.RAN2 understand that the legacy triplet included in SupportedCSI-RS-Resource is relevant to the following definition in sub-clause 5.2.1.6 of TS 38.214.*In any slot, the UE is not expected to have more active CSI-RS ports or active CSI-RS resources than reported as capability.*RAN2 is wondering if the current running CR to 38.306 describing “active Tx ports/resources across multiple slots” by referring to sub-clause 5.2.1.6 of TS 38.214 is in line with RAN1’s understanding. |

For the question 1, the current definition in RAN1 spec (sub-clause 5.2.1.6 of TS 38.214) is clear and there is no need to change the definition (i.e. current definition of “per slot” is enough).

In addition, RAN1realized there are following issues on current running CR to 38.306 (R2-2000689).

1. It introduces a new concept of *configuredCSI-RS-Resource* (in the granularity of per-band and the granularity of per-BC), which indicates the maximum number of “RRC configurable” resources, in addition to the existing *supportedCSI-RS-Resource*, which indicates the maximum number of resources that are “simultaneously active”. This new concept is neither specified in clause 5.2.1.6 of TS 28.214 as claimed by RAN2 nor requested by RAN1 original LS R1-1913295, and it does not help solving the underreporting issue of per-band resource capabilities.
2. It introduces a single triplet of *configuredCSI-RS-Resource* per BC rather than a list of triplets as for *supportedCSI-RS-Resource* per BC. This is not sufficient for a new UE to indicate more aggressive per-band capabilities.

Hence, RAN1 would like to clarify that the intention is to add a new list of triplets for *supportedCSI-RS-Resource (e.g., supportedCSI-RS-Resource-r16) signalled per-band* for each codebook type,and new list of triplets for *supportedCSI-RS-Resource* (e.g., *supportedCSI-RS-ResourcePerBC*) signalled per-BC for each codebook type, with the following description:

* + For each codebook, the new UE capability is conveyed jointly by new per-band and new per-BC signalling. New per-band signalling, with the same description as the current *supportedCSI-RS-Resource*, limits the active CSI-RS resources for a specific codebook at any slot on the corresponding individual band. New per-BC signalling further limits the active CSI-RS resource for a specific codebook at any slot across the bands included in the corresponding band combination.
		- For information, it does not expect gNB to follow restrictions of the new Rel.16 per BC signalling and legacy Rel.15 per band signalling jointly.

Rel.15 gNBs follow the legacy Rel.15 per band capability with conservative numbers.

Rel.16 gNBs may follow the new per band capability with aggressive numbers and the new per BC capability jointly. Alternatively, the Rel.16 gNB may follow the legacy Rel.15 per band signaling.

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| Q2: The maximum value of simultaneous CSI-RS resources and CSI-RS ports.In the existing SupportedCSI-RS-Resource, the maximum value of simultaneous resources is 64 and the one of total Tx ports is 256. RAN2 is wondering if the existing value is enough to address the total capability across all CCs or the larger value is desirable. |

For the question 2, the motivation of the LS (R1-1913295) is to avoid under-reporting of the triplet included in *SupportedCSI-RS-Resource*, compared to the actual UE’s capability, and there is no need to increase the maximum value of simultaneous CSI-RS resources and total CSI-RS ports.

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| Q3: indication of maxNumberTxPortsPerResource in a per BC manner In the RAN1 LS it is stated that “To address above issue, RAN1 has agreed to recommend to introduce new per band capability signaling and per BC capability signaling for component 1 of FG2-36/2-40/2-41/2-43”. The component 1 of FG2-36/2-40/2-41/2-43 contains maxNumberTxPortsPerResource. Currently RAN2 had no consensus to whether to introduce maxNumberTxPortsPerResource per BC. Without this additional field, the number of ports for each resource would be determined based on the values indicated for the band on which the resource is configured, like in Rel-15 signaling (given in the existing per-band signaling). See Annex A for an example. RAN2 would appreciate if RAN1 could provide feedback if this structure does not serve the intended purpose. |

For the question 3, RAN1 concludes that reporting *maxNumberTxPortsPerResource* in the triplet of {*maxNumberTxPortsPerResource*, *maxNumberResourcesPerBC*, *totalNumberTxPortsPerBC*} per band combination is necessary to avoid under reporting issue. The reason is that the complexity of different triplets with the same *maxNumberResourcesPerBC* and *totalNumberTxPortsPerBC* is different depending on the *maxNumberTxPortsPerResource* assumed. Therefore, without including *maxNumberTxPortsPerResource* in the signalled triplet, the UE would have to make the most conservative assumption, which would re-introduce the underreporting problem, which the new signalling was trying to avoid. It is essential to have same structure in the per-band signalling and per-BC signalling. Detailed signaling design based on per-BC reporting of the triplet is up to RAN2. If deemed necessary, RAN2 may consider solutions to reduce signaling overhead.

**2. Actions:**

**To RAN2.**

**ACTION:** RAN1 respectively asks RAN2 to take the above answers into account for the specification work of extend the signalling in TEI16.

**3. Date of Next RAN1 Meetings:**

RAN1 Meeting #101bis-e 25th May – 5th June 2020 e-meeting.

RAN1 Meeting #102 24th – 28th August 2020 Toulouse, France.