3GPP TSG RAN WG1 #105-e R1-210xxxx

e-Meeting, May 10th – 27th, 2021

Source: Moderator (OPPO)

Title: Summary of [105-e-NR-eMIMO-04]

Agenda Item: 7.2.6

Document for: Discussion and Decision

Introduction

This document summarizes the discussion for:

[105-e-NR-eMIMO-04] Maintenance for Multi-TRP 2: addressing MT.5 (H), MT.1 (ND), MT.6 (ND) – Li (OPPO)

* Discussion and decision by May 21st, TPs by May 27th

Discussions

Issue MT.5 (H)

### FL Summary

R1-2105085 noticed that the maximum number of CORESETs in multi-DCI based mTRP is increased from 3 to 5 and but, for FR1, based on current 38.213, the maximum number of RS for RLM is 4 when Lmax = 8. The current 213 does not specify the rule for selecting 4 RLM Rs when 5 CORESETs are configured and Lmax = 8, thus it is unclear which RS should be selected for RLM for that case. In addition, in UE FG16-1g, the number of RLM RS resource within a slot is included. Then if there is no clear rule defined for RLM RS selection, there would be some ambiguity for RLM RS counting for this UE FG.

R1-2105085 proposed to adopt the following TP in 38.213.

***FL proposal***

**Proposal: Adopt the following TP for 38.213:**

|  |
| --- |
| 5 Radio link monitoring<unrelated part omitted>If the UE is not provided *RadioLinkMonitoringRS* and the UE is provided for PDCCH receptions TCI states that include one or more of a CSI-RS- the UE uses for radio link monitoring the RS provided for the active TCI state for PDCCH reception if the active TCI state for PDCCH reception includes only one RS- if the active TCI state for PDCCH reception includes two RS, the UE expects that one RS is configured with *qcl-Type* set to 'typeD' [6, TS 38.214] and the UE uses the RS configured with *qcl-Type* set to 'typeD' for radio link monitoring; the UE does not expect both RS to be configured with *qcl-Type* set to 'typeD'- the UE is not required to use for radio link monitoring an aperiodic or semi-persistent RS- For  and *Lmax* = 8, the UE selects the  RS provided for active TCI states for PDCCH receptions in CORESETs associated with the search space sets in an order from the shortest monitoring periodicity. If more than one CORESETs are associated with search space sets having same monitoring periodicity, the UE determines the order of the CORESET from the highest CORESET index as described in Clause 10.1.<unrelated part omitted> |

### First round of comments

Companies are encouraged to provide their view on this TP in the table below:

|  |  |
| --- | --- |
| **Company** | **comments** |
| QC | We first would like to understand the issue better. Hence, we have the following questions:* What is the consequence if the TP is not agreed? Is it more than gNB needs to configure *RadioLinkMonitoringRS* given that the case above is only related to the case that “UE is not provided *RadioLinkMonitoringRS*”, i.e., default behavior?
* Currently, the default rule for BFD-RS selection is not specified for any case (up to the UE the beam of which two CORESETs are considered). Then, is there a similar issue for BFD-RS that needs to be discussed? Why the case of default RLM-RS is more critical than BFD-RS?
* If there is an ambiguity issue in the way FG16-1g is defined (it is not completely clear to us if there is an issue), shouldn’t it be fixed in UE capability rather than changing the RAN1 text just for that purpose?
 |
| OPPO | Fine with the TP. |
| Apple | Support.Response to QC’s questions* When 5 CORESETs are configured, which 4 RLM RSs are selected based on implicit configuration is unclear. Moreover, how to count RLM RSs in FG 16-1g/16-1g-1 is unclear.
* For BFD RS selection, it was concluded to always count 3 RSs in UE FG 16-1g/16-1g-1, since there is no RS selection rule defined. But this is a kind of under-report like solution. But since we have a rule for RLM RS selection, we can easily extend it.
* To fix it in UE capability is also a possible way, we can consider to always count 5 RLM RS. But again, RLM is different from BFD, since we already have legacy rule for RLM RS selection.
 |
| DOCOMO | Support the TP.Agree with Apple that, since we already have legacy rule for RLM RS selection, it is easy to solve this issue by extending the applied case of legacy rule. |
| ZTE | Support the TP.Agree with Apple and DOCOMO |
| Ericsson | Support the TP |

Issue MT.1(ND)

### FL Summary

R1-2104407, R1-2105288, R1-2105842 and R1-2105469 discussed the issue of default TCI state of PDSCH of cross-carrier scheduling when multi-TRP is configured:

* R1-2104407 proposed TP to specify the default TCI state for PDSCH of cross-carrier scheduling in single-DCI based mTRP system
* R1-2105288 proposed TP to specify the default TCI state for PDSCH of cross-carrier scheduling in single-DCI based mTRP system
* R1-2105469 proposed TP to specify the default TCI state for PDSCH of cross-carrier scheduling for both single-DCI based mTRP system and multi-DCI based mTRP system
* R1-2105842 noticed that there is potential conflict between default beam defined for multiple TRPs (for the case one TCI codepoint indicating two TCI states) and default beam for the case of cross-carrier scheduling per the current 38.214 specification and thus proposed to adopt one of the following conclusions:
* Option 1: UE does not expect to be configured with *enableTwoDefaultTCIStates-r16* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.
* Option 2: UE does not expect to be configured with *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states..
* Option 3: UE does not expect to be configured with both *enableTwoDefaultTCIStates-r16* and *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.

From the understanding of FL, R1-2104407/ R1-2105288/ R1-2105469 proposed to clarify the method of mTRP default TCI state for PDSCH of cross-carrier scheduling. However, R1-2105842 proposed to make conclusion that the feature of two default TCI states of S-DCI mTRP system and cross-carrier scheduling are not used at the same time.

Based on the proposals in the tdocs and comments received during preparation phase, we have the following options or proposals for this issue:

* adopt one TP to clarify the default TCI state of PDSCH in mTRP and cross-carrier scheduling based on the TPs for 38. 214 proposed by R1-2104407/ R1-2105288/ R1-2105469:

|  |  |
| --- | --- |
| TP#1 by R1-2104407 | 5.1.5 Antenna ports quasi co-location------------------------------------------------- <Unchanged parts are omitted> ------------------------------------------------If the PDCCH carrying the scheduling DCI is received on one component carrier, and the PDSCH scheduled by that DCI is on another component carrier and the UE is configured with *enableDefaultBeam-ForCCS*:- The *timeDurationForQCL* is determined based on the subcarrier spacing of the scheduled PDSCH. If µPDCCH < µPDSCH an additional timing delay $d\frac{2^{μ\_{PDSCH}}}{2^{μ\_{PDCCH}}}$ is added to the *timeDurationForQCL*, where *d* is defined in 5.2.1.5.1a-1, otherwise *d* is zero;- For both the cases, when the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL,* and when the DL DCI does not have the TCI field present, the UE obtains its QCL assumption for the scheduled PDSCH* from the activated TCI state with the lowest ID applicable to PDSCH in the active BWP of the scheduled cell if all TCI codepoints indicates only one TCI state; or
* from the activated TCI states for the lowest codepoint among the TCI codepoints containing two different TCI states when the UE is configured with *enableTwoDefaultTCI-States* and at least one TCI codepoint indicates two TCI states for the scheduled cell.

------------------------------------------------- <Unchanged parts are omitted> ------------------------------------------------ |
| TP#2 by R1-2105288 | 5.1.5 Antenna ports quasi co-location--- start of TP ---If the PDCCH carrying the scheduling DCI is received on one component carrier, and the PDSCH scheduled by that DCI is on another component carrier and the UE is configured with *enableDefaultBeam-ForCCS*:- The *timeDurationForQCL* is determined based on the subcarrier spacing of the scheduled PDSCH. If µPDCCH < µPDSCH an additional timing delay $d\frac{2^{μ\_{PDSCH}}}{2^{μ\_{PDCCH}}}$ is added to the *timeDurationForQCL*, where *d* is defined in 5.2.1.5.1a-1, otherwise *d* is zero;- For both the cases, when the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL,* and when the DL DCI does not have the TCI field present, the UE obtains its QCL assumption for the scheduled PDSCH from the activated TCI state with the lowest ID applicable to PDSCH in the active BWP of the scheduled cell;- When a UE is configured with *enableTwoDefaultTCI-States* and at least one TCI codepoint indicates two TCI states for the component carrier of scheduled PDSCH, the UE may assume that the DM-RS ports of PDSCH or PDSCH transmission occasions of the component carrier are quasi co-located with the RS(s) with respect to the QCL parameter(s) associated with the TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.--- end of TP --- |
| TP#3 by R1-2105469 | **5.1.5 Antenna ports quasi co-location**< Unchanged parts are omitted >If the PDCCH carrying the scheduling DCI is received on one component carrier, and the PDSCH scheduled by that DCI is on another component carrier and the UE is configured with *enableDefaultBeam-ForCCS*:- The *timeDurationForQCL* is determined based on the subcarrier spacing of the scheduled PDSCH. If µPDCCH < µPDSCH an additional timing delay $d\frac{2^{μ\_{PDSCH}}}{2^{μ\_{PDCCH}}}$ is added to the *timeDurationForQCL*, where *d* is defined in 5.2.1.5.1a-1, otherwise *d* is zero;- For both the cases, when the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL,* and when the DL DCI does not have the TCI field present, the UE obtains its QCL assumption for the scheduled PDSCH from the activated TCI state with the lowest ID applicable to PDSCH in the active BWP of the scheduled cell. If a UE is configured with *enableDefaultTCIStatePerCoresetPoolIndex* and the UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in different *ControlResourceSets*, the UE obtains its QCL assumption for the scheduled PDSCH from the activated TCI state with the lowest ID applicable to PDSCH corresponding to the *CORESETPoolIndex*, which is same as the *CORESETPoolIndex* of PDCCH scheduling that PDSCH in the active BWP of the scheduled cell; if a UE is configured with *enableTwoDefaultTCI-States*, and at least one TCI codepoint indicates two TCI states, the UE obtains its QCL assumption for the scheduled PDSCH from the activated TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states applicable to PDSCH in the active BWP of the scheduled cell.< Unchanged parts are omitted > |

* Make one of the following conclusions:
	+ Option B-1: UE does not expect to be configured with *enableTwoDefaultTCIStates-r16* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.
	+ Option B-2: UE does not expect to be configured with *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states..
	+ Option B-3: UE does not expect to be configured with both *enableTwoDefaultTCIStates-r16* and *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.
* To conclude that clarification/spec change is not needed for this issue.

***FL proposal***

As the discussion is to make a conclusion (ND issue), the following possible conclusion is proposed based on the comments from preparation phase. However, I am not sure whether Option 1 is still valid since it is an ND issue.

**Possible conclusion:**

* **Option 1: adopt one TP for 38.214 to clarify the default TCI state of PDSCH in mTRP and cross-carrier scheduling**
	+ **The TP is based on the TPs proposed by R1-2104407/ R1-2105288/ R1-2105469**
* **Option 2: select one from the following conclusions**
	+ **Alt 2-1: UE does not expect to be configured with *enableTwoDefaultTCIStates-r16* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.**
	+ **Alt 2-2: UE does not expect to be configured with *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.**
	+ **Alt 2-3: UE does not expect to be configured with both *enableTwoDefaultTCIStates-r16* and *enableDefaultBeamForCS* for a serving cell scheduled by another serving cell and one TCI codepoint indicating two TCI states.**
* **Option 3: To conclude no spec change is needed in rel-16 for the issue of default TCI state of mTRP PDSCH in case of cross-carrier scheduling.**
* **Option 4: Other (please provide details).**

### First round of comments

Companies are encouraged to provide their views on **the options** in the table below:

|  |  |
| --- | --- |
| **Company** | **comments** |
| QC | Prefer Option 3. First, the discussions should be limited to single-DCI case. For multi-DCI, the basic x-carrier operation is not supported (irrespective of the default beam issue) as the scheduled CC does not have any CORESET (hence no CORESETPoolIndex value).For single-DCI, the existing rule applies to x-carrier scheduling as well since the default beam is based on MAC-CE (and not based on CORESET). The RRC configuration “***enableDefaultBeamForCS***” is only related to single-TRP behavior. What enables two default beams for single-DCI is “***enableTwoDefaultTCIStates-r16***” irrespective of self or cross carrier scheduling. Hence, existing spec is complete for single-DCI case and no addition is needed. |
| OPPO | Support Option 3. We agree with QC that current specification can support single DCI based M-TRP and cross carrier scheduling well. No further restriction/optimization is needed.  |
| Apple | Support option 3. If we want to modify default PDSCH beam, we need to modify default AP-CSI-RS beam as well, since UE can only generate limited number of default beams. |
| DOCOMO | Support option 3. We agree with QC/OPPO/Apple. |
| ZTE | Support option 3. We agree with QC/OPPO/Apple/DOCOMO |
| Ericsson | Support Option 3. |

Issue MT.6(ND)

### FL Summary

For the DL SPS transmission in S-DCI-based mTRP system:

* R1-2104651 noticed that in current spec, the RV sequence for SPS in case of FDMSchemeB, TDMSchemeA, and Inter-slot TDM scheme is not mentioned. TP was proposed to specify the RV values
* R1-2105809 also proposed TP to specify the RV values of DL SPS transmission with single DCI based multi-TRP PDSCH repetition schemes
* R1-2105288 proposed TP to Extend the single-DCI M-TRP dynamic grant PDSCH transmission schemes to include SPS PDSCH for enhanced PDSCH reliability for URLLC service types

For DL SPS transmission in multi-DCI based mTRP system, R1-2105288 proposed TP to Extend the agreement in RAN1#99 to include two SPS PDSCHs which overlap in time domain and are associated to two different TRPs according to the value of CORESETPoolIndex.

Per the comments during preparation phase, some companies commented that this issue is new feature or optimization, which should be introduced in the late stage, and that would cause NBC change.

**Therefore, based on the proposals in the tdocs and comments during preparation phase, we have the following solutions for this issue:**

* For DL SPS transmission in single-DCI based multi-TRP system, adopt one TP for 38.214 based on the following TPs #1, #2 and #3:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TP#1 by R1-2104651 | ============TP for 38.214 Section 5.1.2.1====================================--Unchanged part omitted------------------------When a UE is configured by the higher layer parameter *RepSchemeEnabler* set to '*TDMSchemeA'* and indicated DM-RS port(s) within one CDM group in the DCI field "*Antenna Port(s)"*, the number of PDSCH transmission occasions is derived by the number of TCI states indicated by the DCI field *'Transmission Configuration Indication'* of the scheduling DCI*.* - If two TCI states are indicated by the DCI field '*Transmission Configuration Indication*', the UE is expected to receive two PDSCH transmission occasions, where 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. The second TCI state is applied to the second PDSCH transmission occasion, and the second PDSCH transmission occasion shall have the same number of symbols as the first PDSCH transmission occasion. If the UE is configured by the higher layers with a value$ \overbar{K}$ in *StartingSymbolOffsetK*, it shall determine that the first symbol of the second PDSCH transmission occasion starts after $\overbar{K}$ symbols from the last symbol of the first PDSCH transmission occasion. If the value$ \overbar{K}$ is not configured via the higher layer parameter *StartingSymbolOffsetK*, $\overbar{K}$ = 0 shall be assumed by the UE. The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n=0, 1$ applied respectively to the first and second TCI state. For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 is assumed to be 0. The UE expects the PDSCH mapping type indicated by DCI field “*Time domain resource assignment*’ to be mapping type B, and the indicated PDSCH mapping type is applied to both PDSCH transmission occasions.- Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1. When a UE configured by the higher layer parameter *PDSCH-config* that indicates at least one entry in *pdsch-TimeDomainAllocationList* contain*RepNumR16* in *PDSCH-TimeDomainResourceAllocatio*n, - 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 in pdsch-TimeDomainAllocationList which contain RepNumR16 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, 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 RepNumR16 in PDSCH-TimeDomainResourceAllocation equals to two, the second TCI state is applied to the second PDSCH transmission occasion. When the value indicated by RepNumR16 in PDSCH-TimeDomainResourceAllocation is larger than two, the UE may be further configured to enable CycMapping or SeqMapping in RepTCIMapping. - When CycMapping 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 SeqMapping is enabled, first TCI state is applied to the first and second PDSCH transmissions, and the second TCI state is applied to the third and fourth PDSCH transmissions, and the same TCI mapping pattern continues to the remaining PDSCH transmission occasions. The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions associated with the first TCI state, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n$ is counted only considering PDSCH transmission occasions associated with the first TCI state. The redundancy version for PDSCH transmission occasions associated with the second TCI state is derived according to Table 5.1.2.1-3, where additional shifting operation for each redundancy version $rv\_{s} $is configured by higher layer parameter RVSeqOffset and $n$ is counted only considering PDSCH transmission occasions associated with the second TCI state. For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 and 5.1.2.1-3 is assumed to be 0, and the UE is not expected to be indicated with *RepNumR16* repetitions larger than the time duration derived by the periodicity P obtained from the corresponding *sps-Config*.Table 5.1.2.1-3: Applied redundancy version for the second TCI state when *RVSeqOffset* is present

|  |  |
| --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion with second TCI state |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| $$0$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ |
| $$2$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ |
| $$3$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ |
| $$1$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ |

- If one TCI state is indicated by the DCI field 'Transmission Configuration Indication' together with the DCI field "Time domain resource assignment' indicating an entry in pdsch-TimeDomainAllocationList which contain RepNumR16 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, the first PDSCH transmission occasion follows Clause 5.1.2.1, the same TCI state is applied to all PDSCH transmission occasions. The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n$ is counted considering PDSCH transmission occasions. For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 is assumed to be 0, and the UE is not expected to be indicated with *RepNumR16* repetitions larger than the time duration derived by the periodicity P obtained from the corresponding *sps-Config*.- Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1. ===========================================================================TP for 38.214 Section 5.1.2.3====================================--Unchanged part omitted-----------------------For a UE configured by the higher layer parameter *RepSchemeEnabler* set to '*FDMSchemeB',* andwhen 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)",* each PDSCH transmission occasion shall follow the Clause 7.3.1 of [4, TS 38.211] with themapping to resource elements determined by the assigned PRBs for corresponding TCI state of the PDSCH transmission occasion, and the UE shall only expect at most two code blocks per PDSCH transmission occasion when a single transmission layer is scheduled and a single code block per PDSCH transmission occasion when two transmission layers are scheduled. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n=0, 1$ are applied to the first and second TCI state, respectively. For PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by CS-RNTI with NDI=0, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 is assumed to be 0.=============================================================== |
| TP#2 by R1-2105809 | 5.1.2 Resource allocation5.1.2.1 Resource allocation in time domain---- Unchanged texts omitted ----When a UE is configured by the higher layer parameter repetitionScheme set to 'tdmSchemeA' and indicated DM-RS port(s) within one CDM group in the DCI field 'Antenna Port(s)', the number of PDSCH transmission occasions is derived by the number of TCI states indicated by the DCI field 'Transmission Configuration Indication' of the scheduling DCI.- If two TCI states are indicated by the DCI field '*Transmission Configuration Indication*', the UE is expected to receive two PDSCH transmission occasions, where 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. The second TCI state is applied to the second PDSCH transmission occasion, and the second PDSCH transmission occasion shall have the same number of symbols as the first PDSCH transmission occasion. If the UE is configured by the higher layers with a value$ \overbar{K}$ in *StartingSymbolOffsetK*, it shall determine that the first symbol of the second PDSCH transmission occasion starts after $\overbar{K}$ symbols from the last symbol of the first PDSCH transmission occasion. If the value$ \overbar{K}$ is not configured via the higher layer parameter *StartingSymbolOffsetK*, $\overbar{K}$ = 0 shall be assumed by the UE. The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n=0, 1$ applied respectively to the first and second TCI state. For PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in Table 5.1.2.1-2 is assumed to be 0. The UE expects the PDSCH mapping type indicated by DCI field '*Time domain resource assignment*' to be mapping type B, and the indicated PDSCH mapping type is applied to both PDSCH transmission occasions.- Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1. ---- Unchanged texts omitted ----The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions associated with the first TCI state, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n$ is counted only considering PDSCH transmission occasions associated with the first TCI state. The redundancy version for PDSCH transmission occasions associated with the second TCI state is derived according to Table 5.1.2.1-3, where additional shifting operation for each redundancy version $rv\_{s} $is configured by higher layer parameter *sequenceOffsetforRV* and $n$ is counted only considering PDSCH transmission occasions associated with the second TCI state. For PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in Tables 5.1.2.1-2 and 5.1.2.1-3 is assumed to be 0. Table 5.1.2.1-3: Applied redundancy version for the second TCI state when sequenceOffsetforRV is present

|  |  |
| --- | --- |
| *rvid* indicated by the DCI scheduling the PDSCH | *rvid* to be applied to *n*th transmission occasion with second TCI state |
| *n* mod 4 = 0 | *n* mod 4 = 1 | *n* mod 4 = 2 | *n* mod 4 = 3 |
| $$0$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ |
| $$2$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ |
| $$3$$ | $$(3+ rv\_{s}) mod 4$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ |
| $$1$$ | $$(1+ rv\_{s}) mod 4$$ | $$(0+ rv\_{s}) mod 4$$ | $$(2+ rv\_{s}) mod 4$$ | $$(3+ rv\_{s}) mod 4$$ |

- If one TCI state is 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 PDSCH transmission occasion follows Clause 5.1.2.1, the same TCI state is applied to all PDSCH transmission occasions. The UE may expect that each PDSCH transmission occasion is limited to two transmission layers. For all PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n$ is counted considering PDSCH transmission occasions. For PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in Tables 5.1.2.1-2 is assumed to be 0. - Otherwise, the UE is expected to receive a single PDSCH transmission occasion, and the resource allocation in the time domain follows Clause 5.1.2.1.---- Unchanged texts omitted ----5.1.2.3 Physical resource block (PRB) bundling---- Unchanged texts omitted ----For a UE configured by the higher layer parameter *repetitionScheme* set to 'fdmSchemeB*',* andwhen 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)',* each PDSCH transmission occasion shall follow the Clause 7.3.1 of [4, TS 38.211] with themapping to resource elements determined by the assigned PRBs for corresponding TCI state of the PDSCH transmission occasion, and the UE shall only expect at most two code blocks per PDSCH transmission occasion when a single transmission layer is scheduled and a single code block per PDSCH transmission occasion when two transmission layers are scheduled. For two PDSCH transmission occasions, the redundancy version to be applied is derived according to Table 5.1.2.1-2, where $n=0, 1$ are applied to the first and second TCI state, respectively. For PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, "*rvid* indicated by the DCI scheduling the PDSCH" in Tables 5.1.2.1-2 is assumed to be 0.---- Unchanged texts omitted ---- |
| TP#3 by R1-2105288 | 5.1 UE procedure for receiving the physical downlink shared channel--- start of TP ---When a UE is configured by higher layer parameter *repetitionScheme* set to one of 'fdmSchemeA*'*, 'fdmSchemeB*'*, 'tdmSchemeA*'*, if 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)'*.- When two TCI states are indicated in a DCI and the UE is set to 'fdmSchemeA*',* the UE shall receive a single PDSCH transmission occasion of the TB with each TCI state associated to a non-overlapping frequency domain resource allocation as described in Clause 5.1.2.3. - When two TCI states are indicated in a DCI and the UE is set to 'fdmSchemeB*'*, the UE shall receive two PDSCH transmission occasions of the same TB with each TCI state associated to a PDSCH transmission occasion which has non-overlapping frequency domain resource allocation with respect to the other PDSCH transmission occasion as described in Clause 5.1.2.3. - When two TCI states are indicated in a DCI and the UE is set to 'tdmSchemeA*'*, the UE shall receive two PDSCH transmission occasions of the same TB with each TCI state associated to a PDSCH transmission occasion which has non-overlapping time domain resource allocation with respect to the other PDSCH transmission occasion and both PDSCH transmission occasions shall be received within a given slot as described in Clause 5.1.2.1. When a UE is configured by the higher layer parameter *repetitionNumber* in *PDSCH-TimeDomainResourceAllocation*, the UE may expect to be indicated with one or two TCI states in a codepoint of 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)'*. - When two TCI states are indicated in a DCI with '*Transmission Configuration Indication*' field, the UE may expect to receive multiple slot level PDSCH transmission occasions of the same TB with two TCI states used across multiple PDSCH transmission occasions in the *repetitionNumber* consecutive slots as defined in Clause 5.1.2.1. - When one TCI state is indicated in a DCI with '*Transmission Configuration Indication*' field, the UE may expect to receive multiple slot level PDSCH transmission occasions of the same TB with one TCI state used across multiple PDSCH transmission occasions in the *repetitionNumber* consecutive slots as defined in Clause 5.1.2.1. When a UE is configured by the higher layer parameter *repetitionScheme* set to one of 'fdmSchemeA*'*, 'fdmSchemeB*'*, 'tdmSchemeA*'*, or is configured with *repetitionNumber,* if UE receives PDSCH(s) without corresponding PDCCH transmissions, UE receives the PDSCH occasions, according the codepoint of the DCI field *'Transmission Configuration Indication'* in the activation PDCCH.--- end of TP --- |

* **F**or DL SPS transmission in multi-DCI based multi-TRP system, adopt one TP for 38.214 based on the following TP#4:

|  |  |
| --- | --- |
| TP#3 by R1-2105288 | 5.1 UE procedure for receiving the physical downlink shared channel--- start of TP ---When a UE is not indicated with a DCI that DCI field "*Time domain resource assignment*' indicating an entry in *pdsch-TimeDomainAllocationList* which contain *RepNumR16* in *PDSCH-TimeDomainResourceAllocatio*n, and it is indicated with one TCI states in a codepoint of the DCI field *'Transmission Configuration Indication',* the UE procedure for receiving the PDSCH upon detection of a PDCCH follows Clause 5.1. For any SPS configuration, the corresponding SPS PDSCH with or without PDCCH is associated with a value of *CORESETPoolIndex* of the CORESET in which the activation DCI of the SPS configuration is received.If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, after resolving overlapping with symbols in the slot indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*, a UE receives one or more PDSCHs without corresponding PDCCH transmissions in the slot by applying the following pseudo-code to SPS PDSCHs associated with the same value of *CORESETPoolIndex* as specified below.‒ Step 0: set *j=0*, where *j* is thenumber of selected PDSCH(s) for decoding. *Q* is the set of activated PDSCHs without corresponding PDCCH transmissions within the slot‒ Step 1: A UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within *Q*, set *j=j+1*. Designate the received PDSCH as survivor PDSCH.‒ Step 2: The survivor PDSCH in step 1 and any other PDSCH(s) overlapping (even partially) with the survivor PDSCH in step 1 are excluded from *Q*. ‒ Step 3: Repeat step 1 and 2 until *Q* is empty or *j* is equal to *N*, where *N* is the maximum number of unicast PDSCHs per *CORESETPoolIndex* per slot if UE is provided *CORESETPoolIndex* with the value of 1, or the number of unicast PDSCHs in a slot supported by the UE otherwise--- end of TP --- |

* This is a non-essential/optimization issue, no specification change is needed

***FL proposal:***

As the discussion is to make a conclusion (ND issue), the following possible conclusion is proposed based on the comments from preparation phase. However, I am not sure whether Option 1 is still valid since it is an ND issue.

**Possible conclusion:**

* **Option 1: adopt one TP for 38.214 to specify RV values of SPS transmission with mTRP URLLC schemes in single-DCI based mTRP and associate the DL SPS with CORESETPoolindex in multi-DCI based mTRP system**
	+ **The TP is based on the TPs proposed by R1-2104651, R1-2105809 and R1-2105288**
* **Option 2: DL SPS transmission in multi-TRP system is an optimization issue and no spec change is needed for that in rel-16.**
* **Option 3: Other (please provide details).**

### First round of comments

Companies are encouraged to provide their view on **options** in the table below:

|  |  |
| --- | --- |
| **Company** | **comments** |
| QC | The discussion should be limited to single-DCI at this stage. For multi-DCI, there are other issues including association with CORESETPoolIndex, HARQ-Ack (including RRC changes as two lists of PUCCH resources are needed for SPS HARQ-Ack in case of separate feedback), overlapping SPS PDSCHs, etc.For single-DCI based mTRP, SPS is already supported in the spec, and the TPs are only to clarify the RV value. Even if the clarification that “RV is assumed to be 0” is not agreed, the RV value in activating DCI is anyway 0 (for validation as in 38.213 Section 10.2). Hence, either way, UE implements the same thing. The clarification is only needed because this is explicitly mentioned for the case of single-TRP:“The redundancy version to be applied on the *n*th transmission occasion of the TB, where *n* = 0, 1, …*pdsch- AggregationFactor* -1, is determined according to table 5.1.2.1-2 and "*rvid* indicated by the DCI scheduling the PDSCH" in table 5.1.2.1-2 is assumed to be 0 for PDSCH scheduled without corresponding PDCCH transmission using *sps- Config* and activated by DCI format 1\_1 or 1\_2.”Hence, from our point of view, regardless of whether the TP is agreed or not, SPS for single-DCI based multi-TRP is supported by the spec. At the same time, it is better to align the description with the single-TRP case. |
| OPPO | We prefer Option 2. On one hand, it is too late to support DL SPS transmission for multi-TRP which is a new feature in this stage. Secondly, there is no clear use case for m-TRP transmission via DL SPS scheduling. For m-TRP transmission, gNB should be able to dynamically switch to S-TRP when the channel state between one of the TRPs become worse (e.g. one TRP is blocked), or change the TCI states of PDSCHs when the channel changes. SPS cannot provide such flexibility for m-TRP.  |
| Apple | Support option 2. We failed to see spec broken. |
| DOCOMO | Support Option 2.For SPS in mDCI based MTRP, it is a new feature and under discussion in Rel-17.For SPS in sDCI based MTRP, we see the analysis from QC. But, since spec. is not broken, we prefer Option2. |
| ZTE | We prefer Option 1 and agree with QC’s analysis, the TP makes spec clearer. However, considering the current situation, we can also accept Option 2.  |
| Ericsson |  We prefer Option 1 and agree with QC’s comments. |

Conclusion

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References

1. R1-2104407 Maintenance on multi-TRP transmission Lenovo, Motorola Mobility
2. R1-2104482 Correction on power control for PUSCH CATT
3. R1-2104582 Maintenance of multi-beam operation ZTE
4. R1-2104583 Maintenance of Multi-TRP enhancements ZTE
5. R1-2104651 Remaining Issues on Multi-TRP Enhancements Qualcomm Incorporated
6. R1-2104728 Text proposals for overlapping between PUSCH/HARQ and CSI OPPO
7. R1-2104729 Text proposals for TCI state activation OPPO
8. R1-2105085 Remaining issues on Rel-16 Multi-TRP enhancement Apple
9. R1-2105287 Summary for Rel.16 NR eMIMO maintenance Moderator (Samsung)
10. R1-2105288 On Rel.16 multi-TRP/panel transmission Samsung
11. R1-2105289 On Rel-16 multi-beam maintenance Samsung
12. R1-2105351 Discussion on DRX interaction with CPU occupancy Nokia
13. R1-2105352 DRX interaction with CPU occupancy Nokia
14. R1-2105468 Maintenance on number of SRS resource set(s) for DCI format 0\_1 and DCI format 0\_2 vivo
15. R1-2105469 Maintenance on beam related issues vivo
16. R1-2105537 Correction on enabling configuration of time restriction over L1-SINR measurement Huawei, HiSilicon
17. R1-2105538 Corrections on RRC names and interpretation for Multi-TRP Huawei, HiSilicon
18. R1-2105809 Draft CR on DL SPS based PDSCH repetitions Ericsson
19. R1-2105810 Maintenance for single-DCI based multi-TRP in Rel-16 Ericsson
20. R1-2105842 Interoperation between cross-carrier scheduling and multiple TRPs ASUSTeK