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

e-Meeting, April 20th – 30th, 2020

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Title: FL summary for Multi-TRP/Panel Transmission

Agenda Item: 7.2.6.2

Document for: Discussion and Decision

1. Introduction

Rel-16 enhancement on MIMO WID includes objectives of enhancing multi-TRP/Panel transmission with ideal and non-ideal backhaul. During the work of rel-16, designs for multiple-PDCCH based and single-PDCCH based multi-TRP/Panel transmission were discussed and specified. Enhancements of multi-TRP transmission for URLLC were also specified. In this contribution, we summarize the remaining issues for multi-TRP transmission that are raised by companies in contributions [1~20].

The issues are summarized with following structures: issues for multi-PDCCH based transmission, issues for single-PDCCH based or URLLC and editorial changes proposed by companies.

1. Issues for Multi-PDCCH based Transmission
   1. Issue #a-1: PDCCH used to schedule for initial/re-transmission in Multi-DCI based M-TRP

Regarding the PDCCH used to schedule initial and re-transmission of same TB in multi-DCI based M-TRP system, [1] proposed that the PDCCH scheduling the initial transmission and re-transmission of a TB are associated to the *ControlResourceSets* having the same value of *CORESETPoolIndex*. The argument is to avoid additional complexity at both gNB and UE, thus the restriction similar to CA in Rel-15 can be added to Multi-DCI based M-TRP in Rel-16. Based on the input in the contribution, FL made the following offline proposal:

Offline Proposal #a-1: in Multi-DCI based Multi-TRP, the PDCCHs scheduling the initial transmission and re-transmission of a TB are associated to the *ControlResourceSets* having the same value of *CORESETPoolIndex.*

* The TP for TS 38.214 is:

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| < Start of the text proposal > 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 is expected that *ControlResourceSets* associated to initial transmission and retransmission of the same TB have the same value of *CORESETPoolIndex*. 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.  \*\*\* Unchanged text is omitted \*\*\*  < End of the text proposal > |

* 1. Issue #a-2: To determine the default value of *R* used in PDCCH blind detection

Contributions [1][3][10][14] discussed the issue of *R* value used in PDCCH blind detection. In current TS 38.213 section 10, the value for *R* is TBD when the UE does not report a value of *R*. [1][3][10] and [14] propose that the value of R is 1 when the UE does not report it. [14] also proposes that the value R can be the higher layer parameter *BDFactorR* here. However, per FL’s understanding, the RRC parameter *BDFactorR* is used to configure the value of r, not R.

Therefore, based on the proposals in [1][3][10][14], the following offline proposal is made:

Proposal #a-2: the value of R is 1 if the UE does not report it and adopt the TP for TS 38.213:

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| < Start of the text proposal >  **10 UE procedure for receiving control information**  \*\*\* Unchanged text is omitted \*\*\*  If a UE can support  - a first set of serving cells where the UE is either not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with a single value for all CORESETs on all DL BWPs of each serving cell from the first set of serving cells, and  - a second set of serving cells where the UE is provided *CORESETPoolIndex* with a value 0 for a first CORESET and with a value 1 for a second CORESET on any DL BWP of each serving cell from the second set of serving cells  the UE determines, for the purpose of reporting *pdcch-BlindDetectionCA*, a number of serving cells as where is either a value reported by the UE or if the UE does not report a value of R.  < End of the text proposal > |

* 1. Issue#a-3 Clarify the CRS rate match behavior for multi-DCI based M-TRP

Companies [1][2][3][5][14][20] propose to clarify the CRS rate match behavior for multi-DCI based M-TRP in TS 38.214.

Regarding the CRS rate match for multi-DCI based M-TRP system, we made the following agreement in RAN1#98bis:

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| **Agreement**  For multi-DCI based multi-TRP/panel transmission, the UE shall rate match around:   * Configured CRS patterns which optionally associated with a higher layer signaling index per CORESET (if configured) and are applied to the PDSCH scheduled with a DCI detected on a CORESET with the same higher layer index.   + This is a UE optional feature with separate UE capability signalling   + If UE does not support this feature, the default UE behaviour is the following:     - For multi-DCI based multi-TRP/panel transmission, the UE shall rate match PDSCH around configured CRS patterns from multiple TRPs |

One argument for the change is due to the latest update of RAN2 RRC parameters. In RAN2, two lists of LTE CRS patterns could be configured so that each list is assumed to be rate matched, with respect to *CORESETPoolIndex* value 0 or 1 respectively. [2][5][20] also propose to clarify that the UE shall rate match to lte-CRS-PatternList if lte-CRS-PatternListSecond is not provided.

For the reference, the latest RRC parameters are copied here:

lte-CRS-PatternList-r16 SetupRelease { LTE-CRS-PatternList-r16 } OPTIONAL, -- Cond LTE-CRS

lte-CRS-PatternListSecond-r16 SetupRelease { LTE-CRS-PatternList-r16 } OPTIONAL, -- Cond CORESETPool

Based on the proposals in [1][2][3][5][14][20], the following offline proposal is made:

Proposal #a-3: To clarify the CRS rate match behavior, adopt the following TP for TS38.214:

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| < Start of the text proposal >  5.1.4.2 PDSCH resource mapping with RE level granularity  \*\*\* Unchanged text is omitted \*\*\*  - If the UE configured by higher layer parameter *PDCCH-Config* with two different values of *CORESETPoolIndex* in *ControlResourceSet* and also configured by the higher layer parameter *LTE-CRS-PatternList-r16* in *ServingCellConfig*, the following REs are declared as not available for PDSCH:  - REs indicated by *lte-CRS-PatternList-r16* if PDCCH that schedule corresponding PDSCH is associated with a *ControlResourceSet* with the value of *CORESETPoolIndex* of 0, or REs indicated by *lte-CRS-PatternListSecond-r16* if PDCCH that schedule corresponding PDSCH is associated with *ControlResourceSet* with the value of *CORESETPoolIndex* of 1 for a UE supporting the capability of [*separate-lte-CRS-ToMatchAround*];  - REs indicated by *CRS-PatternList-r16* in *ServingCellConfig* for a UE not supporting the capability of [*separate-lte-CRS-ToMatchAround*] or when a UE is not provided with *lte-CRS-PatternListSecond-r16*.  < End of the text proposal > |

* 1. Issue #a-4: Define PDCCH monitoring occasion for Type-2 HARQ-ACK codebook in Multi-DCI M-TRP

We discussed specifying PDCCH monitoring occasion for Type-2 HARQ-ACK codebook in last meeting (RAN1#100e). For this meeting, companies [1][5][6][11][18][20] discussed this issue and proposed TPs for TS 38.213.

Regarding on the definition of the PDCCH monitoring occasion:

* [1][5][6] [18] and [20] propose that the PDCCH monitoring occasion should be indexed only by starting time, i.e., re-use the rel15 method and they propose almost similar TP
* [11] also thinks the PDCCH monitoring occasion shall be defined and ordered by the time domain only but they propose different TP.

Based on the inputs, an offline proposal is made:

Proposal #a-4-1: For definition of the PDCCH monitoring occasion, down-select one of the following TP for TS 38.214:

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| --- | --- |
| Alt1 by [1][5][6][18][20] | < Start of the text proposal > 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel \*\*\* Unchanged text is omitted \*\*\*  The set of PDCCH monitoring occasions for a DCI format scheduling PDSCH receptions or SPS PDSCH release is defined as the union of PDCCH monitoring occasions across active DL BWPs of configured serving cells. PDCCH monitoring occasions are indexed in an ascending order of start times of the search space sets. The cardinality of the set of PDCCH monitoring occasions defines a total number  of PDCCH monitoring occasions.  < End of the text proposal > |
| Alt2 by [11] | 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel --- start of TP ---  The set of PDCCH monitoring occasions for a DCI format scheduling PDSCH receptions or SPS PDSCH release is defined as the union of PDCCH monitoring occasions across active DL BWPs of configured serving cells. PDCCH monitoring occasions are ~~first~~ indexed in an ascending order ~~across serving cells indexes for a same~~of start time of search space sets associated with DCI formats scheduling PDSCH receptions or SPS PDSCH release on the serving cells~~,~~. For indexing within a same start time of the search space sets, the search space sets ~~and~~are ~~then~~indexed in an ascending order of ~~start times of the search space sets~~across serving cell indexes. For indexing within a serving cell for a same start time of search space sets, if a ~~the~~ UE is not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with value 0 for one or more first CORESETs and is provided*CORESETPoolIndex* with value 1 for one or more second CORESETs on an active DL BWP of a serving cell, and is provided *ACKNACKFeedbackMode* = *JointFeedback* for the active UL BWP, ~~PDCCH monitoring occasions~~the search space sets for the first CORESETs are indexed prior to ~~PDCCH monitoring occasions~~the search space sets for the second CORESETs. The cardinality of the set of PDCCH monitoring occasions defines a total number  of PDCCH monitoring occasions.  --- end of TP --- |

[5][6] and [20] also propose to clarify the counter DAI and total DAI for multi-DCI based M-TRP case. We had the following agreement made in RAN1#99:

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| --- |
| Agreement  For joint dynamic HARQ-ACK codebook among M-TRP,   * Counter DAI is jointly counted across two TRPs (i.e. different value of *CORESETPoolIndex* (if configured)), and total DAI should count total number of DCIs in a PDCCH monitoring occasion across CCs and TRPs. |

Based on the proposals in [5][6][20], offline proposal is proposed:

Proposal #a-4-2: Update TS 38.214 to clarify the counter DAI and total DAI calculation of Type-2 HARQ-ACK codebook for JointFeedback mode

[11] also discussed the issue of determination of PDCCH monitoring occasions of dynamic HARQ-ACK codebook. In Rel-15, the determination of PDCCH monitoring occasions of dynamic HARQ-ACK codebook is based on PDSCH-to-HARQ\_feedback timing indicator field values K1, slot offsets K0, and pdsch-AggregationFactor. In rel16, scheme 4 uses dynamic slot repetition with parameter *RepNumR16*. [11] proposes to include *RepNumR16* for determining PDCCH. Based on the proposal in [11], offline proposal is proposed:

Proposal #a-4-3: For dynamic HARQ-ACK codebook, PDCCH monitoring occasion set is determined based on PDSCH-to-HARQ\_feedback timing indicator field values K1, slot offsets K0, pdsch-AggregationFactor and *RepNumR16*.

* 1. Issue #a-5: What is the default HARQ-ACK feedback mode if RRC parameter *ackNackFeedbackMode-r16* is not configured

RRC parameter *ackNackFeedbackMode-r16* is used to configure HARQ-ACK feedback mode for multi-DCI based M-TRP transmission. Companies [1], [11] and [14] discussed what shall be the default mode if the parameter *ackNackFeedbackMode-r16* is not provided.

* Companies [1] and [14] propose to specify in TS 38.213 that if RRC parameter *ackNackFeedbackMode-r16* is not provided, the mode is separate feedback.
* [11] suggested that if the parameter *ackNackFeedbackMode-r16* is not configured, it is inter-slot TDM scheme and no change to the current specification.

Based on the proposals in [1][11][14], offline proposal is made:

Proposal #a-5: When RRC parameter *ackNackFeedbackMode-r16* is not provided, down-select from:

* Alt1: the feedback mode is separate feedback and update the TS 38.213 accordingly.
* Alt2: no change in the TS 38.213 and the feedback mode is inter-slot TDM.
  1. Issue#a-6: Determine the default QCL for AP CSI-RS in multi-DCI based M-TRP

Companies [2][3][4][12][15][18][20] discussed the default QCL for AP CSI-RS when the scheduling offset is less than threshold in multi-DCI based M-TRP system:

* [2] propose that the default TCI-state for AP CSI-RS follows rel15 behavior for each *CORESETPoolIndex* value.
* [3] propose that the default QCL for aperiodic CSI-RS may follow the default QCL for PDSCH if there is not any other DL signal with an indicated TCI state in the same symbols as the CSI-RS
* [4] propose that in multi-DCI based M-TRP, the default TCI-state for AP CSI-RS is QCL assumption of CORESET with lowest ID with the same value of *CORESETPoolIndex*.
* [12] propose that for multi-DCI based multi-TRP transmission, the default TCI state for aperiodic CSI-RS is assumed as the TCI state of the lowest CORESET ID among the CORESETs with the same CORESETPoolIndex as the PDCCH triggering the CSI-RS
* [15] propose that for multi-TRP operation, the default aperiodic CSI-RS beam should be the same as the default PDSCH beam, since UE is not able to use different default beams to buffer downlink signals.
* [18] propose that for AP CSI-RS, the UE applies QCL assumption of CORESET with lowest ID associated with the same value of CORESETPoolIndex.
* [20] propose that
  + If there is no known DL signal in the symbols of the AP CSI-RS, UE processes the AP CSI-RS via the default PDSCH beam associated with the CORESETPoolIndex for the AP CSI-RS;
  + If there are two known PDSCHs associated with different CORESETPoolIndex in the symbols of the AP CSI-RS, UE process the AP CSI-RS via the known PDSCH beam associated with the CORESETPoolIndex for the AP CSI-RS.

Based on the proposals and discussion in [2][3][4][12][15][18][20], offline proposal is:

Proposal #a-6: In multi-DCI based M-TRP, when the scheduling offset AP CSI-RS is less than *beamSwitchTiming*:

* If there is any other DL signal, the UE applies QCL assumption of the other signal also to receive the AP CSI-RS
* Otherwise, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *ID* among all the CORESETs with the same value of *CORESETPoolIndex* as the PDCCH triggering the AP CSI-RS, in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored
  1. Issue#a-7: uplink power control issues in multi-DCI based M-TRP

Companies [2][4][7] [15] discussed couple of issues of uplink control on PUSCH and/or PUCCH in multi-DCI based M-TRP:

* [2] propose that: the closed-loop power control shall be independent for PUSCH transmission scheduled by different TRP (i.e., CORESETs with different CORESETPoolIndex) regardless of the configured close loop index.
* [4] proposed for multi-DCI based M-TRP
  + Support TRP specific pathloss RS for PUSCH and PUCCH and clarify the default pathloss reference signal for PUSCH or PUCCH.
  + Define different values for default close loop indexes for PUSCH/PUCCH targeting to different TRPs.
* [7] proposed:
  + In multi-DCI based M-TRP, at least two pathloss RSs shall be configured and default pathloss reference signal for PUCCH shall be determined according to the CORESETPoolIndex of the PDCCH;
  + TPC command in DCI format 2\_2 only applies to PUCCH resource associated with the same *CORESETPoolIndex*.
* [15] propose that the PUSCH/PUCCH associated with different *CORESET-poolIndex* should be configured with different closed-loop power control process index.

Based on the proposals in [2][4][7][15], offline proposals are:

Proposal #a-7-1: In multi-DCI based M-TRP, the uplink power control on PUCCH and PUSCH:

* Alt1: the closed loop power control is independent between PUSCH or PUCCH associated with different CORESETPoolIndex values regardless of the configured close loop index.
* Alt2: the PUSCH/PUCCH associated with different *CORESET-poolIndex* are configured with different/separate closed-loop power control process index

Proposal #a-7-2: Support TRP-specific pathloss RS and clarify the default TRP-specific pathloss RS for PUSCH and PUCCH.

Proposal #a-7-3: TPC command in DCI format 2\_2 only applied to PUCCH resource associated with the same TRP

* 1. Issue#a-8: active BWP operation in multi-DCI based M-TRP system

Companies [2][4][7][11][12][16] discussed the issues of active BWP operation in multi-DCI based M-TRP system. For the reference, we made the following agreement on active BWP in RAN1#96:

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| **Agreement**  For a UE supporting multiple-PDCCH based multi-TRP/panel transmission and each PDCCH schedules one PDSCH, at least for eMBB with non-ideal backhaul, support following restrictions:   * The UE may be scheduled with fully/partially/non-overlapped PDSCHs at time and frequency domain by multiple PDCCHs with following restrictions:   + …   + The UE is expected to be scheduled with the same active BWP bandwidth and the same SCS if the UE is expected to receive multiple PDSCHs simultaneously at given symbols.   + The number of active BWPs for a UE is 1 per CC   + … |

Companies made the following proposal on active BWP issue:

* [2] suggest that the condition of “if the UE is expected to receive multiple PDSCHs simultaneously at given symbols” in the agreement is not captured in TS 38.214 yet and propose TP
* [4] suggests current description in 38.214 is too restrictive and propose a TP to support BWP switching only in PDCCH associated with *CORESETPoolIndex*=0.
* [7] propose that if a UE detects two DCIs indicating a same active DL BWP change in a same slot, the UE is not required to receive or transmit in the cell during a time duration from the end of the third symbol of a slot where the UE receives the DCI until the beginning of a slot indicated by the smaller slot offset value of the time domain resource assignment fields in the two DCI.
* [11] observes that it is up to gNB implementation to coordinate each other to ensure the same BWP for scheduling two different PDSCHs by two different DCIs to the UE
* [12] propose that, when UE is scheduled with different active BWPs through multi-PDCCHs, only one PDCCH is applied and the other PDCCH is dropped.
* [16] suggest to add clarification that only PDCCH in CORESET associated CORESETPoolIndex = 0 can indicate BWP switching.

The TPs proposed by [2][4][7][12][16] are summarized as:

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| TP#1 by [2] | **5.1 UE procedure for receiving the physical downlink shared channel**  <Unchanged parts are 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, and the UE is expected to be activated one BWP per serving cell. When the UE is scheduled with multiple PDSCHs simultaneously at given symbols in a serving cell, 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 parts are omitted> |
| TP#2 by [4] | 5.1 UE procedure for receiving the physical downlink shared channel  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. For a PDCCH associated to *ControlResourceSet* having value of *CORESETpoolIndex* equal to 1, the UE doesn’t expect the bandwidth part indicator field in a DCI of the PDCCH indicates a different BWP from the active BWP. 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:  - For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH associated with a value of *CORESETpoolIndex* ending in symbol *i*, the UE can be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH associated with a different value of *CORESETpoolIndex* that ends later than symbol *i*.  - In a given scheduled cell, the UE can receive a first PDSCH in slot *i*, with the corresponding HARQ-ACK assigned to be transmitted in slot *j*, and a second PDSCH associated with a value of *CORESETpoolindex* different from that of the first PDSCH starting later than the first PDSCH with its corresponding HARQ-ACK assigned to be transmitted in a slot before slot *j*. |
| TP by [7] | 5.1 UE procedure for receiving the physical downlink shared channel  ------------------------------------------------- <Unchanged parts are 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. If a UE detects two DCIs in a same slot indicating a same active DL BWP with different time domain resource assignment field value, the UE is not required to receive or transmit in the cell during a time duration from the end of the third symbol of a slot where the UE receives the DCI until the beginning of a slot indicated by the smaller slot offset value of the time domain resource assignment fields in the two DCI.  ------------------------------------------------- <Unchanged parts are omitted>------------------------------------------------- |
| TP by [12] | ------------------------------------------Start of Text Proposal to TS 38.214 v16.1.0----------------------------------  5.1 UE procedure for receiving the physical downlink shared channel  --------------- Unchanged parts 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 SCS. When UE is scheduled with different active BWPs through multi-PDCCHs, the PDCCH associated to *ControlResourceSet* having value of *CORESETpoolIndex* equal to 1 is dropped. 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 parts omitted -------------  --------------------------------------- End of Text Proposal ------------------------------------ |
| TP by [16] | **5.1 UE procedure for receiving the physical downlink shared channel**  < Unchanged parts are 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. The UE may only receive the BWP switching indication in the PDCCH associated to a *ControlResourceSet* without *CORESETPoolIndex* or a *ControlResourceSet* 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 parts are omitted > |

Proposal #a-8: Update the TS 38.214 with a TP based on the TPs proposed by [2][4][7][12][16]

* 1. Issue#a-9: CSI/SR UCI overlapping with two HARQ-ACK PUCCH /PUSCH of two different TRPs

[3][4][13] discussed the issues that other UL transmission, for example CSI or SR in PUCCH might overlap with two PUCCHs that are sent to different TRPs. [4] explained that in multi-DCI based M-TRP system, CSI or SR transmission might overlap with two PUCCHs or PUSCH that are transmitted to two different TRPs within one slot, as shown in Figure shown below. The UE behavior is not clear in current specification.



[4][3][14] make the following proposals for this issue:

* [3] propose to clarify that the UE does not expect that happens.
* [4] prefer the following two options to resolve the issue to avoid RRC change.
  + Option 2: UE doesn’t expect two PUCCHs with separate HARQ-ACK or two PUSCHs within a slot associated with different values of *CORESETPoolIndex* to be simultaneously overlapped with another UL signal.
  + Option 3: A UL signal is always multiplexed with the PUCCH/PUSCH associated with *CORESETPoolIndex=0* if the UL signal is simultaneously overlapped two PUCCHs/PUSCHs associated with different values of *CORESETPoolIndex*.
* [13] propose to associate those PUCCH with CORESETPoolIndex value using the rule:
  + For PUCCHs not triggered by PDCCH, if spatial information is not configured, they are associated with CORESETPoolIndex with the same value as CORESET with lowest ID on active DL BWP of serving cells, otherwise, they are always associated with CORESETPoolIndex with a value of 0

Based on the proposals in [3][4][13], offline proposal is

Proposal#a-9: to resolve the issue of one UCI overlapping with two HARQ-ACK PUCCH/PUSCH of two different TRPs, down-select from:

* Alt1: the UE does not expect that scenarios happen
* Alt2: the UE always multiplexes that UL signal with PUCCH/PUSCH associated with *CORESETPoolIndex=0*.
* Alt3: use one predefined rule to associate those UL signal with CORESETPoolIndex value: if spatial information is not configured, they are associated with CORESETPoolIndex with the same value as CORESET with lowest ID on active DL BWP of serving cells, otherwise, they are always associated with CORESETPoolIndex with a value of 0
  1. Issue#a-10: In multi-DCI based M-TRP, separate HARQ-ACK feedback vs sub-slot-based HARQ-ACK feedback.

Company [3] discussed the issue of separate feedback mode in multi-DCI based M-TRP vs the sub-slot based HARQ feedback mode. Sub-slot based HARQ-ACK feedback mode is supported by rel16 based on the agreement made in URLLC session and multi-TRP session agreed to support two TDMed PUCCH HARQ-ACK for separate feedback mode.

* [3] proposed to clarify that in separate HARQ-ACK mode, the UE is only allowed to transmit two TDMed PUCCH for HARQ in one slot, not within each subslot and [3] proposed the following TP:

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| --- |
| ------------------------------------------Start of Text Proposal ----------------------------------  **9.2 UCI reporting in physical uplink control channel**  UCI types reported in a PUCCH include HARQ-ACK information, SR, LRR, and CSI. UCI bits include HARQ-ACK information bits, if any, SR information bits, if any, LRR information bit, if any, and CSI bits, if any. The HARQ-ACK information bits correspond to a HARQ-ACK codebook as described in Clause 9.1. For the remaining of this clause, any reference to SR is applicable for SR and/or for LRR.  A UE may transmit one or two PUCCHs on a serving cell in different symbols within a slot. When the UE transmits two PUCCHs in a slot and the UE is not provided *ACKNACKFeedbackMode* = *SeparateFeedback*, at least one of the two PUCCHs uses PUCCH format 0 or PUCCH format 2.  ~~If a UE is provided~~ *~~ACKNACKFeedbackMode~~* ~~=~~ *~~SeparateFeedback~~*~~, the UE may transmit up to two PUCCHs with HARQ-ACK information in different symbols within a slot.~~  In Clauses 9.2.3, 9.2.5.1 and 9.2.5.2, a UE assumes 11 CRC bits if a number of respective UCI bits is larger than or equal to 360; otherwise, the UE determines a number of CRC bits based on the number of respective UCI bits as described in [5, TS 38.212].  < Unchanged parts are omitted >  **9.2.3 UE procedure for reporting HARQ-ACK**  If a UE is provided *ACKNACKFeedbackMode* = *SeparateFeedback* and it is not provided *subslotLength-ForPUCCH*, the UE may transmit up to two PUCCHs with HARQ-ACK information in different symbols within a slot. Otherwise, a~~A~~ UE does not expect to transmit more than one PUCCH with HARQ-ACK information in a slot.  < Unchanged parts are omitted >  --------------------------------------- End of Text Proposal ------------------------------------ |

Based on the proposal in [3], offline proposal is:

Proposal #a-10: Clarify in TS 38.214 that when separate HARQ-ACK feedback mode is configured, the UE is allowed to transmit to TDMed PUCCH within a slot, not within a sub-slot.

* 1. Issue#a-11: PDCCH monitoring priority based QCL-Type D in multi-DCI based M-TRP

Companies [8][11][14][20] discussed the issues on PCCH monitoring priority based on QCL-TypeD in multi-DCI based M-TRP systems.

* [8] proposed to remove the applicability of current PDCCH priority based on QCL-typeD for multi-DCI based M-TRP, and extend the applicability of PDCCH priority based on QCL-typeD to multi-DCI based M-TRP
* [11] propose to NOT support simultaneous reception of PDCCHs with multiple different QCL-TypeDs.
* [14] suggest to remove the applicability of the current PDCCH prioritization based on QCL Type D properties to multi-DCI multi-TRP transmission
* [20] propose to apply the QCL-typeD priority rule on first and second CORESETs with same CORESETPoolIndex values separately for UE capable of receiving two QCL-TypeD simultaneously.

Based on the proposals in [8][11][14][20], offline proposal is:

Proposal a-11: For the PDCCH monitoring priority rule based QCL-TypeD in multi-DCI based M-TRP:

* Alt1: do not support simultaneous reception of PDCCHs with different QCL-TypeDs
* Alt2: for UE capable of two simultaneous QCL-TypeD, apply the priority rule within CORESETs with same CORESETPoolIndex.
  1. Issue#a-12: Radio link monitoring in multi-DCI based M-TRP

Companies [15] and [18] discussed the issue of radio link monitoring in multi-DCI based M-TRP system:

* [15] proposes that for multi-DCI based system, UE only needs to monitor the CORESET(s) with *CORESETPoolIndex* configured to be 0 for RLM
* [18] propose to monitor only the CORESET with index = 0 in multi-DCI based system;

Based on the proposals in [15] and [18], offline proposal is:

Proposal #a-12: For radio link monitoring in multi-DCI based M-TRP system, the UE only monitors the RS in active TCI-state for PDCCH reception in CORESETs associated with *CORESETPoolIndex* value 0.

* 1. Issue#a-13: Default spatial setting for PUCCH in multi-DCI based M-TRP

[13] proposed to specify the default spatial setting for PUCCH in multi-DCI based M-TRP system when spatial relation info is not configured to the PUCCH. [13] propose:

* In multi-DCI based multi-TRP, when PUCCH resources not configured with spatial information, the default information is TCI state/QCL assumption of CORESET with lowest ID among CORESETs with the same value of CORESETPoolIndex as PUCCH resources.

Based on the proposal in [13], offline proposal is:

Proposal #a-13: In multi-DCI based M-TRP, if a PUCCH resource is not provided with spatial relation configuration, the default spatial setting is TCI state/QCL assumption of CORESET with lowest ID among CORESETs with the same value of CORESETPoolIndex as PUCCH resource

* 1. Issue#a-14: Support receiving more than one SPS PDSCH in multi-DCI based M-TRP

Company [20] discussed the issue of SPS PDSCH in multi-DCI based M-TRP. [20] propose that SPS PDSCH association with *CORESETPoolIndex* should be based on the DCI that activates the SPS configuration and propose the following TP:

|  |
| --- |
| ============TP for 38.214 Section 5.1 ====================================  --Unchanged part omitted------------------------  If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet,* and if an *sps-Config* is activated by a DCI format, the corresponding SPS PDSCHs are associated with a value of *CORESETPoolIndex* of the CORESET in which the DCI format is detected.  If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are partially or fully overlapping in time and they are associated with the same value of *CORESETPoolIndex* or if *CORESETPoolIndex* is not configured, a UE is not required to receive a PDSCH among these PDSCHs other than one with the lowest configured *sps-ConfigIndex*. UE is expected to receive partially or fully overlapping SPS PDSCHs in a given serving cell if they are associated with different *CORESETPoolIndex* values.--Unchanged part omitted------------------------  =============================================================== |

Based on the proposal in [20], offline proposal is:

Proposal #a-14: In multi-DCI based M-TRP, SPS PDSCHs are associated with associated with a value of *CORESETPoolIndex* of the CORESET in which the DCI format is detected.

## Issue #a-15 update TS 38.214 to capture the case if the UE does not support the feature of supporting two default TCI-states in multi-DCI based M-TRP

[6] proposed that we have the following agreement:

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| **Agreement@#99**  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* |

But the yellow part is not captured in TS 38.214 yet.

[6] proposed the following TP for TS 38.214:

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| --- |
| 5.1.5 Antenna ports quasi co-location  **---- Unchanged text are omitted ----**  Independent of the configuration of *tci-PresentInDCI* and *tci-PresentInDCI-ForFormat1\_2* in RRC connected mode, if all the TCI codepoints are mapped to a single TCI state and the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL*, the UE may assume that the DM-RS ports of PDSCH 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). If none of configured TCI states for the serving cell of scheduled PDSCH contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH. If a UE configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet,* for both cases,when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL,* if the UE is capable of supporting two default TCIs, the UE may assume that the DM-RS ports of PDSCH associated with a value of *CORESETPoolIndex* 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 *CORESET-ID* among CORESETs, which are configured with the same value of *CORESETPoolIndex* as the PDCCH scheduling that PDSCH, in the latest slot in which one or more CORESETs associated with the same value of *CORESETPoolIndex* as the PDCCH scheduling that PDSCH within the active BWP of the serving cell are monitored by the UE, and if the UE is not capable of supporting two default TCIs, the UE may assume that the DM-RS ports of PDSCH 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 CORESET-ID in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored by the UE. If the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and atleast one configured TCI states for the serving cell of scheduled PDSCH contains the'QCL-TypeD', and at least one TCI codepoint indicates two TCI states, the UE may assume that the DM-RS ports of PDSCH of a serving cell 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.  **---- Unchanged text are omitted ----** |

Proposal#a-15: adopt the above TP proposed for TS 38.214

1. Issues for single-PDCCH based Transmission & URLLC Enhancement
   1. Issue#b-1: Determine default QCL for AP CSI-RS in single-DCI based M-TRP

Companies [2][3][15][19][20] discussed the default QCL for AP CSI-RS when the scheduling offset is less than threshold in single-DCI based M-TRP system:

* [2] propose that for single-DCI based MTRP, if the slot offset is smaller than the threshold and at least one TCI codepoint contains two TCI states, the default TCI state of AP CSI-RS is the first one of TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.
* [3] propose that:
  + If there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies indicated one of the one or two of QCL assumption of the other DL signal when receiving the aperiodic CSI-RS.
  + If there is no other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the indicated one of the one or two of the QCL assumptions for PDSCH reception.
* [15] propose that for multi-TRP operation, the default aperiodic CSI-RS beam should be the same as the default PDSCH beam, since UE is not able to use different default beams to buffer downlink signals.
* [19] propose that when the PDSCH is scheme 3 or scheme 4, UE applies the QCL assumption of PDSCH transmission occasion on the same symbol as the CSI-RS when receiving AP CSI-RS.
* [20] propose that
  + If there is no known DL signal in the symbols of the AP CSI-RS, UE processes the AP CSI-RS via the default PDSCH beam whose TCI state is identical to the indicated TCI state of the AP CSI-RS.

Based on the proposals in [2][3][15][20], offline proposal is:

Proposal #b-1: In single-DCI based M-TRP, when the scheduling offset AP CSI-RS is less than *beamSwitchTiming*

* If there is any other DL signal, the UE applies QCL assumption of the other signal also to receive the AP CSI-RS
* if there is no known DL signal in the symbols of AP CSI-RS, down-select the following two alts for default QCL assumption for AP CSI-RS:
  + Alt1: the first one of TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.
  + Alt2: the TCI state indicated by the DCI, which is one of the default PDSCH TCI-states.
  1. Issue #b-2: Default TCI-state for PDSCH of Scheme 3 and Scheme 4

Companies [3][15][16][19] discussed the issues of default TCI state for PDSCH in URLLC scheme 3 and 4.

* [3] propose that in case of default TCI-state, for PDSCH with scheme 3 or scheme 4
  + For scheme 3, the first and second TCI states of the two default TCI states or the TCI states indicated by the scheduling DCI are applied to the first and second PDSCH transmission occasions respectively. If the offset between the reception of the DL DCI and one of the two PDSCH transmission occasions is less than the threshold timeDurationForQCL, default TCI states are applied, otherwise TCI states indicated by the scheduling DCI is applied;
  + For scheme 4, when CycMapping is enabled, the first and second TCI states of the default TCI states or the TCI states indicated by the scheduling DCI are applied are applied to the first and second PDSCH transmission occasions, respectively, and so on. When SeqMapping is enabled, the first TCI state of the default TCI states or the TCI states indicated by the scheduling DCI is applied to the first and second PDSCH transmissions, and the second TCI state of the default TCI states or the TCI states indicated by the scheduling DCI is applied to the third and fourth PDSCH transmissions, and so on. If the offset between the reception of the DL DCI and one of the PDSCH transmission occasions is less than the threshold timeDurationForQCL, default TCI states are applied to the PDSCH transmission occasion, otherwise TCI states indicated by the scheduling DCI is applied.
* [15] propose that default TCI-state feature is not applied to scheme 3 or scheme 4 in single-DCI based M-TRP.
* [16] propose that for URLLC scheme 2a/2b and scheme 3 and scheme 4, two transmission occasions are assumed, and one of the two TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states is associated to one PDSCH transmission occasion; and for URLLC scheme 4, one of the two TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states is associated to one PDSCH transmission occasion following current rule; And the indicated TCI field in the corresponding PDCCH is ignored.
* [19] suggests that UE applies default TCI-state on the n-th transmission with offset < threshold, and the UE applies the indicated TCI-state on n-th transmission with offet >= threshold

Based on the proposals by companies [3][15][16][19], the following offline proposal are made:

Proposal #b-2: discuss and determine the default TCI state for the Scheme 3 and Scheme 4.

* 1. Issue#b-3: Default TCI-state for PDSCH when DCI has no TCI field

Companies [3][7][13] discussed the issue of default TCI-state for PDSCH in the case that the DCI does not have TCI field. Their proposals are:

* [3] propose two alts:
  + Alt1: the first TCI state of the two default different TCI states
  + Alt2: the TCI state of the CORESET for the PDCCH transmission with the DCI if the TCI state of the CORESET for the PDCCH is one of the two default TCI states.
* [7] propose the QCL parameter(s) is the first TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.
* [13] propose
  + If tci-PresentInDCI is not configured for the CORESET scheduling the PDSCH, not support multi-TRP transmission scheduled by PDCCH in the CORESET
  + When the offset is less than timeDurationForQCL follow Rel-15 default TCI state for the case when TCI field is not present in DCI.

Based on the proposals by companies [3][7][13], the following offline proposal are made:

Proposal #b-3: discuss and determine the default TCI state of PDSCH in the case of DCI without TCI field.

* 1. Issue#b-4: Default TCI-state for PDSCH when DCI indicates one TCI-state

Companies [2][3][5][7] discussed the issue of default TCI-state of PDSCH when DCI indicates one TCI-state and their proposals are:

* [2] propose in this case, single-TRP or TDM scheme 4 may be scheduled. The indicated TCI state can be replaced by the first of two default TCI states. The mapping among the first one of default TCI states, DMRS ports and the allocated time/frequency resources can still follow the case when the offset between PDCCH and the corresponding PDSCH is larger than the threshold.
* [3] suggest two alts for this case:
  + Alt: the first TCI state of the two default different TCI states,
  + Alt2: the indicated TCI state if it is one of the two default different TCI states, or the TCI state of the CORESET for the PDCCH transmission with the DCI if the TCI state of the CORESET for the PDCCH is one of the two default TCI states.
* [5] propose the QCL assumption is the indicated TCI state if it is one of the TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states, otherwise, it is the first TCI state of TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states;
* [7] propose the UE may assume that the DM-RS ports of PDSCH of a serving cell 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.

Based on the proposals by companies [2][3][5][7], the following offline proposal are made:

Proposal #b-4: discuss and determine the default TCI state of PDSCH when DCI indicates one TCI state

* + Alt1: the first one of TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.
  + Alt2: the QCL assumption is the indicated TCI state if it is one of the TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states, otherwise, it is the first TCI state of TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states.
  + Alt3: the indicated TCI state if it is one of the two default different TCI states, or the TCI state of the CORESET for the PDCCH transmission with the DCI if the TCI state of the CORESET for the PDCCH is one of the two default TCI states
  1. Issue#b-5: Default TCI-state for PDSCH when DCI indicates two TCI-states

Companies [2] and [3] discussed the issue of default TCI-state of PDSCH when DCI indicates two TCI-states and their proposals are:

* [2] propose that if the TCI codepoint indicates two TCI states, one of SDM, FDM scheme 2a, FDM scheme 2b, TDM scheme 3 and TDM scheme 4 may be scheduled. Two indicated TCI states can be replaced by the two default TCI states. The mapping among the default TCI states, DMRS ports and the allocated time/frequency resources can follow the case when the offset between PDCCH and the corresponding PDSCH is larger than the threshold.
* [3] propose that if two TCI states are indicated:
  + For scheme 3, the first and second TCI states of the two default TCI states or the TCI states indicated by the scheduling DCI are applied to the first and second PDSCH transmission occasions respectively. If the offset between the reception of the DL DCI and one of the two PDSCH transmission occasions is less than the threshold timeDurationForQCL, default TCI states are applied, otherwise TCI states indicated by the scheduling DCI is applied;
  + For scheme 4, when CycMapping is enabled, the first and second TCI states of the default TCI states or the TCI states indicated by the scheduling DCI are applied are applied to the first and second PDSCH transmission occasions, respectively, and so on. When SeqMapping is enabled, the first TCI state of the default TCI states or the TCI states indicated by the scheduling DCI is applied to the first and second PDSCH transmissions, and the second TCI state of the default TCI states or the TCI states indicated by the scheduling DCI is applied to the third and fourth PDSCH transmissions, and so on. If the offset between the reception of the DL DCI and one of the PDSCH transmission occasions is less than the threshold timeDurationForQCL, default TCI states are applied to the PDSCH transmission occasion, otherwise TCI states indicated by the scheduling DCI is applied.

Based on the proposals by companies [2][3], the following offline proposal are made:

Proposal #b-5: discuss and determine the default TCI state of PDSCH when DCI indicates two TCI states

* 1. Issue#b-6: Capture UE capability of supporting two default TCI-states in single-DCI based M-TRP

Companies [5][10] suggest to capture the “UE capability” part in the spec and made the following proposals:

* [5] propose that A Release-16 UE incapable of simultaneously monitoring two default TCI states follows the Release-15 UE behavior for default QCL assumption.
* [10] propose to adopt the one TP to fully capture the agreement regarding the capability of supporting two default TCI states in subsection 5.1.5 of 38.214.

For the reference, we made the following agreement in RAN1#99 meeting:

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| --- |
| Agreement  For single-DCI based Multi-TRP/panel transmission with at least one configured TCI states for the serving cell of scheduled PDSCH containing 'QCL-TypeD',   * If the offset between the reception of the PDCCH and the corresponding PDSCH is less than timeDurationForQCL and after the reception of activation command of TCI states for UE specific PDSCH, the UE may assume that DMRS ports of PDSCH follows QCL parameters indicated by default TCI state(s) as following:   + Use the TCI-states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states which are activated for PDSCH. * If all the TCI codepoints are mapped to a single TCI state, then Rel-15 behavior is followed   The support of this feature is part of UE capability. |

Based on the proposals by companies [5][10], the following offline proposal are made:

Proposal #b-6: Capture the UE capability of supporting two default TCI states in 38.214 and adopt the following TP.

|  |
| --- |
| -----------------------------------------Start of text proposal of 5.1.5 in TS 38.214 --------------------------------------------  For the UE supporting default QCL assumption with two TCI states, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and atleast one configured TCI states for the serving cell of scheduled PDSCH contains the'QCL-TypeD', and at least one TCI codepoint indicates two TCI states, the UE may assume that the DM-RS ports of PDSCH of a serving cell 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 text proposal ------------------------------------------------------ |

* 1. Issue#b-7: Default TCI-state for PDSCH in cross-carrier scheduling

Companies [3] and [11] discussed the issue of default TCI state for PDSCH in cross-carrier scheduling case in multi-TRP systems.

* [3] propose the default TCI state for PDSCH of cross-carrier scheduling is:
  + In multi-DCI based system, 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.
  + In single-DCI based system, 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.
* [11] propose the default TCI-state for PDSCH cross-carrier scheduling in single-DCI based M-TRP is the TCI states corresponding to the lowest codepoint among codepoints containing two different TCI states of the scheduled cell.

Based on the proposals in [3][11], the offline proposals are:

Proposal #b-7: For PDSCH with cross-carrier scheduling in M-TRP system, if the scheduling offset is less than threshold, the default QCL assumption for PDSCH is:

* In multi-DCI based system: QCL is 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
* In single-DCI based system: QCL is the TCI states corresponding to the lowest codepoint among codepoints containing two different TCI states of the scheduled cell
  1. Issue#b-8: Specify mapping type for PDSCH in scheme 3

Companies [5][10][13][19][20] discussed the issues related with PDSCH mapping in Scheme 3.

Regarding the mapping type for PDSCHs in scheme 3, companies propose

* [5] propose that in Scheme 3, all PDSCH transmission occasions are of PDSCH mapping type B
* [10] propose that for Scheme3, The PDSCH mapping type for the first PDSCH transmission occasion is indicated by the Time domain resource assignment field of the DCI and the relative positions of DMRS symbols within the second PDSCH transmission occasion are the same as the first transmission occasion.
* [13] and [20] proposed that mapping type of 1st PDSCH is indicated by the DCI and mapping type of 2nd PDSCH is Type B.

[19] suggest that in current TS38.214 specification, the time restriction for S and L combinations does not take into account the case when ‘TDMSchemeA’ is configured and is indicated to the UE and [19] propose TP to clarify that.

Based on the proposals in [5][10][13][19][20], offline proposals are made:

Proposal #b-8-1: about the mapping type in Scheme 3, down-select from:

* Alt1: All PDSCH transmission occasions are mapping type B
* Alt2: Mapping type of 1st PDSCH is indicated by the DCI and relative positions of DMRS symbols within the second PDSCH transmission occasion are the same as the first transmission occasion
  + Note: From the understanding of FL, Alt2 is what captured in current specification.
* Alt3: Mapping type of 1st PDSCH transmission is indicated by the DCI and mapping type of 2nd PDSCH transmission is Type B.

Proposal #b-8-2: Update TS 38.214 to capture the restriction for S and L combinations of Scheme 3

* 1. Issue#b-9: PT-RS transmission in single-DCI based M-TRP

Companies [6][14][15][19] discussed the issue of 2-port PT-RS transmission in single-DCI based M-TRP system.

Regarding the power boosting for 2-port PT-RS, companies propose very similar proposals:

* [6] propose that power boosting for PTRS should be defined considering 2-port PTRS transmission and consider the number of PDSCH layers associated with each TCI state.
* [15] propose that for PT-RS power boosting, the EPRE ratio should be configured to be based on the number of PDSCH layers corresponding to the TCI state associated with the PT-RS port.
* [14] proposed PT-RS EPRE for each PT-RS port is based on PDSCH layers of each PT-RS port.
* [19] propose when two PT-RS ports are configured, the power boosting ratio for each PT-RS port depends on the number of PDSCH layers transmitted from the same TRP, not the total number of PDSCH layers.

[6] also suggested that it is possible that the higher layer parameter *maxNrofPorts* equal to *n2* but the UE is not indicated with two TCI-states and one CDM group (for example in scheme 2a/2b/3 or scheme 4). In those cases, the UE shall receive single-port PT-RS

* [6] propose to clarify in TS 38.214 that in those cases, the UE receive only one port PT-RS even though *maxNrofPorts* is equal to *n2*.

Based on the proposals in [6][14][15][19], the offline proposals are:

Proposal #b-9-1: in single-DCI based M-TRP, for 2-port PT-RS power boosting, the EPRE ratio is based on the number of PDSCH layers corresponding to the TCI state associated with each PT-RS port

Proposal #b-9-2: Clarify in TS 38.214 that when maxNrofPorts equal to n2, the UE receives single port PTRS if the UE is indicated a single TCI state or a single CDM group and adopt the following TP

|  |
| --- |
| 5.1.6.3 PT-RS reception procedure  **---- Unchanged text are omitted ----**  If the UE is configured with the higher layer parameter *maxNrofPorts* equal to *n2*,   * 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 if the UE is indicated with two TCI states by the codepoints of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) within two CDM groups in the DCI field "*Antenna Port(s)"*, the UE shall receive two PT-RS ports which are associated to the lowest indexed DM-RS port among the DM-RS ports corresponding to the first/second indicated TCI state, respectively. * Otherwise, the UE shall receive a single PT-RS port which is associated to a DMRS port according to Clause 5.1.6.3.   **---- Unchanged text are omitted ----** |

* 1. Issue#b-10: configuring single-DCI based and multi-DCI based M-TRP simultaneously?

Companies [10][12][15][19] discussed the issue of whether we can configure single-DCI based and multi-DCI based M-TRP at the same time.

* [10] propose that: when a UE is configured with two different values of CORSETPoolindex, only one TCI state can be indicated in each DCI
* [12] propose to clarify in TS 38.213 that the UE is not expected to be configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet* and at the same timeat least one TCI codepoint is mapped to two TCI states.
* [15] propose that for multi-TRP operation, the UE is not expected to be configured to operate in Single-DCI and Multi-DCI operation simultaneously
* [19] propose to not specify restriction to prevent single-PDCCH + multi-PDCCH mixed mode multi-TRP operation in TS 38.214.

We can observe that [10][12][15] propose to not support configuring single-DCI and multi-DCI based at the same time while [19] prefer to support that.

From the understanding of FL, RAN2 uses different MAC CE messages to activate TCI-states for PDSCH in single-DCI based and multi-DCI based M-TRP systems.

* The MAC CE of Section 6.1.3.14 in 38.321 Draft activates TCI-states for multi-DCI based system, which contains a CORSETPool ID
* The MAC CE of Section 6.1.3.YY in 38.321 Draft is used to activate TCI-states for single-DCI based M-TRP system, which can map up to two TCI-states to one codepoint.

Thus, with the RAN2 MAC CE design, we are not able to activate up to two TCI-states mapping to one codepoint for each CORESET Pool index, i.e., supporting single-DCI based + multi-DCI based mode.

Based on the proposals in [10][12][15][19], offline proposal is

Proposal#b-10: For multi-TRP transmission, clarify in TS 38.214 that configuring single-DCI based and multi-DCI based simultaneously is not supported.

* 1. Issue#b-11: Type-1 HARQ-ACK codebook determination for Scheme 3

Company [18] discussed the issue of Type-1 HARQ-ACK codebook determination for Scheme 3.



Fig.1 Time domain resource allocation for TDM scheme A



Fig.2 PDSCH time domain resource allocation table configuration

[18] proposes:

* For TDM scheme A, the HARQ-ACK bit location in type-1 HARQ-ACK codebook is determined based on the 1st PDSCH reception occasion
* propose the following TP for 38.213:

|  |
| --- |
| 9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel  <Unchanged parts are omitted>  For the set of slot timing values *K*1, the UE determines a set of *M*A,c occasions for candidate PDSCH receptions or SPS PDSCH releases according to the following pseudo-code. A location in the Type-1 HARQ-ACK codebook for HARQ-ACK information corresponding to a single SPS PDSCH release is same as for a corresponding SPS PDSCH reception. A location in the Type-1 HARQ-ACK codebook for HARQ-ACK information corresponding to multiple SPS PDSCH releases by a single DCI format is same as for a corresponding SPS PDSCH reception with the lowest SPS configuration index among the multiple SPS PDSCH releases. 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)*”*,* and if two TCI states are indicated by the DCI field ‘*Transmission Configuration Indication*’, a location in the Type-1 HARQ-ACK codebook for HARQ-ACK information corresponding to two PDSCH reception occasions by a single DCI format is same as for the first PDSCH reception.  <Unchanged parts are omitted> |

Proposal #b-11: For TDM scheme A, the HARQ-ACK bit location in type-1 HARQ-ACK codebook is determined based on the 1st PDSCH reception occasion

* 1. Issue#b-12: RV values for DL SPS based multi-TRP repetition transmission

[19] discussed the issues of DL SPS transmission based PDSCH repetition. [19]proposes to re-use a similar approach adopted for Rel-15 based DL SPS PDSCH repetition for indicating RV values for DL SPS based multi-TRP PDSCH repetition schemes.

Proposal #b-12: To indicate RV values for DL SPS based multi-TRP PDSCH repetition schemes, reuse a similar approach adopted for Rel-15 based DL SPS PDSCH repetition and update TS 38.214 accordingly.

* 1. Issue#b-13: PDSCH processing time for Scheme 3

Company [20] discussed the issue on PDSCH processing time for scheme 3 and propose to specify the PDSCH processing time for Scheme 3 in TS 38.214

Based on the proposal in [20], offline proposal is:

Proposal #b-13: Specify in TS 38.214 the following UE processing time for Scheme 3:

|  |
| --- |
| - For a PDSCH that consists of two PDSCH transmission occasions in one slot, , where  - is determined by considering the first PDSCH transmission occasion in the slot, and as described above.  - is determined by considering the second PDSCH transmission occasion in the slot, and as described above.  - is the higher layer parameter *StartingSymbolOffsetK,* if configured; else = 0. |

1. TPs for editorial changes
   1. TP #c-1 correcting one parameter typo of PDCCH monitoring in TS 38.213

[1] found there is a typo on parameters on PDCCH BD/CCE limit in TS 38.213. The argument is In current spec, the BD/CCE limit calculated by the formula is applied to the scheduling cell from the downlink cells, which may be interpreted as the number of all configured DL cells across all SCS groups. This typo may wrongly apply the BD/CCE limit for all downlink cells with undesired numerology groups.

TP #c-1 for TS 38.213:

|  |
| --- |
| 10.1 UE procedure for determining physical downlink control channel assignment < Unchanged parts are omitted >  If a UE is configured with downlink cells with active DL BWPs using SCS configuration , where , a DL BWP of an activated cell is the active DL BWP of the activated cell, and a DL BWP of a deactivated cell is the DL BWP with index provided by *firstActiveDownlinkBWP-Id* for the deactivated cell, the UE is not required to monitor more than  PDCCH candidates or more than non-overlapped CCEs per slot on the active DL BWP(s) of scheduling cell(s) from the downlink cells.  < End of the text proposal > |

## TP #c-2 Update the TCI-state activation in 38.214 according to RAN2 MAC CE design

[3][14] [7] proposed to update the TCI-state activation text for multi-DCI based M-TRP in TS 38.214 based on the MAC CE design of RAN2. In the clause 6.1.3.14 of TS38.321 [7], the “R” field in the TCI States Activation/Deactivation for UE-specific PDSCH MAC CE has been updated with “CORESET Pool ID” field to indicate the *CORESETPoolIndex* to which the activated TCI states are associated. A Rel-16 UE with no *CORESETPoolIndex* configured would assume the “CORESET Pool ID” bit set to 0. Therefore, a single MAC CE is applied for TCI state activation/deactivation for UE-specific PDSCH for both cases when no *CORESETPoolIndex* is configured or only one value of *CORESETPoolIndex* is configured, and when two different values of *CORESETPoolIndex* are configured.

|  |  |
| --- | --- |
| TP by [3] | ------------------------------------------Start of Text Proposal ----------------------------------  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] ~~or in clause [6.1.3.x] of [10, TS 38.321]~~, used to map up to 8 TCI states to the codepoints of the DCI field 'Transmission Configuration Indication' in one CC/DL BWP or in a set of CCs/DL BWPs, respectively. When a set of TCI state IDs are activated for a set of CCs/DL BWPs, where the applicable list of CCs is determined by indicated CC in the activation command, the same set of TCI state IDs are applied for all DL BWPs in the indicated CCs. When two different values of *CORESETPoolIndex* are configured, the mapping is applied to the DCI field 'Transmission Configuration Indication' of the PDCCH corresponding to the *CORESETPoolIndex* indicated by the activation command.  When a UE supports two TCI states in a codepoint of the DCI field '*Transmission Configuration Indication'* the UE may receive an activation command, as described in clause ~~[~~6.1.3.~~X~~24~~]~~ of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 TCI states in the activation command.  < Unchanged parts are omitted >  --------------------------------------- End of Text Proposal ------------------------------------ |
| TP by [7] | 5.1 UE procedure for receiving the physical downlink shared channel  ------------------------------------------------- <Unchanged parts are omitted> -------------------------------------------  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] or in clause [6.1.3.x] of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'* in one CC/DL BWP or in a set of CCs/DL BWPs, respectively. When a set of TCI state IDs are activated for a set of CCs/DL BWPs, where the applicable list of CCs is determined by indicated CC in the activation command, the same set of TCI state IDs are applied for all DL BWPs in the indicated CCs. If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet*, the activated TCI state(s) are associated with a *CORESETPoolIndex* as described in clause [6.1.3.x] of [10, TS 38.321].  --------------------------------------- <Unchanged parts are omitted>---------------------------------------------  If the PDSCH is scheduled by a DCI format having the TCI field present, the TCI field in DCI in the scheduling component carrier points to the activated TCI states in the scheduled component carrier or DL BWP, the UE shall use the *TCI-State* according to the value of the '*Transmission Configuration Indication*' field in the detected PDCCH with DCI for determining PDSCH antenna port quasi co-location. The UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL type parameter(s) given by the indicated TCI state if the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than a threshold *timeDurationForQCL*, where the threshold is based on reported UE capability [13, TS 38.306]. If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet*, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL type parameter(s) given by the indicated TCI state associated with a same value of *CORESETPoolIndex* as the PDCCH scheduling that PDSCH within the active BWP of the serving cell are monitored by the UE, if the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than a threshold *timeDurationForQCL*. When the UE is configured with a single slot PDSCH, the indicated TCI state should be based on the activated TCI states in the slot with the scheduled PDSCH. When the UE is configured with a multi-slot PDSCH, the indicated TCI state should be based on the activated TCI states in the first slot with the scheduled PDSCH, and UE shall expect the activated TCI states are the same across the slots with the scheduled PDSCH. When the UE is configured with CORESET associated with a search space set for cross-carrier scheduling and the UE is not configured with [*enableDefaultBeamForCSS*], the UE expects *tci-PresentInDCI* is set as 'enabled' or *tci-PresentInDCI-ForFormat1\_2* is configured for the CORESET, and if one or more of the TCI states configured for the serving cell scheduled by the search space set contains 'QCL-TypeD', the UE expects the time offset between the reception of the detected PDCCH in the search space set and the corresponding PDSCH is larger than or equal to the threshold *timeDurationForQCL.*  ------------------------------------------------- <Unchanged parts are omitted>--------------------------------------------- |
| TP by [14] | **TP to TS 38.214, Sec. 5.1.5**  < Unchanged text is omitted>  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] or in clause [6.1.3.x] of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'* in one CC/DL BWP or in a set of CCs/DL BWPs, respectively. When a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet,* the applicable TCI states is determined by indicated CORESET Pool Index in the activation command. When a set of TCI state IDs are activated for a set of CCs/DL BWPs, where the applicable list of CCs is determined by indicated CC in the activation command, the same set of TCI state IDs are applied for all DL BWPs in the indicated CCs.  When a UE supports two TCI states in a codepoint of the DCI field '*Transmission Configuration Indication'* the UE may receive an activation command, as described in clause [6.1.3.X] of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 TCI states in the activation command.  < Unchanged text is omitted> |

These three TPs basically make the same change and an offline proposal is:

Proposal #c-2: Update the TS 38.214 based on the TP proposed with the following TP proposed by [14]:

|  |
| --- |
| **TP to TS 38.214, Sec. 5.1.5**  < Unchanged text is omitted>  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] or in clause [6.1.3.x] of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'* in one CC/DL BWP or in a set of CCs/DL BWPs, respectively. When a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet,* the applicable TCI states is determined by indicated CORESET Pool Index in the activation command. When a set of TCI state IDs are activated for a set of CCs/DL BWPs, where the applicable list of CCs is determined by indicated CC in the activation command, the same set of TCI state IDs are applied for all DL BWPs in the indicated CCs.  When a UE supports two TCI states in a codepoint of the DCI field '*Transmission Configuration Indication'* the UE may receive an activation command, as described in clause [6.1.3.X] of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 TCI states in the activation command.  < Unchanged text is omitted> |

## TP #c-3 Clarify DMRS table and entry {0,2,3} in TS 38.214

We made the following agreement in RAN1#99 on DMRS {0,2,3}:

|  |
| --- |
| **Agreement**  For DMRS type-2, for layer combination 1+2, at least support DMRS entry {0,2,3} with 2 CDM groups without data   * {0,2,3} is used assuming SU-MIMO   For DMRS type-1, {0,2,3} is used assuming SU-MIMO |

Company [4] suggests that the agreement “DMRS entry {0,2,3} can only be applied for SU-MIMO” is not captured in the specification yet and the new tables in 38.212 are not captured in the description of 38.214 too. So, [4] proposed the following TP for TS 38.214 to capture the missing part:

|  |
| --- |
| 5.1.6.2 DM-RS reception procedure  A UE may be scheduled with a number of DM-RS ports by the antenna port index in DCI format 1\_1 as described in Clause 7.3.1.2 of [5, TS 38.212].  If a UE is assigned with antenna port indices of {0,2,3}, the UE does not expect potential co-scheduled UE(s) in other DM-RS ports of the corresponding CDM groups.  For DM-RS configuration type 1,  - if a UE is scheduled with one codeword and assigned with the antenna port mapping with indices of {2, 9, 10, 11 or 30} in Table 7.3.1.2.2-1, 7.3.1.2.2-1A, Table 7.3.1.2.2-2 and 7.3.1.2.2-2A of Clause 7.3.1.2 of [5, TS 38.212], or  - if a UE is scheduled with two codewords,  the UE may assume that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE.  For DM-RS configuration type 2,  - if a UE is scheduled with one codeword and assigned with the antenna port mapping with indices of {2, 10 or 23} in Table 7.3.1.2.2-3, Table 7.3.1.2.2-3A, Table 7.3.1.2.2-4 and Table 7.3.1.2.2-4A of Clause 7.3.1.2 of [5, TS38.212], or  - if a UE is scheduled with two codewords,  the UE may assume that all the remaining orthogonal antenna ports are not associated with transmission of PDSCH to another UE.  If a UE receiving PDSCH is configured with the higher layer parameter *phaseTrackingRS* in *DMRS-DownlinkConfig*, the UE may assume that the following configurations are not occurring simultaneously for the received PDSCH:  - any DM-RS ports among 1004-1007 or 1006-1011 for DM-RS configurations type 1 and type 2, respectively are scheduled for the UE and the other UE(s) sharing the DM-RS REs on the same CDM group(s), and  - PT-RS is transmitted to the UE.  The UE is not expected to simultaneously be configured with the maximum number of front-loaded DM-RS symbols for PDSCH by higher layer parameter *maxLength* being set equal to 'len2' and more than one additional DM-RS symbol as given by the higher layer parameter *dmrs-AdditionalPosition*.  The UE is not expected to assume co-scheduled UE(s) with different DM-RS configuration with respect to the actual number of front-loaded DM-RS symbol(s), the actual number of additional DM-RS, the DM-RS symbol location, and DM-RS configuration type as described in Clause 7.4.1.1 of [4, TS 38.211].  The UE does not expect the precoding of the potential co-scheduled UE(s) in other DM-RS ports of the same CDM group to be different in the PRG-level grid configured to this UE with PRG =2 or 4.  The UE does not expect the resource allocation of the potential co-scheduled UE(s) in other DM-RS ports of the same CDM group to be misaligned in the PRG-level grid to this UE with PRG=2 or 4.  When receiving PDSCH scheduled by DCI format 1\_1, the UE shall assume that the CDM groups indicated in the configured index from Tables 7.3.1.2.2-1, 7.3.1.2.2-1A, 7.3.1.2.2-2, 7.3.1.2.2-2A, 7.3.1.2.2-3, 7.3.1.2.2-3A, 7.3.1.2.2-4, 7.3.1.2.2-4A, of [5, TS. 38.212] contain potential co-scheduled downlink DM-RS and are not used for data transmission, where "1", "2" and "3" for the number of DM-RS CDM group(s) in Tables 7.3.1.2.2-1, 7.3.1.2.2-1A, 7.3.1.2.2-2, 7.3.1.2.2-2A, 7.3.1.2.2-3, 7.3.1.2.2-3A, 7.3.1.2.2-4, 7.3.1.2.2-4A of [5, TS. 38.212] correspond to CDM group 0, {0,1}, {0,1,2}, respectively. |

Proposal#c-3: adopt the TP proposed by [4] for TS 38.214

## TP #c-4 Correction on TCI state numbers in MAC CE activation TCI-state description in TS 38.214

We have the following agreement on TCI state activation for single-DCI based M-TRP:

|  |
| --- |
| **Agreement**  The maximum number of activated TCI states in mTRP operation is 8. The number of bits of TCI field in DCI is 3 if higher layer parameter tci-PresentInDCI is enabled. The total number of simultaneously activated TCI states is up to 8. |

[4] suggest to update the text in TS 38.214 to avoid misunderstanding that only only 8 TCI states can be mapped to the codepoints of the TCI field for single-DCI based M-TRP. [4] Proposed the following TP

|  |
| --- |
| 5.1.5 Antenna ports quasi co-location  When a UE supports two TCI states in a codepoint of the DCI field ‘*Transmission Configuration Indication’* the UE may receive an activation command, as described in subclause [6.1.3.X] of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 different TCI states in the activation command. |

Proposal#c-4: adopt the following TP proposed by [4] for TS 38.214

|  |
| --- |
| 5.1.5 Antenna ports quasi co-location  When a UE supports two TCI states in a codepoint of the DCI field ‘*Transmission Configuration Indication’* the UE may receive an activation command, as described in subclause [6.1.3.X] of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 different TCI states in the activation command. |

* 1. TP #c-5 Correcting the description on DAI bits in DCI format 1\_2.

In RAN1#100 e-meeting, it was agreed that when multiple values of *CORESETPoolIndex* are configured, 4bits DAI will be used even when only one serving cell is configured in the DL.

[4] suggested that in current 38.212, that agreement is only implemented to DCI format 1\_1, but not implemented in DCI format 1\_2. Both DCI formats 1\_1 and 1\_2 can be used for scheduling multi-DCI based M-TRP transmission. [4] proposed to apply the same wording on DAI bit description in DCI format 1\_2 as in DCI format 1\_1 with the following proposed TP for TS 38.212:

|  |
| --- |
| 7.3.1.2.3 Format 1\_2  DCI format 1\_2 is used for the scheduling of PDSCH in one cell.  The following information is transmitted by means of the DCI format 1\_2 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:  - Identifier for DCI formats – 1 bits  - The value of this bit field is always set to 1, indicating a DL DCI format.  (omitted part)  - Downlink assignment index – 0, 1, 2 or 4 bits  - 0 bit if the higher layer parameter *Downlinkassignmentindex-ForDCIFormat1\_2* is not configured;  - 1, 2 or 4 bits determined by higher layer parameter *Downlinkassignmentindex-ForDCIFormat1\_2* otherwise,  - 4 bits if more than one serving cell are configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, and the UE is not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with value 0 for one or more first CORESETs and is provided *CORESETPoolIndex* with value 1 for one or more second CORESETs, and is provided *ACKNACKFeedbackMode = JointFeedback*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI  - 1 or 2 bits if only one serving cell is configured in the DL and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, when the UE is not configured with *CORESETPoolIndex* or the value of *CORESETPoolIndex* is the same for all CORESETs if *CORESETPoolIndex* is provided or the UE is not configured with *ACKNACKFeedbackMode = JointFeedback*, where the 1 bit or 2 bits are the counter DAI. |

Proposal#c-5: adopt the above TP proposed for TS 38.212

## TP #c-6 Description of QCL assumption in 211

[10] suggest to remove one Text description on QCL in TS 38.211. The argument by [10] is that in Rel-15, as only single-TRP transmission is supported, it’s state in subsection 7.4.1.1.2 of 211 that The UE may assume that DMRS ports associated with a PDSCH are QCL with QCL Type A, Type D (when applicable) and average gain. However, with such restriction, NC-JT can’t be supported. Actually, the QCL assumption of DMRS ports is mainly described in 214 for both single multiple TCI states cases. It’s more relevant to remove the above single-TCI-state restriction in 211.

[10] propose the following TP for TS 38.211:

|  |
| --- |
| ----------------------------------------Start of text proposal of 7.4.1.1.2 in TS 38.214 ------------------------------------------  In absence of CSI-RS configuration, and unless otherwise configured, the UE may assume PDSCH DM-RS and SS/PBCH block to be quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and, when applicable, spatial Rx parameters. The UE may assume that the PDSCH DM-RS within the same CDM group are quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and spatial Rx(when applicable).  ------------------------------------------------------- End of text proposal ------------------------------------------------------ |

Proposal#c-6: adopt the above TP proposed for TS 38.211

## TP #c-7 Clarification on Scheme 4 using consecutive slots and RepNumR16 vs pdsch-AggregationFactor

Companies [4][15][17][19] explained that it is common understanding that the slots used for scheme 4 should be consecutive but that is not captured in specification TS 38.214 yet. Furthermore, in section 5.1.2.1 of TS 38.214, Rel-15 slot aggregation based on pdsch-AggregationFactor and corresponding UE behavior is also described to support RRC based repetition. When pdsch-AggregationFactor and scheme 4 are both configured, the UE should only perform transmission of scheme 4 based on RepNumR16 in PDSCH-TimeDomainResourceAllocation, and pdsch-AggregationFactor should be ignored. This UE behavior it not clearly defined in section 5.1.2.1. Companies [4] and [19] suggest to clarify that *pdsch-AggregationFactor can be overridden when RepNumR16*  is indicated. [15] propose that The UE is not expected to be configured with pdsch-AggregationFactor when the UE is configured with RepNumR16 in at least one entry in pdsch-TimeDomainAllocationList.

Based on the proposals in [4][15][17][19], offline proposal is:

Proposal #b-8: Clarify in TS 38.214 that scheme 4 uses consecutive slots, and *pdsch-AggregationFactor* and *RepNumR16* are not configured at the same time, adopt the following TP:

|  |
| --- |
| 5.1 UE procedure for receiving the physical downlink shared channel < Unchanged parts are omitted >  When a UE is configured by the higher layer parameter *PDSCH-config* that indicates at least one entry in *pdsch-TimeDomainAllocationList* containing *RepNumR16* in *PDSCH-TimeDomainResourceAllocatio*n, 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 in *pdsch-TimeDomainAllocationList* which contain *RepNum16* in *PDSCH-TimeDomainResourceAllocatio*n 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 in consecutive slots of the same TB with two TCI states used across multiple PDSCH transmission occasions 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 in consecutive slots of the same TB with one TCI state used across multiple PDSCH transmission occasions as defined in Clause 5.1.2.1.  < Unchanged parts are omitted >  5.1.2.1 Resource allocation in time domain  < Unchanged parts are omitted >  When receiving PDSCH scheduled by DCI format 1\_1 or 1\_2 in PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCH scheduled without corresponding PDCCH transmission using *sps-Config* and activated by DCI format 1\_1 or 1\_2, if the UE is configured with *pdsch-AggregationFactor* and no entry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, the same symbol allocation is applied across the *pdsch-AggregationFactor* consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the *pdsch-AggregationFactor* consecutive slots and the PDSCH is limited to a single transmission layer. 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.  < Unchanged parts are omitted > |

## TP #c-8 capture one conclusion on DMRS rate match in multi-DCI based system

[13] suggested that one conclusion on DMRS rate match used in multi-DCI is not captured in current spec.

In RAN1#99 meeting, there was one conclusion about DMRS rate matching for multi-DCI based multi-TRP transmission as follow:

|  |
| --- |
| **Conclusion**  For DMRS rate matching mechanism used for multi-DCI based multi-TRP/panel transmission   * For PDSCHs scheduled by M-DCI, the UE does not expect a PDSCH scheduling intended for that UE in a given slot if that PDSCH REs collide with DMRS REs associated with another PDSCH for the same UE |

[13] suggest that the current specification could not reflect the conclusion. From UE’s point of view, they prefer to capture it in specification for the sake of making UE behavior clearer and propose the following TP:

|  |
| --- |
| ----------------------------------------------Start of Text Proposal for TS38.214 ---------------------------------- 5.1.6.2 DM-RS reception procedure --------------------------------------------Unchanged text omitted-----------------------------------  If a UE is configured by the higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet*, the UE may be scheduled with fully or partially overlapping PDSCHs in the time and frequency domain by multiple PDCCHs with the following restrictions,  - the UE is not expected to assume different DM-RS configuration with respect to the actual number of front-loaded DM-RS symbol(s), the actual number of additional DM-RS symbol(s), the actual DM-RS symbol location, and DM-RS configuration type.  - the UE is not expected to assume DM-RS ports in a CDM group indicated by two TCI states.  - the UE is not expected to configure one DMRS CDM group without data by each PDCCH.  ---------------------------------------------End of Text Proposal for TS38.214------------------------------------- |

Proposal#c-8: adopt the above TP proposed for TS 38.214

## TP #c-9 update TS 38.213 to capture UE does not expect A+B\*R>4 for PDCCH blind detection

In RAN1 98bis, there was one agreement about BR/CCEs as follows:

|  |
| --- |
| **Agreement**  If a UE can support and report R>1 for M-DCI based M-TRP/panel transmission,   * The value of r for a downlink cell configured with M-DCI based M-TRP is determined as   + If UE reports pdcch-BlindDetectionCA, the value of r to be applied is optionally configured by RRC, either r=1 or reported value r=R     - Note that when network configures r=1, it does not imply that UE has to support more CCs beyond the UE reported capability   + If UE does not report pdcch-BlindDetectionCA or the value of r is not configured by RRC, r=R. * UE indicates pdcch-BlindDetectionCA when it is possible to configure A+B DL cells to the UE with A>= 0 DL serving cells without multi-DCI based multi-TRP and B >=0 DL serving cells with multi-DCI based multi-TRP such that A+R∙B>4, whereas R is reported by UE capability signaling. * If the UE does not report pdcch-BlindDetectionCA, the UE does not expect to be configured with DL cells to the UE such that A+ R∙B>4 with A>= 0 DL serving cells without multi-DCI based multi-TRP and B >=0 DL serving cells with multi-DCI based multi-TRP, whereas R is reported by UE capability signaling. * The value range of R is [1, 2], and is indicated through UE capability signalling. * Note that this agreement does not preclude a UE from reporting multiple R values and corresponding A and B pairs depending on UE capability * Note that how to capture above into the spec can be up to the editor. |

[13] suggested that the yellow part is not captured in TS 38.213 and proposed the following TP:

|  |
| --- |
| ----------------------------------------------Start of Proposal for TS38.213------------------------------------ 10 UE procedure for receiving control information --------------------------------------------Unchanged text omitted-----------------------------------  If a UE indicates in *UE-NR-Capability* a carrier aggregation capability larger than 4 serving cells and the UE is not provided *PDCCHMonitoringCapabilityConfig* for any downlink cell or if the UE is provided *PDCCHMonitoringCapabilityConfig* = *R15 PDCCH monitoring capability* for all downlink cells where the UE monitors PDCCH, the UE includes in *UE-NR-Capability* an indication for a maximum number of PDCCH candidates and for a maximum number of non-overlapped CCEs the UE can monitor per slot when the UE is configured for carrier aggregation operation over more than 4 cells. When a UE is not configured for NR-DC operation, the UE determines a capability to monitor a maximum number of PDCCH candidates and a maximum number of non-overlapped CCEs per slot that corresponds to  downlink cells, where  -  is if the UE does not provide *pdcch-BlindDetectionCA* where is the number of configured downlink serving cells and the UE does not expect  > 4  - otherwise,  is the value of *pdcch-BlindDetectionCA*  ---------------------------------------------End of Proposal for TS38.213---------------------------------------------- |

Proposal#c-9: adopt the above TP proposed for TS 38.213

## TP #c-10 update one term in Section 5.1.5 of TS 38.214

[19] proposed the TP for TS 38.214 to replace “*CORESET-ID*” with “*controlResourceSetId*” to align with 38.331.

Proposal #c-10, adopt the following TP

|  |
| --- |
| ---------------------------- Start of proposed TP10 for 38.214 ----------------------------------------------------------- 5.1.5 Antenna ports quasi co-location --- Unchanged text omitted ---------  Independent of the configuration of *tci-PresentInDCI* and *tci-PresentInDCI-ForFormat1\_2* in RRC connected mode, if no TCI codepoints are mapped to two different TCI states and the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL*, the UE may assume that the DM-RS ports of PDSCH 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). If none of configured TCI states for the serving cell of scheduled PDSCH contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH. If a UE configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet,* for both cases,when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL,* the UE may assume that the DM-RS ports of PDSCH associated with a value of *CORESETPoolIndex* 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 *~~CORESET-ID~~ controlResourceSetId* among CORESETs, which are configured with the same value of *CORESETPoolIndex* as the PDCCH scheduling that PDSCH, in the latest slot in which one or more CORESETs associated with the same value of *CORESETPoolIndex* as the PDCCH scheduling that PDSCH within the active BWP of the serving cell are monitored by the UE.  ---------------------------- End of proposed TP10 ----------------------------------------------------------- |

* 1. TP #c-11 Clarify the condition for configuring Scheme 2a/ab/3 and Scheme in TS 38.214.

Companies [2][3][6][8][14][15] discussed the text description on the conditions of configuring Scheme 2a/2b/3 and Scheme 4 in TS 38.214.

For the reference, we made agreement on the URCCL schemes configuration condition in RAN1#99:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agreement**  Following TCI state and joint schemes are supported   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | TCI states | CDM groups | URLLCRepNum | URLLCSchemeEnabler | UE Behavior | | 0 (in spec draft) | 1 | >=1 | Not applicable | Not applicable | Rel 15 | | A (one scheme) | 1 | 1 | Condition 1 | Configured or not configured | "Scheme 4" with repetition from the same TRP  Limitations agreed for Scheme 4 apply | | A’ (one scheme) | 1 | >=1 | Condition 2 | Not configured | Rel 15 | | B (in spec draft) | 2 | 1 | Condition 1 | Not configured | Scheme 4 | | C (in spec draft) | 2 | 2 | Condition 2 | Not configured | 1a/NCJT | | E (in spec draft) | 2 | 2 | Condition 4 | Not configured | 1a/NCJT | | F (in spec draft) | 2 | 1 | Condition 4 | Configured | Scheme 2a/2b/3 | | D’’ (one scheme) | 2 | 2 | Condition 4 | Configured | 1a/NCJT | | G’ (one scheme) | 1 | >=1 | Condition 2 | Configured | Rel 15 | | G (one scheme) | 1 | >=1 | Condition 4 | Configured | Rel 15 |   Note:   * Condition 1: indicates ~~at least~~ one entry in *pdsch-TimeDomainAllocationList* containing *URLLCRepNum* (>1) in *TDRA by DCI* * Condition 2: indicates one entry in *pdsch-TimeDomainAllocationList* having no *URLLCRepNum by DCI*, but at least one entry having URLLCRepNum * Condition 4: None of entry in TDRA contains *URLLCRepNum* |

Companies [2][3][8][15] suggest that the condition of “none of entry in TDRA contains RepNumR16” for Scheme 2a/2b/3 and Condition of “*RepSchemeEnabler* is not configured” for scheme 4 are not captured in TS 38.214 yet. [15] propose that UE is not expected to be configured with RepSchemeEnabler if the UE is configured by the higher layer parameter PDSCH-config that indicates at least one entry in pdsch-TimeDomainAllocationList containing RepNumR16 in PDSCH-TimeDomainResourceAllocation. They proposed TPs to update TS 38.214 for that.

However, [14] proposed to allow dynamic switching between scheme 2a/2b/3 and Scheme 4.

From the understanding of FL, we shall respect the agreement made in RAN1#99 and update the TS 38.214 to captured the missing condition. Therefore, suggest the following proposal. The TP proposed by [6] is used here because it is the most completed.

Proposal #c-11: capture the missing conditions for Scheme 2a/2b/3 and Scheme 4 in TS 38.214 and adopt the following TP for TS 38.214:

|  |
| --- |
| 5.1 UE procedure for receiving the physical downlink shared channel  ---- Unchanged text are omitted ----  When a UE is configured by higher layer parameter *RepSchemeEnabler* set to one of '*FDMSchemeA'*, '*FDMSchemeB'*, '*TDMSchemeA'* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16*, if the UE is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* and DM-RS port(s) withina 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.  ---- Unchanged text are omitted ----  5.1.2.1 Resource allocation in time domain  ---- Unchanged text are omitted ----  When a UE is configured by the higher layer parameter *RepSchemeEnabler* set to '*TDMSchemeA'* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16* 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 in *StartingSymbolOffsetK*, it shall determine that the first symbol of the second PDSCH transmission occasion starts after symbols from the last symbol of the first PDSCH transmission occasion. If the value is not configured via the higher layer parameter *StartingSymbolOffsetK*, = 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 applied respectively to the first and second TCI state.  - 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 text are omitted ----  5.1.2.3 Physical resource block (PRB) bundling  ---- Unchanged text are omitted ----  For a UE configured by the higher layer parameter *RepSchemeEnabler* set to '*FDMSchemeA' or* '*FDMSchemeB'* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16, 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 PRBs are assigned to the first TCI state and the remaining PRBs are assigned to the second TCI state, where 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.  - The UE is not expected to receive more than two PDSCH transmission layers for each PDSCH transmission occasion.  For a UE configured by the higher layer parameter *RepSchemeEnabler* set to '*FDMSchemeB'* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16,* 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 are applied to the first and second TCI state, respectively.  ---- Unchanged text are omitted ----  5.1.3.1 Modulation order and target code rate determination  ---- Unchanged text are omitted ----  For a UE configured with *FDMSchemeB* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16*, 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)*", the determined modulation order of PDSCH transmission occasion associated with the first TCI state is applied to the PDSCH transmission occasion associated with the second TCI state.  ---- Unchanged text are omitted ----  5.1.3.2 Transport block size determination  ---- Unchanged text are omitted ----  For a UE configured with *FDMSchemeB* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16* and 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)*", the TBS determination follows the steps 1-4 with the following modification in step 1: a UE determines the total number of REs allocated for PDSCH () by , where *nPRB* is the total number of allocated PRBs corresponding to the first TCI state. and the determined TBS of PDSCH transmission occasion associated with the first TCI state is also applied to the PDSCH transmission occasion associated with the second TCI state.  ---- Unchanged text are omitted ----  5.1.6.3 PT-RS reception procedure  ---- Unchanged text are omitted ----  When a UE configured by the higher layer parameter *RepSchemeEnabler* set to '*FDMSchemeA'* or '*FDMSchemeB'* andconfigured by the higher layer parameter *PDSCH-config* that indicates all entries in *pdsch-TimeDomainAllocationList* without *RepNumR16,* and 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)*", the UE shall receive a single PT-RS port which is associated with the lowest indexed DM-RS antenna port among the DM-RS antenna ports assigned for the PDSCH, a PT-RS frequency density is determined by the number of PRBs associated to each TCI state, and a PT-RS resource element mapping is associated to the allocated PRBs for each TCI state.  ---- Unchanged text are omitted ---- |

* 1. TP #c-12 Clarify that ACKNACKFeedbackMode configuration is not per BWP in TS 38.213

[18] explained that based on the LS on updated Rel-16 LTE and NR parameter lists, the parameter ACKNACKFeedbackMode is configured per cell group rather than per BWP. However, in some sections of TS38.213, the parameter ACKNACKFeedbackMode is configured per BWP. [18] proposed a text proposal to correct that.

Proposal #c-12: Update the TS 38.213 with the following TP proposed by [18]:

|  |
| --- |
| 9.2.3 UE procedure for reporting HARQ-ACK  < Unchanged parts are omitted >  For a PUCCH transmission with HARQ-ACK information, a UE determines a PUCCH resource after determining a set of PUCCH resources for  HARQ-ACK information bits, as described in Clause 9.2.1. The PUCCH resource determination is based on a PUCCH resource indicator field [5, TS 38.212], if present, in a last DCI format, among the DCI formats that have a value of a PDSCH-to-HARQ\_feedback timing indicator field, if present, or a value of *dl-DataToUL-ACK*, or a value of *dl-DataToUL-ACKForDCIFormat1\_2* for DCI format 1\_2, indicating a same slot for the PUCCH transmission, that the UE detects and for which the UE transmits corresponding HARQ-ACK information in the PUCCH where, for PUCCH resource determination, detected DCI formats are first indexed in an ascending order across serving cells indexes for a same PDCCH monitoring occasion and are then indexed in an ascending order across PDCCH monitoring occasion indexes. For indexing DCI formats within a serving cell for a same PDCCH monitoring occasion, if the UE is not provided *CORESETPoolIndex* or is provided *CORESETPoolIndex* with value 0 for one or more first CORESETs and is provided *CORESETPoolIndex* with value 1 for one or more second CORESETs on an active DL BWP of a serving cell, and with *ACKNACKFeedbackMode* = *JointFeedback* ~~for the active UL BWP~~, detected DCI formats from PDCCH receptions in the first CORESETs are indexed prior to detected DCI formats from PDCCH receptions in the second CORESETs.  < Unchanged parts are omitted > |

1. Summary on Priority of the Issues
   1. Company inputs on the priority of each Issues

Please input in the Table 1 on which issue(s) you think is essential/high priority or low priority/optimization for this e-meeting. For details of each issue of #a-1 to #b-13, please refer to Section 3 and Section 4. Please note that the companies which addressed the topic in their Tdocs have been listed in the table for each issue by the FL.

**Table 1: company inputs on priority of each issues #a1~#b13**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Issue#** | **Description of Issues** | **Companies which think it is essential/high priority** | **Companies who think it is lowe priority/optimization** | **Additional comments** |
| #a-1 | PDCCH used to schedule for initial/re-transmission in Multi-DCI based M-TRP | HW |  |  |
| #a-2 | To determine the default value of R used in PDCCH blind detection | HW, vivo, CATT, Nokia, Ericsson |  | Ericsson: This issue removes a TBD in the spec which we think is good to fix. Given the TP in proposal #a-2 is simple, it would be good to see if anyone has concerns If this TP is non-controversial, perhaps we can agree this without a dedicated email discussion? |
| #a-3 | Clarify the CRS rate match behavior for multi-DCI based M-TRP | HW, ZTE, vivo, MTK, Nokia, Qualcomm, Ericsson |  | Ericsson: Latest 38.331 should be taken into account in the TP. We think the TP in Proposal 4 of R1-2002294 better reflects the agreements rather than what is captured in Proposal #a-3. |
| #a-4 | Define PDCCH monitoring occasion for Type-2 HARQ-ACK codebook in Multi-DCI M-TRP | HW, MTK, LGE, Samsung, NTT DOCOMO, Qualcomm,, ZTE, Apple, Ericsson |  | Ericsson: We agree this must be a high priority item to solve. We support Alt #1 feature lead’s Proposal #a-4-1. Since we discussed these issues in last e-meeting without convergence, we prefer not to have a prolonged discussion on this issue in this e-meeting. |
| #a-5 | What is the default HARQ-ACK feedback mode if RRC parameter ackNackFeedbackMode-r16 is not configured | HW, Samsung, Nokia |  |  |
| #a-6 | Determine the default QCL for AP CSI-RS in multi-DCI based M-TRP | ZTE, vivo, OPPO, CMCC, Apple, NTT DOCOMO, Qualcomm, Ericsson |  | Ericsson: This issue is related to #b-1. So we propose to discuss #a-6 and #b-1 together. |
| #a-7 | uplink power control issues in multi-DCI based M-TRP | ZTE, OPPO, Lenovo/MOT, Apple |  |  |
| #a-8 | active BWP operation in multi-DCI based M-TRP system | ZTE, OPPO, Lenovo/MOT, CMCC, NEC, NTT DOCOMO |  |  |
| #a-9 | CSI/SR UCI overlapping with two HARQ-ACK PUCCH /PUSCH of two different TRPs | vivo,OPPO, Spreadtrum |  |  |
| #a-10 | In multi-DCI based M-TRP, separate HARQ-ACK feedback vs sub-slot-based HARQ-ACK feedback | vivo |  |  |
| #a-11 | PDCCH monitoring priority based QCL-Type D in multi-DCI based M-TRP | Intel, Samsung, Nokia, Qualcomm, ZTE |  |  |
| #a-12 | Radio link monitoring in multi-DCI based M-TRP | Apple, NTT DOCOMO |  |  |
| #a-13 | Default spatial setting for PUCCH in multi-DCI based M-TRP | Spreadtrum |  |  |
| #a-14 | Support receiving more than one SPS PDSCH in multi-DCI based M-TRP | Qualcomm, ZTE, Ericsson |  |  |
| #a-15 | update TS 38.214 to capture the case if the UE does not support the feature of supporting two default TCI-states in multi-DCI based M-TRP | LGE, CATT |  |  |
| #b-1 | Determine default QCL for AP CSI-RS in single-DCI based M-TRP | ZTE, vivo, Apple, Ericsson, Qualcomm, NTT DOCOMO |  | ZTE: issue from b-1 to b-5 can be discussed together in one email thread since they all belong to default TCI states for PDSCH |
| #b-2 | Default TCI-state for PDSCH of Scheme 3 and Scheme 4 | vivo, Apple, NEC, Ericsson,ZTE, NTT DOCOMO |  | Ericsson: In our view, default TCI-state for schemes 3 and 4 is not clearly defined as for these TDM based schemes only one of the TCI states needs to be applied per PDSCH transmission occasion. It would be good to define the behavior in the spec. |
| #b-3 | Default TCI-state for PDSCH when DCI has no TCI field | vivo, Lenovo/MOT, Spreadtrum, ZTE |  |  |
| #b-4 | Default TCI-state for PDSCH when DCI indicates one TCI-state | ZTE, vivo, MTK, Lenovo/MOT |  |  |
| #b-5 | Default TCI-state for PDSCH when DCI indicates two TCI-states | ZTE, vivo, Ericsson |  |  |
| #b-6 | Capture UE capability of supporting two default TCI-states in single-DCI based M-TRP | MTK, CATT |  |  |
| #b-7 | Default TCI-state for PDSCH in cross-carrier scheduling | vivo, Samsung, NTT DOCOMO |  |  |
| #b-8 | Specify mapping type for PDSCH in scheme 3 | MTK, CATT, Spreadtrum, Ericsson, Qualcomm, NTT DOCOMO |  | Ericsson: For proposal #b-8-1 in the FL summary, we think it is simpler to support Alt1. |
| #b-9 | PT-RS transmission in single-DCI based M-TRP | LGE, Nokia, Apple, Ericsson, NTT DOCOMO |  |  |
| #b-10 | configuring single-DCI based and multi-DCI based M-TRP simultaneously? | CATT, CMCC, Apple, Ericsson, ZTE , NTT DOCOMO |  | Ericsson: We don’t see a strong need to add restrictions in RAN1 specifications. As we stated in our tdoc, this can be left to UE capability discussion. |
| #b-11 | Type-1 HARQ-ACK codebook determination for Scheme 3 | NTT DOCOMO |  |  |
| #b-12 | RV values for DL SPS based multi-TRP repetition transmission | Ericsson, ZTE |  |  |
| #b-13 | PDSCH processing time for Scheme 3 | Qualcomm, ZTE |  |  |

* 1. Company inputs on the editorial TPs

Please input the following information on each editorial TP in Table 2:

* Do you think it is agreeable in principle and we can work on the wording later.
* Do you have concern on it.

For details of each TP, please refer to Section 4.

**Table 2: company input on “whether it is agreeable in principle”/concern on each editorial TP #c-1~#c11**

|  |  |  |  |
| --- | --- | --- | --- |
| TP#s | Description of the TP | Do you think it is **Agreeable in principle?**  Do you have concern on it? | **Additional comments** |
| #c-1 | TP #c-1 correcting one parameter typo of PDCCH monitoring in TS 38.213 | ZTE: agree  Apple: agree  NTT DOCOMO: Agree.  CATT: agree  Ericsson: Agree |  |
| #c-2 | TP #c-2 Update the TCI-state activation in 38.214 according to RAN2 MAC CE design | ZTE: agree in principle  Apple: agree in principle  NTT DOCOMO: Agree.  CATT: agree | Ericsson: There are multiple TPs provided by [3], [7] and [14]. So which version to go with and/or how to merge the different TPs may need some discussion. |
| #c-3 | TP #c-3 Clarify DMRS table and entry {0,2,3} in TS 38.214 | ZTE: agree  Apple: agree in principle  NTT DOCOMO: Agree.  CATT: agree  Ericsson: Ok. |  |
| #c-4 | TP #c-4 Correction on TCI state numbers in MAC CE activation TCI-state description in TS 38.214 | ZTE: agree  Apple: agree in principle  NTT DOCOMO: Seems not necessary.  CATT: not necessary  Ericsson: Ok. |  |
| #c-5 | TP #c-5 Correcting the description on DAI bits in DCI format 1\_2. | ZTE: agree  Apple: agree in principle  NTT DOCOMO: Agree.  CATT: agree  Ericsson: Looks ok. |  |
| #c-6 | TP #c-6 Description of QCL assumption in 211 | ZTE: it is not appropriate to remove Rel-15 description.  Apple: We understand the issue, but we think further discussion is needed whether it is good to remove this from 211  NTT DOCOMO: Agreeable in principle.  CATT: removing the restriction from 211 seems to be a simple way to address the issue.  Ericsson: We share similar views Apple. I may be better to discuss this further in a future meeting rather than removing the Rel-15 description. |  |
| #c-7 | TP #c-7 Clarification on Scheme 4 using consecutive slots and RepNumR16 vs pdsch-AggregationFactor | ZTE: agree  Apple: agree in principle  NTT DOCOMO: clarification on scheme 4 using consecutive slots is agreeable in principle.  CATT: agree  Ericsson: Agree. | NTT DOCOMO: Regarding RepNumR16 vs pdsch-AggregationFactor, we prefer *pdsch-AggregationFactor can be overridden when RepNumR16*  is indicated. |
| #c-8 | TP #c-8 capture one conclusion on DMRS rate match in multi-DCI based system | ZTE: seems not necessary  Apple: Need further discussion  NTT DOCOMO: Agree to have further discussion.  CATT: further discussion is needed  Ericsson: Doesn’t seem necessary. |  |
| #c-9 | TP #c-9 update TS 38.213 to capture UE does not expect A+B\*R>4 for PDCCH blind detection | ZTE: agree  Apple: We prefer further discussion. We acknowledge the agreement; however, our understanding is that when pdcch-BlindDetectionCA is not indicated, it implies no linear scaling is needed by the UE.  NTT DOCOMO: Agree.  CATT: further discussion is needed |  |
| #c-10 | TP #c-10 update one term in Section 5.1.5 of TS 38.214 | ZTE: agree  Apple: agree  NTT DOCOMO: Agree.  CATT: agree  Ericsson: Agree |  |
| #c-11 | TP #c-11 Clarify the condition for configuring Scheme 2a/ab/3 and Scheme 4 in TS 38.214. | ZTE: Agree. This issue should be solved in this emeeting since it is related to the LS from RAN2.  Apple: agree  NTT DOCOMO: Agree.  CATT: agree  Ericsson: We can discuss this further in the email thread for LS reply to RAN2. |  |
| #c-12 | TP #c-12 Clarify that ACKNACKFeedbackMode configuration is not per BWP in TS 38.213 | Apple: We are fine even though it is not necessary  NTT DOCOMO: Agree.  CATT: agree  Ericsson: Agree |  |

1. List of contributions
2. R1-2001563 Remaining issues on multi-TRP in R16 Huawei, HiSilicon
3. R1-2001596 Maintenance of multi-TRP enhancements ZTE
4. R1-2001678 Discussion on remaining issues on multi TRP operation vivo
5. R1-2001726 Text proposals for enhancements on multi-TRP and panel Transmission OPPO
6. R1-2001822 Enhancements on Multi-TRP/Panel Transmission MediaTek Inc.
7. R1-2001913 Text proposals on enhancements on multi-TRP/panel transmission LG Electronics
8. R1-2001971 Remaining issues on multi-TRP/panel transmission Lenovo, Motorola Mobility
9. R1-2002004 Corrections to multi-TRP Intel Corporation
10. R1-2002052 TP on Multi-TRP/Panel Transmission Futurewei
11. R1-2002090 Remaining issues on multi-TRP/panel transmission CATT
12. R1-2002139 On Rel.16 multi-TRP/panel transmission Samsung
13. R1-2002212 Remaining issues on multi-TRP/panel transmission CMCC
14. R1-2002270 Discussion on remaining issues for multi-TRP operation Spreadtrum Communications
15. R1-2002294 Maintenance of Rel-16 Multi-TRP operation Nokia, Nokia Shanghai Bell
16. R1-2002337 Remaining issues for Multi-TRP enhancement Apple
17. R1-2002364 Remaining issues on multi-TRP transmission NEC
18. R1-2002378 Clarification on Multi-TRP URLLC Scheme 4 Convida Wireless
19. R1-2002448 Remaining issues on multi-TRP/panel transmission NTT DOCOMO, INC
20. R1-2002472 Remaining issues on Multi-TRP/Panel Transmission Ericsson
21. R1-2002551 Multi-TRP Enhancements Qualcomm Incorporated