**3GPP TSG-RAN WG1 Meeting #104-e R1-2xxxxxx**

**E-meeting, January 25 – February 5, 2021**

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| *CR-Form-v12.1* |
| **[DRAFT] CHANGE REQUEST** |
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|  | **38.214** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **16.4.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | CR on multi-TRP  |
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| ***Source to WG:*** | Moderator (OPPO), LG Electronics, CATT, Intel |
| ***Source to TSG:*** | R1 |
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| ***Work item code:*** | NR\_newRAT-Core |  | ***Date:*** | 2021-01-25 |
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| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)**Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | Reason #1: In RAN1#99 meeting, the following is agreed:**Agreement**For multi-DCI based multi-TRP/panel transmission, if *CORESETPoolIndex* is configured,* If the time offset between the reception of the PDCCH and the corresponding PDSCH is less than a threshold, UE could assume that the DM-RS ports of PDSCH are QCL-ed with the RS(s) with respect to the QCL parameter(s) used for PDCCH of the lowest CORESET index among CORESETs configured with the same value of *CORESETPoolIndex,*
	+ in the respective latest slot in which one or more CORESETs associated with each of *CORESETPoolIndex* within the active BWP of the serving cell are monitored by the UE
		- The support of this feature is indicated by UE capability
		- If the UE does not support the above feature, Rel-15 behavior is reused regardless of *CORESETPoolIndex*

According to the agreement, if UE does not support default QCL assumption per CORESET pool, a default beam is determined in the same way as Rel-15 regardless of CORESET pool. In this case, the default beam can be applied to multiple PDSCHs since two PDSCHs scheduled by different TRPs can be overlapped in time domain. For example, if time offset between DCI 1 and PDSCH 1 scheduled by DCI 1 is less than *timeDurationForQCL,* and PDSCH 1 and PDSCH 2, scheduled by TRP 1 and TRP 2, respectively, are overlapped in time domain, default beam should be applied to not only PDSCH 1 but also PDSCH 2. However, this behaviour is unclear in current specification because it does not consider time domain overlapped multiple PDSCHs. Reason #2: In clause 5.1.2.1 of 38.214, It’s noted that both “transmission occasion” and “transmission” are used as thermology to describe the specification of scheme 4. The unaligned terminology could cause confusion and misunderstanding.Reason #3: The text description of UE procedure for receiving multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain in clause 5.1 of 38.214 could be interpreted in two different ways. That could casue misunderding on the specification.Reason#4: For 'fdmSchemeA*'* and 'fdmSchemeB*'* the PRGs are assigned to TCI states depending on even or odd index of PRG. However, the indexing of PRGs including index of the first PRG is not defined in TS 38.214. |
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| ***Summary of change:*** | Change #1: In 5.1.5, change PDSCH to PDSCH(s) considering the possiblity that a default beam is applied to multiple PDSCHs of multi-TRP, overlapped in time domain, if UE does not support default QCL assumption per CORESET pool.Change #2: In 5.1.2.1, update the terminology “transmissions” to “transmission occasions”Change #3: In Clause 5.1 of TS 38.214, put an comma between “only” and “when” in the sentence of “The UE may expect the reception of full/partially-overlapped PDSCHs in time only when PDCCHs that schedule two PDSCHs are associated to different ControlResourceSets having different values of coresetPoolIndex” Change #4: It is clarified that PRGs are numbered continuously in increasing order with the first PRG index equal to 0, similar to subband indexing defined in Section 5.2.3 of TS 38.214. |
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| ***Consequences if not approved:*** | It is unclear whether the default beam is applied to the time domain overlapped PDSCH as well, if UE does not support default QCL assumption per CORESET pool.The terminology in PDSCH scheme 4 description is not aligned with each other and that could cause misunderstanding.The description on receiving overlapped PDSCHs of multi-TRP could cause misunderstanding on the specification.TS 38.214 is ambiguous on even/odd partition of PRGs between two TCI states for 'fdmSchemeA*' or* 'fdmSchemeB*'*. |
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| ***Clauses affected:*** | 5.15.1.2.15.1.2.35.1.5 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  |  |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
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| ***Other comments:*** | Isolated impact analysis:* No impact to existing gNB and UE implementation.
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| ***This CR's revision history:*** |  |

## 5.1 UE procedure for receiving the physical downlink shared channel

\*\*\* Unchanged text is omitted \*\*\*

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time, only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex*. For a *ControlResourceSet* without *coresetPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *coresetPoolIndex* as 0. When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* the following operations are allowed:

\*\*\* Unchanged text is omitted \*\*\*

#### 5.1.2.1 Resource allocation in time domain

\*\*\* Unchanged text is omitted \*\*\*

When a UE configured by the higher layer parameter *PDSCH-config* that indicates at least one entry contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*,

- If two TCI states are indicated by the DCI field 'Transmission Configuration Indication' together with the DCI field 'Time domain resource assignment' indicating an entry which contains *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* and DM-RS port(s) within one CDM group in the DCI field 'Antenna Port(s)', the same SLIV is applied for all PDSCH transmission occasions across the *repetitionNumber* consecutive slots, the first TCI state is applied to the first PDSCH transmission occasion and resource allocation in time domain for the first PDSCH transmission occasion follows Clause 5.1.2.1.

 When the value indicated by *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* equals to two, the second TCI state is applied to the second PDSCH transmission occasion. When the value indicated by *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation* is larger than two, the UE may be further configured to enable *cyclicMapping* or *sequenticalMapping* in *tciMapping*.

- When *cyclicMapping* is enabled, the first and second TCI states are applied to the first and second PDSCH transmission occasions, respectively, and the same TCI mapping pattern continues to the remaining PDSCH transmission occasions.

- When *sequenticalMapping* is enabled, first TCI state is applied to the first and second PDSCH transmission occasions, and the second TCI state is applied to the third and fourth PDSCH transmission occasions, and the same TCI mapping pattern continues to the remaining PDSCH transmission occasions.

\*\*\* Unchanged text is omitted \*\*\*

#### 5.1.2.3 Physical resource block (PRB) bundling

\*\*\* Unchanged text is omitted \*\*\*

For a UE configured by the higher layer parameter *RepetitionScheme-r16* set to ‘*FDMSchemeA’ or* ‘*FDMSchemeB’, and* when the UE is indicated with two TCI states in a codepoint of the DCI field *‘Transmission Configuration Indication* and DM-RS port(s) within one CDM group in the DCI field “*Antenna Port(s)*”,

- If  is determined as “wideband”, the first $\left⌈\frac{n\_{PRB}}{2}\right⌉$ PRBs are assigned to the first TCI state and the remaining $\left⌊\frac{n\_{PRB}}{2}\right⌋$ PRBs are assigned to the second TCI state, where $n\_{PRB} $is the total number of allocated PRBs for the UE.

- If  is determined as one of the values among {2, 4}, even PRGs within the allocated frequency domain resources are assigned to the first TCI state and odd PRGs within the allocated frequency domain resources are assigned to the second TCI state, wherein the PRGs are numbered continuously in increasing order with the first PRG index equal to 0.

- The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion.

\*\*\* Unchanged text is omitted \*\*\*

5.1.5 Antenna ports quasi co-location

\*\*\* Unchanged text is omitted \*\*\*

Independent of the configuration of *tci-PresentInDCI* and *tci-PresentForDCI-Format1-2-r16* in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and at least one configured TCI state for the serving cell of scheduled PDSCH contains the 'QCL-TypeD',

- the UE may assume that the DM-RS ports of PDSCH(s) of a serving cell are quasi co-located with the RS(s) with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored by the UE. In this case, if the 'QCL-TypeD' of the PDSCH DM-RS is different from that of the PDCCH DM-RS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (when PDSCH and the CORESET are in different component carriers).

# \*\*\* Unchanged text is omitted \*\*\*