**3GPP TSG RAN Meeting #100 RP-231039**

**Taipei, Taiwan, June 12-14, 2023**

## Status Report to TSG

**Agenda item:** 9.3.1.4

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | NR MIMO evolution for downlink and uplink | | | | |
| included in this status report | Study Item:  No | Core part:  Yes | Performance part:  Yes | | Testing part:  No |
| **Acronym** | NR\_MIMO\_evo\_DL\_UL | | | | |
| **Unique ID** | 940096 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-223276 | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item:  n/a | Core part: 12/2023 | Performance part: 06/2024 | Testing part: n/a | |
| **Overall Completion level** | Study Item:  n/a | Core part:  85% | Performance Part:  0% | Testing part: n/a | |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |  |
| --- | --- | --- |
| **Leading WG** | | RAN1 |
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## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.  
 One time unit (TU) corresponds to ~ 2 hours in the meeting.  
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.  
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

**In RAN1#112bis-e, the following agreements were made.**

Multi-TRP enhancement

**Conclusion**

On unified TCI framework extension for S-DCI based MTRP operation, there is no consensus to support dynamic switching between single-TRP operation and multi-TRP operation for channels/signals based on the number of TCI states mapped to the received TCI codepoint in DCI format 1\_1/1\_2

* FFS: How to switch between Rel-17 sTRP operation and Rel-18 mTRP operation

**Agreement**

On unified TCI framework extension, the Rel-17 timeline for updating the indicated joint/DL/UL TCI state(s) is retained, i.e., the indicated joint/DL/UL TCI state(s) applied to the DL reception or UL transmission in each slot is updated based on the Rel-17 beam application time

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, the UE shall apply the first indicated joint/UL TCI state to PUSCH transmission(s) scheduled/activated by DCI format 0\_0 (including DG and Type2 CG)

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, an RRC configuration is provided to a Type1 CG configuration to inform that the UE shall apply the first, the second, or both indicated joint/UL TCI states to the corresponding CG-PUSCH transmission

* If the first or the second indicated joint/UL TCI state is applied, the UE shall apply the first or the second indicated joint/UL TCI state to all PUSCH antenna port(s) of corresponding PUSCH transmission occasions(s)
* If both indicated joint/UL TCI states are applied:
  + For TDM based PUSCH Tx scheme, the UE shall apply the first indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the first SRS resource set for CB/NCB, and the second indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the second SRS resource set for CB/NCB
  + FFS: SDM and SFN based PUSCH Tx schemes

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, PDSCH-CJT Tx scheme is RRC-configured, and dynamic switching between PDSCH-CJT and other S-DCI based PDSCH Tx schemes is not supported

**Agreement**

If the UE is configured with *SSB-MTC-AdditionalPCI* and receives TCI state activation command (MAC-CE) that activates a set of joint/DL /UL TCI state(s) specific to each *coresetPoolIndex* value for M-DCI based MTRP in unified TCI framework extension, the activated joint/DL /UL TCI state(s) specific to one *coresetPoolIndex* value is associated with the serving cell PCI and the activated joint/DL /UL TCI state(s) specific to another *coresetPoolIndex* value can be associated with a PCI other than the serving cell PCI .

* Note: How to implement above in specification is up to spec editor

**Agreement**

On unified TCI framework extension for M-DCI based MTRP , after NW response to TRP-specific BFR request to a BFD-RS set associated with a *coresetPoolIndex* value, QCL assumption/spatial Tx filter/PL-RS for channel(s)/signal(s) that applies the indicated joint/DL /UL TCI state specific to the *coresetPoolIndex* value are updated according to the new beam (q new ) corresponding to the BFD-RS set.

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, the presence of the [TCI selection field] can be RRC-configured per DL BWP

* FFS: Whether the presence of the [TCI selection field] can be configured individually for DCI format 1\_1 and DCI format 1\_2 in the same DL BWP

**Agreement**

On unified TCI framework extension for S-DCI based MTRP operation, support the followings:

* For a serving cell configured with joint DL/UL TCI mode, a full-set or any sub-set of {first joint TCI state, second joint TCI state} can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 by TCI state activation command (MAC-CE)
* For a serving cell configured with separate DL/UL TCI mode, a full-set or any sub-set of {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state} can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 by TCI state activation command (MAC-CE)
* TCI state activation command (MAC-CE) should indicate that each joint/DL/UL TCI state mapped to a TCI codepoint is the first or second joint/DL/UL TCI state (detail on how to indicate above is up to RAN2 design)
* The first/second indicated joint/DL/UL TCI state(s) is updated according to the corresponding first/second joint/DL/UL TCI state(s) mapped to the TCI codepoint received by the UE
  + If the UE receives a TCI codepoint mapped with a sub-set of {first joint TCI state, second joint TCI state} or {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state}, the UE shall update the first/second indicated joint/DL/UL TCI state(s) according to the first/second joint/DL/UL TCI state(s) in the subset and keep other indicated first/second joint/DL/UL TCI state(s) that is not updated by the received TCI codepoint

**Agreement**

On unified TCI framework extension for M-DCI based MTRP, support at least Opt2 for PUCCH transmission, and Opt1 is not supported

* Note: Opt3 and Opt4 are not precluded

**Conclusion**

On unified TCI framework extension for S-DCI based MTRP, there is no consensus in RAN1 on whether to reuse the Rel-17 RRC parameter *followUnifiedTCIstate* as a part of the RRC configuration that informs the UE shall apply the first one, the second one, both, or none of the indicated joint/DL TCI states to a CORESET

* Above does not impact how RAN2 writes their specifications

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each CSI-RS resource set or for each CSI-RS resource in each aperiodic CSI-RS resource set to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the CSI-RS resource if the aperiodic CSI-RS resource set for CSI/BM is configured to follow unified TCI state

* Above applies at least if the offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in the aperiodic CSI-RS resource set is equal to or larger than a threshold (if the threshold is needed)
* FFS: If the UE is configured for CSI-RS resource set, for an aperiodic CSI-RS resource set configured with two Resource Groups for NCJT CSI and configured to follow unified TCI state, if above RRC configuration is not provided to the aperiodic CSI-RS resource set, the UE shall apply the first indicated joint/DL TCI state to the CSI-RS resource(s) in Group 1 and the second indicated joint/DL TCI state to the CSI-RS resource(s) in Group 2.
* ‘per CSI-RS resource set’ or ‘per CSI-RS resource’ is up to UE capability

**Agreement**

On unified TCI framework extension, support the following cases for CA operation:

* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in S-DCI based MTRP
* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in M-DCI based MTRP
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in S-DCI based MTRP
  + FFS: How to support common TCI state ID activation/update for this case
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in M-DCI based MTRP
  + FFS: How to support common TCI state ID activation/update for this case
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in S-DCI based MTRP and CC(s) operating in M-DCI based MTRP
  + FFS: How to support common TCI state ID activation/update for this case
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP, CC(s) operating in S-DCI based MTRP, and CC(s) operating in M-DCI based MTRP
  + FFS: How to support common TCI state ID activation/update for this case

**Agreement**

On unified TCI framework extension for M-DCI based MTRP, an RRC configuration is provided to a Type1 CG configuration to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the corresponding CG-PUSCH transmission, where the first and the second indicated joint/DL TCI states correspond to the indicated joint/UL TCI states specific to *coresetPoolIndex* value 0 and value 1, respectively.

**Working Assumption**

For intra-cell multi-DCI based Multi-TRP operation with two TA enhancement, support the case where a PDCCH order sent by TRPX triggers RACH procedure towards either TRPX or TRPY.

* FFS: details of PRACH power control

**Agreement**

For multi-DCI based Multi-TRP operation with two TA enhancement, support at least RAR-based solution where RAR is only received from a TRP that is associated with Type 1 CSS

* RAR based
* FFS: RAR-less solution reusing the solution agreed in Rel-18 Mobility Enh

**Agreement**

For intercell multi-DCI based Multi-TRP operation with two TA enhancement, support indication of which PRACH configuration to be used in the RACH procedure in the PDCCH order.

* FFS: Whether *additionalPCI* or a generic identifier is indicated in PDCCH order
* FFS: The detail of the indication in PDCCH order in terms of whether to support PRACHtriggered for inactive *additionalPCI*.

**Conclusion**

For multi-DCI based Multi-TRP operation with two TA enhancement, how to indicate the TAG ID via absolute TA command MAC CE is left up to RAN2:

* One of two TAG IDs configured in the SpCell can be indicated

**Agreement**

For intra-cell multi-DCI based Multi-TRP operation with two TA enhancement, down-select one of the following alternatives:

* Alt 1: indicate TAG ID as part of TA command in RAR
* Alt 2: indicate TAG ID as part of PDCCH order
* Alt 3: divide SSBs into two groups, one for each TRP. If a SSB associated to a RACH procedure belongs to the nth group (n=1, 2), then the TA obtained via the RACH procedure corresponds to the nth TRP.

**Agreement**

For multi-DCI based inter-cell multi-TRP and intra-cell multi-TRP operation with two TAGs configured in a CC, for a CFRA based PDCCH order from one TRP triggering PRACH towards another TRP, study whether and, if needed, how to determine the transmit power of the triggered PRACH preamble

CSI enhancement

**Agreement**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, only the following linkages are supported (marked ‘x’), for Rel-16 eType-II based

* For *NTRP* =1,
  + fully reuse seven out of the eight Parameter Combinations from Rel-16 eType-II as indicated in the table below
    - FFS (by RAN1#112bis-e): whether to add one more Parameter Combination for L=4 based on the legacy Rel-16 eType-II FD combo {½, ½, ¼, ¼; ½} or the agreed FD combo {½, ½, ½, ½; ½}, or not to add from the indicated seven below
* For *NTRP* >1, only the following linkages are supported (marked ‘x’)
* Note: Configured linkage(s) are associated with the configured value of *NTRP*, regardless whether the dynamic TRP selection (the dynamic change of *N* given *NTRP*) is configured. Also, the configured linkage(s) are valid for any dynamically selected SD basis and/or any dynamically selected CSI-RS resource (TRP).
* FFS: UE feature/capability to support only a subset of linkages

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **NTRP** | **SD combo** | **FD combo {pv},** | | | | | |
| {1/8, 1/8, 1/16, 1/16}, ¼ | {1/8, 1/8, 1/16, 1/16}, ½ | {1/4, ¼, 1/8, 1/8}, ¼ | {1/4, ¼, 1/8, 1/8}, ½ | {1/4, ¼, ¼, ¼}, ¾ | {1/2, ½, ½, ½}, ½ |
| 1 | 2 |  |  | x | x |  |  |
| 4 |  |  | x | x | x |  |
| 6 w/ restriction |  |  |  | x | x |  |
| 2 | {2,2} | x |  |  |  |  |  |
| {2,4}  {4,2} | x |  |  |  |  |  |
| {4,4} |  | x |  | x |  | x |
| 3 | {2,2,2} | x | x |  |  |  |  |
| {2,2,4}  {2,4,2}  {4,2,2} | x | x |  |  |  |  |
| {4,4,4} | x | x | x | x | x | x |
| 4 | {2,2,2,2} | x |  |  |  |  | N/A |
| {2,2,2,4} | x |  |  |  |  | N/A |
| {2,2,4,4} |  |  |  | x | x | N/A |
| {4,4,4,4} |  | x |  | x | x | N/A |

**Agreement**

On the Type-II codebook refinement for CJT mTRP, regarding CBSR, amplitude restriction is CSI-RS-resource-specific.

* FFS: Whether CBSR is always configured for each CSI-RS resource or not

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, regarding CBSR for NTRP>1, there is no consensus in supporting the additional optional soft amplitude restriction. Therefore, only hard amplitude restriction (per CSI-RS resource, based on the legacy design) is supported.

**Agreement**

On the Type-II codebook refinement for CJT mTRP, *for mode-1*, support the use of per-CSI-RS-resource FD basis selection offset (relative to a reference CSI-RS resource) for independent FD basis selection across *N* CSI-RS resources, i.e. (example formulation) where:

* is commonly selected across *N* CSI-RS resources
* is the layer-common FD basis selection offset for CSI-RS resource *n* relative to a layer-common reference CSI-RS resource with
  + Therefore, (*N* – 1) FD basis selection offset values are reported
  + Basic feature:
  + Optional feature:
* FFS: UCI design details, details on

**Agreement**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, for Rel-17 FeType-II based,

* For =1, the Rel-17 legacy Parameter Combination is fully reused
* Regarding the combinations {M, beta}, it is proposed to reuse the legacy as below, with restriction on M=2.

|  |  |  |
| --- | --- | --- |
| **M** | **** | **Condition** |
| 1 | ½ |  |
| ¾ |  |
| 1 |  |
| 2 | ½ | FFS: N\_trp<=3, NL=1 |
| ¾ | FFS: N\_trp<=3, NL =1 |

* Alpha\_n combinations for are derived from the Ln combinations for Rel-16 based refinement, where each entry in the combination is the nearest value of min{1, 2Ln/Pcsi-rs} to {1/2, ¾, 1}, .
  + Note: no other dependency of combinations is introduced, such as dependency on Pcsi-rs.
  + FFS: pruning on combinations

**Agreement**

For the Type-II codebook refinement for high/medium velocities, when a UE is configured with X=2 for CQI calculation and reporting, the 2nd CQI is located in UCI part 2

**Agreement**

For the Type-II codebook refinement for high/medium velocities, when WCSI>1, if a UE supports X=2 for CQI calculation, the value of X (either 1 or 2) is gNB-configured via higher-layer (RRC) signalling

**Agreement**

For the Type-II codebook refinement for high/medium velocities, regarding the bitmap(s) for indicating the locations of the NZCs,

* When the UE is configured with Q=1: for each layer, one 2-dimensional bitmap of size-2LM reusing the legacy design is used
* When the UE is configured with Q=2: for each layer,
  + Basic feature: two 2-dimensional bitmaps, each of size-2LM reusing the legacy design for each of the two selected DD basis vectors, are used
  + Optional feature, if the following down-selection succeeds: down-select from the following two alternatives in RAN#112bis-e:
    - Alt3A: A single 2-dimensional bitmap of size to report the selected pairs of FD basis vector and DD basis vector and a single 2-dimensional bitmap of size for indicating the location of the NZCs, where each row corresponds to a selected SD basis vector and each column corresponds to one of the selected pairs of FD basis vector and DD basis vector.
    - Alt4’: Q different bitmaps are supported for each layer, each of the Q bitmaps corresponds to DD basis q = 0 or 1.
      * For each polarization, each of the Q bitmaps contains bits included in a set of SD basis and FD basis pairs , satisfying , where
        + ,
        + is the SD basis indicated by SCI
        + Two polarizations have same set of in the bitmap

**Agreement**

For the Type-II codebook refinement for high/medium velocities based on Rel-16 eType-II regular codebook, at least the following Parameter Combinations are supported

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | |  |
|  |  |
| 4 | 1/4 | 1/4 | 1/4 |
| 4 | 1/4 | 1/4 | 1/2 |
| 4 (\*) | 1/2 | 1/4 | 1/2 |
| 4 (\*) | 1/4 | 1/4 | 3/4 |
| 6 (\*) | 1/4 | -- | 1/2 |
| 6 (\*) | 1/4 | -- | 3/4 |

(\*) Note: From legacy. For L=6, the same restriction and UE optionality as legacy apply

* Select at most 3 additional Parameter Combinations from the list below

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | |  |
|  |  |
| 2 | 1/8 | 1/16 | 1/4 |
| 2 | 1/8 | 1/16 | 1/2 |
| 2(\*) | ¼ | 1/8 | ¼ |
| 2 (\*) | ¼ | 1/8 | ½ |
| 4 | 1/8 | 1/16 | 1/4 |
| 4 (\*) | ¼ | 1/8 | 1/4 |

(\*) Note: From legacy.

* FFS: UE feature/capability to support only a subset of Parameter Combinations

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value,

* At least the following size-*Q* quantization alphabet is supported: where
  + TBD: supported value(s) of *N* (e.g. or a larger value), *Q*, s (e.g. ½, ¼, 1/8, …), whether a center threshold is also supported (and if so, higher-layer configured)
* FFS: Whether different schemes can be supported for different use cases

**Working Assumption**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation,

* KTRS ≥1 TRS resource set(s) can be configured in the CSI reporting setting when ReportQuantity is ‘tdcp’
  + Note: the TRS resource set(s) configured for TDCP report do not impact or impose any new requirements on the UE behavior when processing TRS used as QCL type A/D source for reception of PDxCH.
* No further spec enhancement on TRS is supported
* [All the TRS resources in the configured resource set(s) share the same RE locations]
* FFS: Whether to add further restrictions on the TRS resource set(s) on, e.g. QCL relationship, power control, RE location, slot offset between TRS resource set(s), relation with resource set used for legacy usage

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, for Rel-16-based refinement, for *NTRP*>1, in addition to the supported SD combinations/permutations, there is no consensus on supporting at least one additional combination where at least one of the *Ln* values (*n*=1, …,*NTRP*) is 6

**Agreement**

On the Type-II codebook refinement for high/medium velocities, regarding UCI omission, support reusing the legacy UCI omission mechanism with (Alt3) the following priority function: Prio(,l,m,q)=2L.RI.Mv.q + 2L.RI.P(m)+ RI.l +  where P(m) = m

* Note: This implies that DD basis is designated the least priority
* FFS: Details on the location of the new UCI parameters in G0/1/2

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the value of parameter Y for Y>1, the value of Y is gNB-configured via higher-layer (RRC) signalling

**Agreement**

On the Type-II codebook refinement for CJT mTRP, *for mode-1*, the layer-common reference CSI-RS resource is fixed to the first of the N selected CSI-RS resource(s)

* FFS: Whether more refined definition is needed for “the first”, e.g. related to the ordering of CSI-RS resources in the resource set, depending on RAN2 outcome

**Agreement**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, for *NTRP* =1, in addition to the already agreed seven Parameter Combinations, support the following Parameter Combination (based on legacy Parameter Combination #6): *L*=4, {*pv*;*b*}={ ½, ½, ¼ , ¼; ½ }

**Conclusion**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, no additional configuration signalling for indicating the linkage is needed. Per previous agreements (RAN1#111 and 112):

* “The *single* value of {*pv,b*} is gNB-configured via higher-layer (RRC) signalling”
* “*The* set of *NL* combinations of values for {*L*1, ..., *LNTRP*} is gNB-configured via higher-layer (RRC) signalling”

Such configuration shall be according to the supported/agreed linkages.

**Conclusion**

On the Type-II codebook refinement for high/medium velocity, regarding CBSR, there is no consensus in supporting the additional optional soft amplitude restriction. Therefore, only hard amplitude restriction (based on the legacy design) is supported.

**Agreement**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation, confirm the following working assumption as an agreement with the following change

* KTRS ≥1 TRS resource set(s) can be configured in the CSI reporting setting when ReportQuantity is ‘tdcp’
  + Note: the TRS resource set(s) configured for TDCP report do not impact or impose any new requirements on the UE behavior when processing TRS used as QCL type A/D source for reception of PDxCH.
* No further spec enhancement on TRS is supported
* ~~[~~All the TRS resources in the configured resource set(s) share the same RE locations~~]~~
* FFS: Whether to add further restrictions on the TRS resource set(s) on, e.g. QCL relationship, power control, ~~[RE location],~~ slot offset between TRS resource set(s), relation with resource set used for legacy usage

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the value of parameter Y, in addition to Y=1, support Y=2, 3, 4

* FFS: Whether Y=7 is also supported

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, there is no consensus on specifying a new priority rule. Therefore, the priority of the CSI report(s) associated with TDCP reporting is the same as CSI report(s) not carrying L1-RSRP or L1-SINR

**Agreement**

On the Type-II codebook refinement for CJT mTRP, regarding CBSR, one of the NTRP configured CSI-RS resources must be configured with CBSR, while the remaining (NTRP –1) configured CSI-RS resources can be optionally configured with CBSR

* Note: if CBSR of one particular resource is absent, it means no restriction for SD basis selection for the resource.

**Agreement**

On the Type-II codebook refinement for CJT mTRP, regarding UCI omission, support reusing the legacy UCI omission mechanism while (Alt3) replacing SD basis index *l* in legacy Prio calculation with , i.e., SD basis index over all resources: Prio(,l,m,n) = 2Ltot.RI.P(m)+ RI.+RI.l(n)+

* FFS: FD permutation P(.) as Rel-16-analogous, or no permutation i.e. P(m)=m

**Agreement**

For the Rel-18 TRS-based TDCP reporting,

* Support the following D (delay) values: 4 symbols, 1 slot, 2 slots, 3 slots, 4 slots, 5 slots
* **Working assumption**: Support the following D (delay) values in a separate UE Feature Group: 6 slots, 10 slots

FFS: The value of Dbasic

FFS: Applicability of each D value candidate for different SCS values and/or other parameters (e.g. Y, quantization)

**Conclusion**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, for Rel-17 FeType-II based, there is no consensus on introducing restriction “NTRP≤3, NL =1” for M=2.

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, regarding CBSR for NTRP=1, there is no consensus in supporting the additional optional soft amplitude restriction. Therefore, only hard amplitude restriction (per CSI-RS resource, based on the legacy design) is supported.

**Agreement**

For the Type-II codebook refinement for high/medium velocities based on Rel-16 eType-II regular codebook, in addition to the already agreed six Parameter Combinations, the following three Parameter Combinations are supported:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | |  |
|  |  |
| 2 | 1/8 | 1/16 | ¼ |
| 2 (\*) | ¼ | 1/8 | ½ |
| 4 (\*) | ¼ | 1/8 | ¼ |

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value, down-select (by RAN1#113) from the following candidates:

* Alt1: N=2Q-1 where Q=5, s={1/5, ¼, 1/3}
* Alt2: N=2Q where Q=3, s={¼, 1/3, ½, 2/3, ¾}
* Alt3: N=2Q where Q=4, s={¼, ½, 2/3, ¾}
* Alt4: N={2Q –1, …, 2Q+1 –1} (i.e., 7-15) where Q=3, s={1/5, ¼, 1/3, 2/5, ½, 3/5, 2/3, ¾, 4/5}
* Alt4A: N={2Q , 2Q+0.5,…, 2Q+1-0.5} (i.e., 8, 8.5,…,15.5) where Q=3, s={1/5, ¼, 1/3, 2/5, ½, 3/5, 2/3, ¾, 4/5}

Once an alternative is selected, reducing the number of candidate values for *s* is not precluded.

Companies can simulate each alternative with and without a configurable center threshold

**Agreement**

For the Type-II codebook refinement for high/medium velocities, when a UE is configured with X=2 for CQI calculation and reporting, the 2nd CQI includes 4-bit wideband CQI and 2-bit sub-bands CQIs calculated independently from the 1st CQI

**Agreement**

On the Type-II codebook refinement for high/medium velocities, regarding UCI omission

* When X=2 is configured, the 2nd TD CQI location reuses the legacy rule for the 2nd codeword CQI when RI>4, i.e. wideband CQI in G0, even-indexed sub-band CQIs in G1, odd-indexed sub-band CQIs in G2
* FFS: When the configured value of N4 is >1, whether the DD basis selection indicator is placed in G0 or G1

**Agreement**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, for Rel-17 FeType-II based, only the following n combinations are supported (after pruning):

|  |  |
| --- | --- |
| **NTRP** | **combination** |
| 2 | {1/2,1/2} |
| {1/2,1}, {1,1/2} |
| {3/4,3/4} |
| {1,1} |
| 3 | {1/2, 1/2, 1/2} |
| {1/2, 1/2, 3/4}, and its permutations |
| {1/2, 1/2, 1}, and its permutations |
| {1, 1, 1} |
| 4 | {1/2, 1/2, 1/2, 1/2} |
| {1/2, 1/2, 1/2, 1} and its permutations |
| {1/2, 1/2, 1, 1} |
| {1, 1, 1, 1} |

**Conclusion**

There is no consensus on the support of optional bitmap for Q=2

**Agreement**

On the Type-II codebook refinement for CJT mTRP, regarding UCI omission, reuse the Rel-16 eType-II (legacy) permutation function P(m)

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP,

* For Rel-16 eType-II-based:
  + where represents the indices of the *N* selected CSI-RS resources (out of the *NTRP*configured CSI-RS resources)
  + The payload of is determined by where the maximum is taken over the *NL* configured {*Ln*} combinations
* For Rel-17 FeType-II-based:
  + where represents the indices of the *N* selected CSI-RS resources (out of the *NTRP*configured CSI-RS resources)
  + The payload of is determined by where the maximum is taken over the *NL* configured {*an*} combinations
  + Note: .

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding CSI calculation and measurement,

* For the configured *NTRP* CSI-RS resources comprising the CMR, the restriction specified for Rel-17 NCJT CSI is fully reused, i.e. the configured *NTRP* CSI-RS resources are located either in the same slot or two consecutive slots
* On PDSCH EPRE assumption for CQI calculation, down-select between the two alternatives:
  + Alt1. The UE can assume that the PDSCH EPRE for a given CSI-RS port follows the configured *powerControlOffset* value associated with its respective CSI-RS resource
  + Alt2. The UE can assume that the PDSCH EPRE for a given CSI-RS port follows a commonly configured *powerControlOffset* value for all the *N* selected CSI-RS resources
  + Alt3. The UE can assume that the PDSCH EPRE for a given CSI-RS port follows a commonly configured *powerControlOffset* value defined as averagePDSCH-to-averageCSIRS EPRE ratio, where averagePDSCH and averageCSIRS are average power across for all the *N* selected CSI-RS resources
  + Alt4. The UE can assume that the PDSCH EPRE divided by N for a given CSI-RS port follows a commonly configured *powerControlOffset* value for all the N selected CSI-RS resources
  + Alt 5: The UE can assume that the PDSCH EPRE for a given CSI-RS port follows the *powerControlOffset* value for one of the configured NTRP CSI-RS resources
  + Note: In legacy specification, different CSI-RS resources can be configured with different *powerControlOffset* values
* Decide, in RAN1#113, whether an ordering of CSI-RS port indices (e.g. according to the CSI-RS resource ID in TS38.331) for CSI calculation needs to be specified or not

Note: The total number of CSI-RS ports summed across *N* selected (out of the configured *NTRP*) CSI-RS resources will be used in ~~the TS38.214 equation for~~ CSI calculation

**Agreement**

On the Type-II codebook refinement for CJT mTRP, regarding the required number of CPUs and the values of Z/Z’, decide, in RAN1#113, at least based on the following factors:

* The potential increase in the total number of CSI-RS ports due to the selection/configuration of *N/ NTRP* CSI-RS resources for Type-II CSI
* The support for dynamic TRP selection, wherein *N* CSI-RS resources are selected out of the configured *NTRP* CSI-RS resources
  + Note: The fall-back of gNB configuring *N*=*NTRP* via RRC signalling is supported
* The support for dynamic {*Ln*} selection, wherein 1 out of *NL* {*Ln*} combinations is selected
  + Note: The fall-back of gNB configuring *NL*=1 is supported

**Conclusion**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding the supported values of NL, there is no consensus in adding new value(s) (e.g. NL=3) to, or removing any value from the agreed NL ={1,2,4}

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, regarding the codebook parameter *R*, there is no consensus on supporting *R*=4

**Conclusion**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding interference measurement, beyond that supported in legacy specification, there is no consensus on supporting any additional enhancement on IMR (including the configuration for NZP CSI-RS for interference measurement or CSI-IM in relation to the configured CMR(s)).

* Note: This implies that only one NZP CSI-RS resource for interference measurement or only one CSI-IM resource can be configured irrespective of the value of NTRP

**Agreement**

On the Type-II codebook refinement for high/medium velocities, regarding UCI omission, when the configured value of N4 is >~~1~~2, the DD basis selection indicator is placed in G1

**Agreement**

For the Type-II codebook refinement for high/medium velocities,

* For Rel-16 eType-II-based:
* For Rel-17 FeType-II-based:
  + Note: and .

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding CSI calculation and measurement,

* The number of CSI-RS ports is the same for all the K configured CSI-RS resources comprising the CMR and the antenna ports for the same antenna port index across the K CSI-RS resources are the same.
* All the K configured CSI-RS resources comprising the CMR share the same BW and RE locations
* For interference measurement, legacy specification is fully reused, including the configuration for NZP CSI-RS for interference measurement or CSI-IM in relation to the configured CMR, i.e. only one NZP CSI-RS resource for interference measurement or only one CSI-IM resource can be configured irrespective of the value of K
* On PDSCH EPRE assumption for CQI calculation, a same *powerControlOffset* value is assumed for all the K configured CSI-RS resources comprising the CMR
  + Alt 1: The configured *powerControlOffset* value is the same for all the K configured CSI-RS resources comprising the CMR
  + Alt 2: The assumed PDSCH EPRE of all the K CSI-RS resources follows the configured *powerControlOffset* value of one fixed CSI-RS resource, e.g. the first one

Note: This may imply that existing section 5.2.2.~~2.7~~5 of TS38.214 can apply to Rel-18 Type-II Doppler codebook in terms of Rel-18 CMR (burst of CSI-RS resources) and Rel-18 CSI reference resource

**Agreement**

For the Type-II codebook refinement for high/medium velocities, regarding the required number and/or occupation time of CPUs, the values of Z/Z’, and total number active/simultaneous CSI-RS resource/ports, decide, in RAN1#113, *at least* based on the following factors:

* The measurement of *K*>1 CSI-RS resources for Type-II CSI required to perform UE-side prediction, ~~UE-side prediction based on multiple~~ CSI-RS occasion(s) before CSI triggering (FFS whether to support), CSI-RS occasion(s) after CSI triggering and~~, when the configured N~~~~4~~ ~~value is >1,~~ DD compression (when the configured N4 value is >1)

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, the lists of UCI parameters (along with the description of each parameter) are given in Table 1C, 1D, and 1E.

* Note: The manner in which the UCI parameters are captured is up to the spec editors

***Table 1C: UCI parameter list for Rel-16 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers and all N CSI-RS resources, where *KNZ,TOT* ∈{1,2,…, 2*K*0} are reported in UCI part 1 | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 | Complete |
| CSI-RS resource selection bitmap | Part 1 | *Only reported when NTRP >1:*  *NTRP*-bit bitmap to indicate the UE recommendation of *N* CSI-RS resources   * Non-existent if the value of *N* is RRC-configured to NTRP | Complete |
| Indication of number of SD basis vectors {*L*1, …, *LNTRP*} | Part 1 | UE recommendation selecting one of the *NL* RRC-configured value combinations (-bit indicator)   * Non-existent if *NL*=1 | Complete |
| N Bitmap(s) per layer | Part 2 | For RI=1-4: for layer *l* and CSI-RS resource *n*, size-  where *n* denotes the *n*-th CSI-RS resource | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | RI=1: A -bit indicator for the strongest coefficient index  RI>1: See Table 1E below | Complete |
| SD basis subset selection indicator for each of the *N* CSI-RS resources | Part 2 | SD basis subset selection indicator is a -bit indicator for n=0,1,…,*N–*1. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Mode-1: See Table “SCI and FD basis subset selection indicator“ below + (*N –* 1) FD basis selection window offset values (basic) or (optional), *n*=1,2,…,*N*–1  Mode-2: See Table 1E “SCI and FD basis subset selection indicator“ below | Mode-1 complete  Mode-2 complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete |
| LC coefficients: amplitude | Part 2 | Alt1 (agreed): Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer)  Alt3 (WA): Quantized independently across layers (including 2N-1 reference amplitudes for 2N-1 (polarization, CSI-RS resource) pairs excluding the pair of (polarization, CSI-RS resource) associated with the SCI, for each layer) | WA on Alt3 support needs to be confirmed or reverted |
| SD oversampling (rotation) factor q1, q2 | Part 2 | Values of q1,n, q2,n follow Rel.15, reported per CSI RS resource | Complete |

***Table 1D: UCI parameter list for Rel-17 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers and all N CSI-RS resources, where *KNZ,TOT* ∈{1,2,…, 2*K*0} are reported in UCI part 1 | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 | Complete |
| CSI-RS resource selection bitmap | Part 1 | *NTRP*-bit bitmap to indicate the UE recommendation of *N* CSI-RS resources   * Non-existent if the value of *N* is RRC-configured to NTRP | Complete |
| Indication of number of selected ports {*L*1, …, *LNTRP*}, where *Ln*=*n PCSI-RS /2* | Part 1 | UE recommendation selecting one of the *NL* RRC-configured value combinations (-bit indicator)   * Non-existent if *NL*=1 | Complete |
| N Bitmap(s) per layer | Part 2 | For layer *l* and CSI-RS resource *n*, size-, or ( where ) | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | For layer *l*: A -bit indicator for the strongest coefficient index | Complete |
| Port selection indicator for each of the *N* CSI-RS resources | Part 2 | Port selection indicator is a -bit indicator for n=0,1,…,*N–*1, where *Ln*=*n PCSI-RS /2*. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Mode-1: See Mode-2+ (*N –* 1) FD basis selection window offset values (basic) or (optional), *n*=1,2,…,*N*–1  Mode-2: a bit indicator only if *N>M=2,* where is configured with the higher-layer parameter *valueOfN,* when . | Mode-1 complete  Mode-2 complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete |
| LC coefficients: amplitude | Part 2 | Alt1 (agreed): Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer)  Alt3 (WA): Quantized independently across layers (including 2*N*-1 reference amplitudes for 2*N*-1 (polarization, CSI-RS resource) pairs excluding the pair of (polarization, CSI-RS resource) associated with the SCI, for each layer) | WA on Alt3 support needs to be confirmed or reverted |

***Table 1E: SCI and FD basis subset selection indicator for Rel-16-based Type-II CJT***

|  |  |
| --- | --- |
| **SCI and FD basis subset selection indicator** | |
| SCI for RI>1 | Per-layer SCI defined across N CSI-RS resources, where is a –bit () indicator. The location (index) of the strongest LC coefficient for layer before index remapping is  , , and is not reported |
| Index remapping | For layer , the index of each nonzero LC coefficient is remapped with respect to to such that . The FD basis index associated to each nonzero LC coefficient is remapped with respect to to such that . The sets and are reported.  Informative note (for the purpose of reference procedure):  The index of nonzero LC coefficients is remapped as . The codebook index associated with nonzero LC coefficient index is remapped as . |
| Combinatorial indicator for | bits |
| Combinatorial indicator for | bits |
|  | Reported in UCI part 2, ,  bits |

(\*) The red highlight parts are the new components in Rel-18

**Conclusion**

For the Type-II codebook refinement for high/medium velocities, there is no consensus on supporting the following additional features when the value of N4 is 1 (or configured to 1):

* X=2 TD CQIs
* Additional constraint on the value of d: only d=1 is allowed

**Conclusion**

On the Type-II codebook refinement for high/medium velocities, the lists of UCI parameters (along with the description of each parameter) are given in Table 3C, 3D, and 3E.

* Note: The manner in which the UCI parameters are captured is up to the spec editors

***Table 3C: UCI parameter list for Rel-16 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (∈{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the Q selected DD basis and across all the layers, are reported in UCI part 1 | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 | Complete |
| Wideband CQI for the second TD CQI | Part 2 | Only applicable for X=2 (same format as CQIs for 2CW when RI>4 in R15) | Complete |
| Subband CQI for the second TD CQI | Part 2 | Only applicable for X=2 (same format as CQIs for 2CW when RI>4 in R15) | Complete |
| Q Bitmap(s) per layer | Part 2 | Q bitmaps where each bitmap has the same format/design as R16 eType-II | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | RI=1: A -bit indicator for the strongest coefficient index  RI>1: See Table 3E below | Complete |
| SD basis subset selection indicator | Part 2 | SD basis subset selection indicator is a -bit indicator. Details follow Rel.15 | Complete |
| FD basis subset selection indicator | Part 2 | Details follow Rel.16 (Table 3E above) | Complete |
| DD basis subset selection indicator (per layer) | Part 2 | Reported only when N4>2 and Q=2: the selection of Q out of N4 DD basis vectors is indicated by a -bit indicator | Complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete |
| LC coefficients: amplitude | Part 2 | Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer) | Complete |
| SD oversampling (rotation) factor q1, q2 | Part 2 | Values of q1, q2 follow Rel.15 | Complete |

***Table 3D: UCI parameter list for Rel-17 based***

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **UCI** | **Details/description** | **Status** |
| # NZ coefficients | Part 1 | RI (Î{1,…, RIMAX}) and *KNZ,TOT* (the total number of non-zero coefficients summed across all the layers, are reported in UCI part 1 | Complete |
| Wideband CQI | Part 1 | Same as R15 | Complete |
| Subband CQI | Part 1 | Same as R15 (only X=1 TD CQI is supported) | Complete |
| Bitmap per layer | Part 2 | Same as R17 eType-II | Complete |
| Strongest coefficient indicator (SCI) | Part 2 | For layer *l*: A -bit indicator for the strongest coefficient index | Complete |
| Port selection indicator | Part 2 | Port selection indicator is a -bit indicator. Where , Details follow Rel.17 | Complete |
| FD basis subset selection indicator | Part 2 | a bit indicator only if *N>M=2,* where is configured with the higher-layer parameter *valueOfN,* when . | Complete |
| LC coefficients: phase | Part 2 | Quantized independently across layers | Complete |
| LC coefficients: amplitude | Part 2 | Quantized independently across layers (including a reference amplitude for weaker polarization, for each layer) | Complete |

***Table 3E: SCI and FD basis subset selection indicator for Rel-16-based Type-II Doppler***

|  |  |
| --- | --- |
| **SCI and FD basis subset selection indicator** | |
| SCI for RI>1 | Per-layer SCI defined across Q DD basis vectors, where is a –bit () indicator. The location (index) of the strongest LC coefficient for layer before index remapping is  , indicates and is not reported |
| Index remapping | For layer , the index of each nonzero LC coefficient is remapped with respect to to such that . The FD basis index associated to each nonzero LC coefficient is remapped with respect to to such that . The sets and are reported.  Informative note (for the purpose of reference procedure):  The index of nonzero LC coefficients is remapped as . The codebook index associated with nonzero LC coefficient index is remapped as . |
| Combinatorial indicator for | bits |
| Combinatorial indicator for | bits |
|  | Reported in UCI part 2, , ,  bits |

(\*) The red highlighted parts are the new components in Rel-18

**Agreement**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation, at least the following restrictions are supported:

* When all the configured KTRS resource sets are periodic, the UE can assume that all the resource sets share a same QCL-Type-A/C and, if applicable, Type-D source
* If the joint use of P and AP-TRS resource sets is supported for TDCP measurement and calculation, when one of the KTRS configured resource sets is aperiodic, the UE can assume that the aperiodic resource set is configured with QCL-Type-A and, if applicable, Type-D source with the resources of the one of the (KTRS – 1) periodic TRS resource sets
  + Note: Following the legacy specification, no more than 1 of the KTRS resource sets is aperiodic
  + TBD (RAN1#113): whether the joint use of P and AP-TRS resource sets is supported for TDCP measurement and calculation or not
* FFS: whether the UE shall assume the same antenna port for the CSI-RS resources in all the resource sets

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding phase quantization, down-select (by RAN1#113) from the following candidates:

* Alt1. 1-bit (early vs. late) phase indicator
* Alt2. 3-bit (8-PSK) uniform quantization
* Alt3. 4-bit (16-PSK) uniform quantization (full reuse of Rel-16 eType-II W2 phase quantization)
* Alt4. Adaptive/gNB-configurable phase quantizer e.g. , where
  + : legacy (Rel.16) based
    - Linear: legacy -PSK
    - Exponential: legacy Rel.16 amplitude, or
  + a slope value from depending on the amplitude ) of the 1st correlation (smallest delay), e.g. the slope decreases towards 0 as increases towards 1
* Alt5. A given correlation phase value is quantized to based on the following alphabet (where denotes delay):
* Alt6. A given correlation phase value is quantized to based on the following alphabet (where denotes delay and *p(.)* denotes amplitude quantization values used for Rel-16 e-TypeII codebook and ):
  + Mode 1: ,
  + Mode 2:
  + The quantization mode is selected by UE and reported to gNB.
* Alt7. A given correlation phase value is quantized to based on the following alphabet: , with , . TBD value(s) of

The evaluation should consider the impact of delay tracking operation at the UE where the phase difference between two slots can be close to zero.

Note: This proposal doesn’t preclude the UE supporting only smaller delay values (e.g. 4-symbol only) for the phase report (which is already optional)

**Conclusion**

For the Type-II codebook refinement for high/medium velocities, regarding SCI definition, there is no consensus on supporting the index remapping scheme analogous to that for FD basis for DD basis. Therefore, is a –bit indicator where and Q is the number of DD basis vectors (1 or 2)

Reference signal enhancement

**Agreement**

For RAN1#111 agreement of the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 1 for PDSCH, for S-DCI based M-TRP,

* Support all rows of DMRS port combinations and Number of DMRS CDM group(s) without data for Rel.18 eType1 DMRS ports with *maxLength* = 1 for PDSCH for S-TRP, in addition to row 30 for 1CW in RAN1#112 agreement.
  + If MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) is introduced to certain row(s) for S-TRP, the MU-restriction is applied to the same row(s) for S-DCI based M-TRP.

**Agreement**

For the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 2 for PDSCH, for S-DCI based M-TRP case, support all the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data.

* All rows for Rel.18 eType1 DMRS ports with *maxLength* = 2 for PDSCH for S-TRP.
  + If MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) is introduced to certain row(s) for S-TRP, the MU-restriction is applied to the same row(s) for S-DCI based M-TRP.
* For one CW, add new row 68 in Table 7.3.1.2.2-2A-X.
  + For row 68, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group).

Table 7.3.1.2.2-2A-X: Antenna port(s) (1000 + DMRS port), *dmrs-Type*=eType1, *maxLength*=2

|  |  |  |  |
| --- | --- | --- | --- |
| One Codeword:  Codeword 0 enabled,  Codeword 1 disabled | | | |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| … | … | … | … |
| 68 | 2 | 0,2,3 | 1 |

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 1 for PDSCH, for S-DCI based M-TRP case, support all the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data.

* All rows for Rel.18 eType2 DMRS ports with *maxLength* = 1 for PDSCH for S-TRP.
  + If MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) is introduced to certain row(s) for S-TRP, the MU-restriction is applied to the same row(s) for S-DCI based M-TRP.
* For one CW, add new row 60 in Table 7.3.1.2.2-3A-X.
  + For row 60, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group).

Table 7.3.1.2.2-3A-X: Antenna port(s) (1000 + DMRS port), *dmrs-Type*=eType2, *maxLength*=1

|  |  |  |
| --- | --- | --- |
| One Codeword:  Codeword 0 enabled,  Codeword 1 disabled | | |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) |
| … | … | … |
| 60 | 2 | 0,2,3 |

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 2 for PDSCH, for S-DCI based M-TRP case, support all the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data.

* All rows for Rel.18 eType2 DMRS ports with *maxLength* = 2 for PDSCH for S-TRP.
  + If MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) is introduced to certain row(s) for S-TRP, the MU-restriction is also applied to the same row(s) for S-DCI based M-TRP.
* For one CW, add new row 128 in Table 7.3.1.2.2-4A-X.
  + For row 128, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group).

Table 7.3.1.2.2-4A-X: Antenna port(s) (1000 + DMRS port), *dmrs-Type*=eType2, *maxLength*=2

|  |  |  |  |
| --- | --- | --- | --- |
| One Codeword:  Codeword 0 enabled,  Codeword 1 disabled | | | |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| … | … | … | … |
| 128 | 2 | 0,2,3 | 1 |

**Agreement**

Confirm the following Working Assumption in RAN1#112 at least for NCB based PUSCH:

* *To support PUSCH with rank = 5-8, support the following for enhancement of DMRS port allocation tables.*
  + *Option 1: Separate DMRS ports tables for rank 5,6,7,8 for each of eType1/eType2 and maxLength=1/2 (similar to the current UL DMRS ports table).*
    - *FFS: whether/how to reuse the reserved field in antenna ports field for other purposes can be discussed in AI9.1.4.2 [or AI9.1.3.1].*
* Note: The above Working Assumption for CB based PUSCH may be confirmed later.

**Agreement**

For 8Tx PUSCH, specify the factor related to PUSCH to PTRS power ratio per layer per RE () based on the following principles.



* Principle 1: When the *ptrs-Power* configures 01, the factor () is 10log10(L), where L is the total number of PUSCH layers.



* Principle 2: When the *ptrs-Power* configures 00, the factor () is determined as the following



* + Principle 2.1: For fully coherent TPMIs, the factor () is 10log10(L), where L is the total number of PUSCH layers.



* + Principle 2.2: For non-coherent TPMIs, the factor () is 10log10(Qp), where Qp is the number of PTRS ports scheduled to the UE.



* + Principle 2.3: For non-codebook PUSCH, the factor () is 10log10(Qp), where Qp is the number of PTRS ports scheduled to the UE.



* + FFS: The factor () for partial coherent TPMIs



**Agreement**

For RAN1#111 agreement of the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 1 for PDSCH, at least for S-TRP case,

* + For 2 CWs,
    - * Alt.1: Confirm the working assumption in RAN1#112 with modification (in red).
        + Alt.3-1: Support at least row 0-3 for 2 CWs in Table 4-0.

Table 4-0: DMRS ports for 2CWs.

|  |  |  |
| --- | --- | --- |
| **Two Codewords:**  **Codeword 0 enabled,**  **Codeword 1 enabled** | | |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| 0 | 2 | 0,1,2,3,8 |
| 1 | 2 | 0,1,2,3,8,10 |
| 2 | 2 | 0,1,2,3,8,9,10 |
| 3 | 2 | 0,1,2,3,8,9,10,11 |
| [4] | [2] | [0,1,2,3,10] |
| [5] | [2] | [0,1,8,2,3,10] |
| [6] | [2] | [0,1,8,2,3,10,11] |
| [7] | [2] | [0,1,8,9,2,3,10,11] |
| [8] | [2] | [0,2,3,8,9] |
| [9] | [2] | [0,1,2,3,8,9] |

FFS: Additional rows (rows 4~9) if there is technical justification.

**Agreement**

For RAN1#111 agreement of the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 1 for PDSCH, at least for S-TRP case,

* + For 1 CW,
    - Do not support row 21-22
    - FFS: Whether to support row 23

|  |  |  |
| --- | --- | --- |
| **One Codeword:**  **Codeword 0 enabled,**  **Codeword 1 disabled** | | |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| ~~21~~ | ~~[2]~~ | ~~[8-10]~~ |
| ~~22~~ | ~~[2]~~ | ~~[8-11]~~ |

**Working Assumption**

* Adopt Table 7.3.1.1.2-12B/13B/14B/15B/16B/17B/20B/21B/22B/23B to support signalling >4 ranks PUSCH with Rel-15 DMRS ports at least for full or non-coherent UL codebook based PUSCH and non-codebook based PUSCH.
* FFS: Whether/how some of bits in the antenna ports field can be reused for other purpose for >4 ranks PUSCH.

1. Table 7.3.1.1.2-12B: Antenna port(s), transform precoder is disabled, *dmrs-Type*=1, *maxLength*=2, rank = 5

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0-4 | 2 |
| 1-15 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-13B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 1, *maxLength*=2, rank = 6

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0,1,2,3,4,6 | 2 |
| 1-15 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-14B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 1, *maxLength*=2, rank = 7

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0,1,2,3,4,5,6 | 2 |
| 1-15 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-15B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 1, *maxLength*=2, rank = 8

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0,1,2,3,4,5,6,7 | 2 |
| 1-15 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-16B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=1, rank=5

|  |  |  |
| --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) |
| 0 | 3 | 0-4 |
| 1-15 | Reserved | Reserved |

1. Table 7.3.1.1.2-17B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=1, rank=6

|  |  |  |
| --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) |
| 0 | 3 | 0-5 |
| 1-15 | Reserved | Reserved |

1. Table 7.3.1.1.2-20B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=2, rank=5

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 3 | 0-4 | 1 |
| 1 | 2 | 0,1,2,3,6 | 2 |
| 12-31 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-21B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=2, rank=6

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 3 | 0-5 | 1 |
| 1 | 2 | 0,1,2,3,6,8 | 2 |
| 2-31 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-22B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=2, rank=7

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0,1,2,3,6,7,8 | 2 |
| 1-31 | Reserved | Reserved | Reserved |

1. Table 7.3.1.1.2-23B: Antenna port(s), transform precoder is disabled, *dmrs-Type*= 2, *maxLength*=2, rank=8

|  |  |  |  |
| --- | --- | --- | --- |
| Value | Number of DMRS CDM group(s) without data | DMRS port(s) | Number of front-load symbols |
| 0 | 2 | 0,1,2,3,6,7,8,9 | 2 |
| 1-31 | Reserved | Reserved | Reserved |

**Agreement**

For > 4 layers PUSCH with Rel.18 eType 1/eType 2 DMRS ports, support at least the same DMRS port combination(s) as that for rank = 5,6,7,8 for PDSCH with Rel.18 eType 1/eType 2 DMRS ports at least for full or non-coherent UL codebook based PUSCH and non-codebook based PUSCH.

**Agreement**

For the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 2 for PDSCH, at least for S-TRP case, support all rows of DMRS port combinations and Number of DMRS CDM group(s) without data in Table 7.3.1.2.2-2-X.

* FFS: For row 9-11, 24-30, 55-60, and 81-83 (if agreed) in one CW, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) or UE capability.
* FFS: The total number of rows for eType1 DMRS ports with *maxLength* =2 for PDSCH at least for S-TRP case does not exceed 64.

**Table 7.3.1.2.2-2-X: Antenna port(s) (1000 + DMRS port), *dmrs-Type*=eType1, *maxLength*=2**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **One Codeword:**  **Codeword 0 enabled,**  **Codeword 1 disabled** | | | | **Two Codewords:**  **Codeword 0 enabled,**  **Codeword 1 enabled** | | | |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** | **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** |
| 0 | 1 | 0 | 1 | [0 | 2 | 0-4 | 2] |
| 1 | 1 | 1 | 1 | [1 | 2 | 0,1,2,3,4,6 | 2] |
| 2 | 1 | 0,1 | 1 | [2 | 2 | 0,1,2,3,4,5,6 | 2] |
| 3 | 2 | 0 | 1 | [3 | 2 | 0,1,2,3,4,5,6,7 | 2] |
| 4 | 2 | 1 | 1 | 4 | 2 | 0,1,2,3,8 | 1 |
| 5 | 2 | 2 | 1 | 5 | 2 | 0,1,2,3,8,10 | 1 |
| 6 | 2 | 3 | 1 | 6 | 2 | 0,1,2,3,8,9,10 | 1 |
| 7 | 2 | 0,1 | 1 | 7 | 2 | 0,1,2,3,8,9,10,11 | 1 |
| [8 | 2 | 2,3 | 1] | [8 | 1 | 0,1,4,5,8 | 2] |
| [9 | 2 | 0-2 | 1] | [9 | 1 | 0,1,4,5,8,12 | 2] |
| [10 | 2 | 0-3 | 1] | [10 | 1 | 0,1,4,5,8,9,12 | 2] |
| [11 | 2 | 0,2 | 1] | [11 | 1 | 0,1,4,5,8,9,12,13 | 2] |
| 12 | 2 | 0 | 2 | [12 | 2 | 0,1,4,5,8 | 2] |
| 13 | 2 | 1 | 2 | [13 | 2 | 0,1,4,5,8,12 | 2] |
| 14 | 2 | 2 | 2 | [14 | 2 | 0,1,4,5,8,9,12 | 2] |
| 15 | 2 | 3 | 2 | [15 | 2 | 0,1,4,5,8,9,12,13 | 2] |
| 16 | 2 | 4 | 2 | [16 | 2 | 2,3,6,7,10 | 2] |
| 17 | 2 | 5 | 2 | [17 | 2 | 2,3,6,7,10,14 | 2] |
| 18 | 2 | 6 | 2 | [18 | 2 | 2,3,6,7,10,11,14 | 2] |
| 19 | 2 | 7 | 2 | [19 | 2 | 2,3,6,7,10,11,14,15 | 2] |
| 20 | 2 | 0,1 | 2 | [20 | 2 | 0,1, 2,3,10 | 1] |
| 21 | 2 | 2,3 | 2 | [21 | 2 | 0,1,8,2,3,10 | 1] |
| 22 | 2 | 4,5 | 2 | [22 | 2 | 0,1,8, 2,3,10,11 | 1] |
| 23 | 2 | 6,7 | 2 | [23 | 2 | 0,1,8,9,2,3,10,11 | 1] |
| [24 | 2 | 0,4 | 2] | [24 | 1 | 0,1,4,5,12 | 2] |
| [25 | 2 | 2,6 | 2] | [25 | 1 | 0,1,8,4,5,12 | 2] |
| [26 | 2 | 0,1,4 | 2] | [26 | 1 | 0,1,8,4,5,12,13 | 2] |
| [27 | 2 | 2,3,6 | 2] | [27 | 1 | 0,1,8,9,4,5,12,13 | 2] |
| [28 | 2 | 0,1,4,5 | 2] | [28 | 2 | 0,1,4,5,12 | 2] |
| [29 | 2 | 2,3,6,7 | 2] | [29 | 2 | 0,1,8,4,5,12 | 2] |
| [30 | 2 | 0,2,4,6 | 2] | [30 | 2 | 0,1,8,4,5,12,13 | 2] |
| 31 | 1 | 8 | 1 | [31 | 2 | 0,1,8,9,4,5,12,13 | 2] |
| 32 | 1 | 9 | 1 | [32 | 2 | 2,3,6,7,14 | 2] |
| 33 | 1 | 8,9 | 1 | [33 | 2 | 2,3,10,6,7,14 | 2] |
| 34 | 2 | 8 | 1 | [34 | 2 | 2,3,10,6,7,14,15 | 2] |
| 35 | 2 | 9 | 1 | [35 | 2 | 2,3,10,11,6,7,14,15 | 2] |
| 36 | 2 | 10 | 1 | [36 | 2 | 0,2,3,8,9 | 1] |
| 37 | 2 | 11 | 1 | [37 | 2 | 0,1,2,3,8,9 | 1] |
| 38 | 2 | 8,9 | 1 |  |  |  |  |
| 39 | 2 | 10,11 | 1 |  |  |  |  |
| ~~[40~~ | ~~2~~ | ~~8-10~~ | ~~1]~~ |  |  |  |  |
| ~~[41~~ | ~~2~~ | ~~8-11~~ | ~~1]~~ |  |  |  |  |
| ~~[42~~ | ~~2~~ | ~~8,10~~ | ~~1]~~ |  |  |  |  |
| 43 | 2 | 8 | 2 |  |  |  |  |
| 44 | 2 | 9 | 2 |  |  |  |  |
| 45 | 2 | 10 | 2 |  |  |  |  |
| 46 | 2 | 11 | 2 |  |  |  |  |
| 47 | 2 | 12 | 2 |  |  |  |  |
| 48 | 2 | 13 | 2 |  |  |  |  |
| 49 | 2 | 14 | 2 |  |  |  |  |
| 50 | 2 | 15 | 2 |  |  |  |  |
| 51 | 2 | 8,9 | 2 |  |  |  |  |
| 52 | 2 | 10,11 | 2 |  |  |  |  |
| 53 | 2 | 12,13 | 2 |  |  |  |  |
| 54 | 2 | 14,15 | 2 |  |  |  |  |
| [55 | 2 | 8,12 | 2] |  |  |  |  |
| [56 | 2 | 10,14 | 2] |  |  |  |  |
| [57 | 2 | 8,9,12 | 2] |  |  |  |  |
| [58 | 2 | 10,11,14 | 2] |  |  |  |  |
| [59 | 2 | 8,9,12,13 | 2] |  |  |  |  |
| [60 | 2 | 10,11,14,15 | 2] |  |  |  |  |
| ~~61~~ | ~~2~~ | ~~8,10,12,14~~ | ~~2~~ |  |  |  |  |
| 62 | 1 | 0,1,8 | 1 |  |  |  |  |
| 63 | 1 | 0,1,8,9 | 1 |  |  |  |  |
| 64 | 2 | 0,1,8 | 1 |  |  |  |  |
| 65 | 2 | 0,1,8,9 | 1 |  |  |  |  |
| 66 | 2 | 2,3,10 | 1 |  |  |  |  |
| 67 | 2 | 2,3,10,11 | 1 |  |  |  |  |
| [69 | 1 | 0,1,8 | 2] |  |  |  |  |
| [70 | 1 | 0,1,8,9 | 2] |  |  |  |  |
| [71 | 1 | 4,5,12 | 2] |  |  |  |  |
| [72 | 1 | 4,5,12,13 | 2] |  |  |  |  |
| [73 | 2 | 0,1,8 | 2] |  |  |  |  |
| [74 | 2 | 0,1,8,9 | 2] |  |  |  |  |
| [75 | 2 | 4,5,12 | 2] |  |  |  |  |
| [76 | 2 | 4,5,12,13 | 2] |  |  |  |  |
| [77 | 2 | 2,3,10 | 2] |  |  |  |  |
| [78 | 2 | 2,3,10,11 | 2] |  |  |  |  |
| [79 | 2 | 6,7,14 | 2] |  |  |  |  |
| [80 | 2 | 6,7,14,15 | 2] |  |  |  |  |
| [81 | 2 | 5,8,9 | 2] |  |  |  |  |
| [82 | 2 | 7,10,11 | 2] |  |  |  |  |
| [83 | 2 | 7,12,13 | 2] |  |  |  |  |

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 1 for PDSCH, at least for S-TRP case, support all rows of DMRS port combinations and Number of DMRS CDM group(s) without data in Table 7.3.1.2.2-3-X.

* FFS: For rows 9, 10, 20-23, 33, 34, 44-46, 60-62 (if agreed) in one CW, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) or UE capability.

Table 7.3.1.2.2-3-X: Antenna port(s) (1000 + DMRS port), dmrs-Type=eType2, maxLength=1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **One codeword:**  **Codeword 0 enabled,**  **Codeword 1 disabled** | | | **Two codewords:**  **Codeword 0 enabled,**  **Codeword 1 enabled** | | |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| 0 | 1 | 0 | 0 | 3 | 0-4 |
| 1 | 1 | 1 | 1 | 3 | 0-5 |
| 2 | 1 | 0,1 | [2 | 3 | 12-16] |
| 3 | 2 | 0 | [3 | 3 | 12-17] |
| 4 | 2 | 1 | 4 | 2 | 0,1,2,3,12 |
| 5 | 2 | 2 | 5 | 2 | 0,1,2,3,12,14 |
| 6 | 2 | 3 | 6 | 2 | 0-3,12-14 |
| 7 | 2 | 0,1 | 7 | 2 | 0-3,12-15 |
| 8 | 2 | 2,3 | [8 | 3 | 0,1,2,3,12] |
| [9 | 2 | 0-2] | [9 | 3 | 0,1,2,3,12,14] |
| [10 | 2 | 0-3] | [10 | 3 | 0-3,12-14] |
| 11 | 3 | 0 | [11 | 3 | 0-3,12-15] |
| 12 | 3 | 1 | [12 | 2 | 0,2,3,12,13] |
| 13 | 3 | 2 | [13 | 2 | 0,1,2,3,14] |
| 14 | 3 | 3 | [14 | 2 | 0,1,12,2,3,14] |
| 15 | 3 | 4 | [15 | 2 | 0,1,12,2,3,14,15] |
| 16 | 3 | 5 | [16 | 2 | 0,1,12,13,2,3,14,15] |
| 17 | 3 | 0,1 | [17 | 3 | 0,1,2,3,14] |
| 18 | 3 | 2,3 | [18 | 3 | 0,1,12,2,3,14] |
| 19 | 3 | 4,5 | [19 | 3 | 0,1,12,2,3,14,15] |
| [20 | 3 | 0-2] | [20 | 3 | 0,1,12,13,2,3,14,15] |
| [21 | 3 | 3-5] |  |  |  |
| [22 | 3 | 0-3] |  |  |  |
| [23 | 2 | 0,2] |  |  |  |
| 24 | 1 | 12 |  |  |  |
| 25 | 1 | 13 |  |  |  |
| 26 | 1 | 12,13 |  |  |  |
| 27 | 2 | 12 |  |  |  |
| 28 | 2 | 13 |  |  |  |
| 29 | 2 | 14 |  |  |  |
| 30 | 2 | 15 |  |  |  |
| 31 | 2 | 12,13 |  |  |  |
| 32 | 2 | 14,15 |  |  |  |
| [33 | 2 | 12-14] |  |  |  |
| [34 | 2 | 12-15] |  |  |  |
| 35 | 3 | 12 |  |  |  |
| 36 | 3 | 13 |  |  |  |
| 37 | 3 | 14 |  |  |  |
| 38 | 3 | 15 |  |  |  |
| 39 | 3 | 16 |  |  |  |
| 40 | 3 | 17 |  |  |  |
| 41 | 3 | 12,13 |  |  |  |
| 42 | 3 | 14,15 |  |  |  |
| 43 | 3 | 16,17 |  |  |  |
| [44 | 3 | 12-14] |  |  |  |
| [45 | 3 | 15-17] |  |  |  |
| [46 | 3 | 12-15] |  |  |  |
| ~~[47~~ | ~~2~~ | ~~12,14]~~ |  |  |  |
| 48 | 1 | 0,1,12 |  |  |  |
| 49 | 1 | 0,1,12,13 |  |  |  |
| 50 | 2 | 0,1,12 |  |  |  |
| 51 | 2 | 0,1,12,13 |  |  |  |
| 52 | 2 | 2,3,14 |  |  |  |
| 53 | 2 | 2,3,14,15 |  |  |  |
| 54 | 3 | 0,1,12 |  |  |  |
| 55 | 3 | 0,1,12,13 |  |  |  |
| 56 | 3 | 2,3,14 |  |  |  |
| 57 | 3 | 2,3,14,15 |  |  |  |
| 58 | 3 | 4,5,16 |  |  |  |
| 59 | 3 | 4,5,16,17 |  |  |  |
| [60 | 3 | 13,15,17] |  |  |  |
| [61 | 3 | 13,15] |  |  |  |
| [62 | 2 | 13,15] |  |  |  |

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 2 for PDSCH, at least for S-TRP case, support all rows of DMRS port combinations and Number of DMRS CDM group(s) without data in Table 7.3.1.2.2-4-X.

* FFS: For rows 9, 10, 20-23, 42-47, 67, 68, 78-80, 100-105, and 153-158 (if agreed) in one CW, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group) or UE capability.

Table 7.3.1.2.2-4-X: Antenna port(s) (1000 + DMRS port), dmrs-Type=eType2, maxLength=2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **One codeword:**  **Codeword 0 enabled,**  **Codeword 1 disabled** | | | | **Two Codewords:**  **Codeword 0 enabled,**  **Codeword 1 enabled** | | | |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** | **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** |
| 0 | 1 | 0 | 1 | [0 | 3 | 0-4 | 1] |
| 1 | 1 | 1 | 1 | [1 | 3 | 0-5 | 1] |
| 2 | 1 | 0,1 | 1 | [2 | 2 | 0,1,2,3,6 | 2] |
| 3 | 2 | 0 | 1 | [3 | 2 | 0,1,2,3,6,8 | 2] |
| 4 | 2 | 1 | 1 | [4 | 2 | 0,1,2,3,6,7,8 | 2] |
| 5 | 2 | 2 | 1 | [5 | 2 | 0,1,2,3,6,7,8,9 | 2] |
| 6 | 2 | 3 | 1 | 6 | 2 | 0,1,2,3,12 | 1 |
| 7 | 2 | 0,1 | 1 | 7 | 2 | 0-3,12,14 | 1 |
| 8 | 2 | 2,3 | 1 | 8 | 2 | 0-3,12-14 | 1 |
| [9 | 2 | 0-2 | 1] | 9 | 2 | 0-3,12-15 | 1 |
| [10 | 2 | 0-3 | 1] | [10 | 3 | 0,1,2,3,12 | 1] |
| 11 | 3 | 0 | 1 | [11 | 3 | 0-3,12,14 | 1] |
| 12 | 3 | 1 | 1 | [12 | 3 | 0-3,12-14 | 1] |
| 13 | 3 | 2 | 1 | [13 | 3 | 0-3,12-15 | 1] |
| 14 | 3 | 3 | 1 | [14 | 1 | 0,1,6,7,12 | 2] |
| 15 | 3 | 4 | 1 | [15 | 1 | 0,1,6,7,12,18 | 2] |
| 16 | 3 | 5 | 1 | [16 | 1 | 0,1,6,7,12,13,18 | 2] |
| 17 | 3 | 0,1 | 1 | [17 | 1 | 0,1,6,7,12,13,18,19 | 2] |
| 18 | 3 | 2,3 | 1 | [18 | 2 | 0,1,6,7,12 | 2] |
| 19 | 3 | 4,5 | 1 | [19 | 2 | 0,1,6,7,12,18 | 2] |
| [20 | 3 | 0-2 | 1] | [20 | 2 | 0,1,6,7,12,13,18 | 2] |
| [21 | 3 | 3-5 | 1] | [21 | 2 | 0,1,6,7,12,13,18,19 | 2] |
| [22 | 3 | 0-3 | 1] | [22 | 2 | 2,3,8,9,14 | 2] |
| [23 | 2 | 0,2 | 1] | [23 | 2 | 2,3,8,9,14,20 | 2] |
| 24 | 3 | 0 | 2 | [24 | 2 | 2,3,8,9,14,15,20 | 2] |
| 25 | 3 | 1 | 2 | [25 | 2 | 2,3,8,9,14,15,20,21 | 2] |
| 26 | 3 | 2 | 2 | [26 | 3 | 0,1,6,7,12 | 2] |
| 27 | 3 | 3 | 2 | [27 | 3 | 0,1,6,7,12,18 | 2] |
| 28 | 3 | 4 | 2 | [28 | 3 | 0,1,6,7,12,13,18 | 2] |
| 29 | 3 | 5 | 2 | [29 | 3 | 0,1,6,7,12,13,18,19 | 2] |
| 30 | 3 | 6 | 2 | [30 | 3 | 2,3,8,9,14 | 2] |
| 31 | 3 | 7 | 2 | [31 | 3 | 2,3,8,9,14,20 | 2] |
| 32 | 3 | 8 | 2 | [32 | 3 | 2,3,8,9,14,15,20 | 2] |
| 33 | 3 | 9 | 2 | [33 | 3 | 2,3,8,9,14,15,20,21 | 2] |
| 34 | 3 | 10 | 2 | [34 | 3 | 4,5,10,11,16 | 2] |
| 35 | 3 | 11 | 2 | [35 | 3 | 4,5,10,11,16,22 | 2] |
| 36 | 3 | 0,1 | 2 | [36 | 3 | 4,5,10,11,16,17,22 | 2] |
| 37 | 3 | 2,3 | 2 | [37 | 3 | 4,5,10,11,16,17,22,23 | 2] |
| 38 | 3 | 4,5 | 2 | [38 | 2 | 0,1,2,3,14 | 1] |
| 39 | 3 | 6,7 | 2 | [39 | 2 | 0,1,12,2,3,14 | 1] |
| 40 | 3 | 8,9 | 2 | [40 | 2 | 0,1,12,2,3,14,15 | 1] |
| 41 | 3 | 10,11 | 2 | [41 | 2 | 0,1,12,13,2,3,14,15 | 1] |
| [42 | 3 | 0,1,6 | 2] | [42 | 3 | 0,1,2,3,14 | 1] |
| [43 | 3 | 2,3,8 | 2] | [43 | 3 | 0,1,12,2,3,14 | 1] |
| [44 | 3 | 4,5,10 | 2] | [44 | 3 | 0,1,12,2,3,14,15 | 1] |
| [45 | 3 | 0,1,6,7 | 2] | [45 | 3 | 0,1,12,13,2,3,14,15 | 1] |
| [46 | 3 | 2,3,8,9 | 2] | [46 | 1 | 0,1,6,7,18 | 2] |
| [47 | 3 | 4,5,10,11 | 2] | [47 | 1 | 0,1,12,6,7,18 | 2] |
| 48 | 1 | 0 | 2 | [48 | 1 | 0,1,12,6,7,18,19 | 2] |
| 49 | 1 | 1 | 2 | [49 | 1 | 0,1,12,13,6,7,18,19 | 2] |
| 50 | 1 | 6 | 2 | [50 | 2 | 0,1,6,7,18 | 2] |
| 51 | 1 | 7 | 2 | [51 | 2 | 0,1,12,6,7,18 | 2] |
| 52 | 1 | 0,1 | 2 | [52 | 2 | 0,1,12,6,7,18,19 | 2] |
| 53 | 1 | 6,7 | 2 | [53 | 2 | 0,1,12,13,6,7,18,19 | 2] |
| 54 | 2 | 0,1 | 2 | [54 | 2 | 2,3,8,9,20 | 2] |
| 55 | 2 | 2,3 | 2 | [55 | 2 | 2,3,14,8,9,20 | 2] |
| 56 | 2 | 6,7 | 2 | [56 | 2 | 2,3,14,8,9,20,21 | 2] |
| 57 | 2 | 8,9 | 2 | [57 | 2 | 2,3,14,15,8,9,20,21 | 2] |
| 58 | 1 | 12 | 1 | [58 | 3 | 0,1,6,7,18 | 2] |
| 59 | 1 | 13 | 1 | [59 | 3 | 0,1,12,6,7,18 | 2] |
| 60 | 1 | 12,13 | 1 | [60 | 3 | 0,1,12,6,7,18,19 | 2] |
| 61 | 2 | 12 | 1 | [61 | 3 | 0,1,12,13,6,7,18,19 | 2] |
| 62 | 2 | 13 | 1 | [62 | 3 | 2,3,8,9,20 | 2] |
| 63 | 2 | 14 | 1 | [63 | 3 | 2,3,14,8,9,20 | 2] |
| 64 | 2 | 15 | 1 | [64 | 3 | 2,3,14,8,9,20,21 | 2] |
| 65 | 2 | 12,13 | 1 | [65 | 3 | 2,3,14,15,8,9,20,21 | 2] |
| 66 | 2 | 14,15 | 1 | [66 | 3 | 4,5,10,11,22 | 2] |
| [67 | 2 | 12-14 | 1] | [67 | 3 | 4,5,16,10,11,22 | 2] |
| [68 | 2 | 12-15 | 1] | [68 | 3 | 4,5,16,10,11,22,23 | 2] |
| 69 | 3 | 12 | 1 | [69 | 3 | 4,5,16,17,10,11,22,23 | 2] |
| 70 | 3 | 13 | 1 |  |  |  |  |
| 71 | 3 | 14 | 1 |  |  |  |  |
| 72 | 3 | 15 | 1 |  |  |  |  |
| 73 | 3 | 16 | 1 |  |  |  |  |
| 74 | 3 | 17 | 1 |  |  |  |  |
| 75 | 3 | 12,13 | 1 |  |  |  |  |
| 76 | 3 | 14,15 | 1 |  |  |  |  |
| 77 | 3 | 16,17 | 1 |  |  |  |  |
| [78 | 3 | 12-14 | 1] |  |  |  |  |
| [79 | 3 | 15-17 | 1] |  |  |  |  |
| [80 | 3 | 12-15 | 1] |  |  |  |  |
| ~~[81~~ | ~~2~~ | ~~12,14~~ | ~~1]~~ |  |  |  |  |
| 82 | 3 | 12 | 2 |  |  |  |  |
| 83 | 3 | 13 | 2 |  |  |  |  |
| 84 | 3 | 14 | 2 |  |  |  |  |
| 85 | 3 | 15 | 2 |  |  |  |  |
| 86 | 3 | 16 | 2 |  |  |  |  |
| 87 | 3 | 17 | 2 |  |  |  |  |
| 88 | 3 | 18 | 2 |  |  |  |  |
| 89 | 3 | 19 | 2 |  |  |  |  |
| 90 | 3 | 20 | 2 |  |  |  |  |
| 91 | 3 | 21 | 2 |  |  |  |  |
| 92 | 3 | 22 | 2 |  |  |  |  |
| 93 | 3 | 23 | 2 |  |  |  |  |
| 94 | 3 | 12,13 | 2 |  |  |  |  |
| 95 | 3 | 14,15 | 2 |  |  |  |  |
| 96 | 3 | 16,17 | 2 |  |  |  |  |
| 97 | 3 | 18,19 | 2 |  |  |  |  |
| 98 | 3 | 20,21 | 2 |  |  |  |  |
| 99 | 3 | 22,23 | 2 |  |  |  |  |
| [100 | 3 | 12,13,18 | 2] |  |  |  |  |
| [101 | 3 | 14,15,20 | 2] |  |  |  |  |
| [102 | 3 | 16,17,22 | 2] |  |  |  |  |
| [103 | 3 | 12,13,18,19 | 2] |  |  |  |  |
| [104 | 3 | 14,15,20,21 | 2] |  |  |  |  |
| [105 | 3 | 16,17,22,23 | 2] |  |  |  |  |
| 106 | 1 | 12 | 2 |  |  |  |  |
| 107 | 1 | 13 | 2 |  |  |  |  |
| 108 | 1 | 18 | 2 |  |  |  |  |
| 109 | 1 | 19 | 2 |  |  |  |  |
| 110 | 1 | 12,13 | 2 |  |  |  |  |
| 111 | 1 | 18,19 | 2 |  |  |  |  |
| 112 | 2 | 12,13 | 2 |  |  |  |  |
| 113 | 2 | 14,15 | 2 |  |  |  |  |
| 114 | 2 | 18,19 | 2 |  |  |  |  |
| 115 | 2 | 20,21 | 2 |  |  |  |  |
| 116 | 1 | 0,1,12 | 1 |  |  |  |  |
| 117 | 1 | 0,1,12,13 | 1 |  |  |  |  |
| 118 | 2 | 0,1,12 | 1 |  |  |  |  |
| 119 | 2 | 0,1,12,13 | 1 |  |  |  |  |
| 120 | 2 | 2,3,14 | 1 |  |  |  |  |
| 121 | 2 | 2,3,14,15 | 1 |  |  |  |  |
| 122 | 3 | 0,1,12 | 1 |  |  |  |  |
| 123 | 3 | 0,1,12,13 | 1 |  |  |  |  |
| 124 | 3 | 2,3,14 | 1 |  |  |  |  |
| 125 | 3 | 2,3,14,15 | 1 |  |  |  |  |
| 126 | 3 | 4,5,16 | 1 |  |  |  |  |
| 127 | 3 | 4,5,16,17 | 1 |  |  |  |  |
| [129 | 1 | 0,1,12 | 2] |  |  |  |  |
| [130 | 1 | 0,1,12,13 | 2] |  |  |  |  |
| [131 | 1 | 6,7,18 | 2] |  |  |  |  |
| [132 | 1 | 6,7,18,19 | 2] |  |  |  |  |
| [133 | 2 | 0,1,12 | 2] |  |  |  |  |
| [134 | 2 | 0,1,12,13 | 2] |  |  |  |  |
| [135 | 2 | 6,7,18 | 2] |  |  |  |  |
| [136 | 2 | 6,7,18,19 | 2] |  |  |  |  |
| [137 | 2 | 2,3,14 | 2] |  |  |  |  |
| [138 | 2 | 2,3,14,15 | 2] |  |  |  |  |
| [139 | 2 | 8,9,20 | 2] |  |  |  |  |
| [140 | 2 | 8,9,20,21 | 2] |  |  |  |  |
| [141 | 3 | 0,1,12 | 2] |  |  |  |  |
| [142 | 3 | 0,1,12,13 | 2] |  |  |  |  |
| [143 | 3 | 6,7,18 | 2] |  |  |  |  |
| [144 | 3 | 6,7,18,19 | 2] |  |  |  |  |
| [145 | 3 | 2,3,14 | 2] |  |  |  |  |
| [146 | 3 | 2,3,14,15 | 2] |  |  |  |  |
| [147 | 3 | 8,9,20 | 2] |  |  |  |  |
| [148 | 3 | 8,9,20,21 | 2] |  |  |  |  |
| [149 | 3 | 4,5,16 | 2] |  |  |  |  |
| [150 | 3 | 4,5,16,17 | 2] |  |  |  |  |
| [151 | 3 | 10,11,22 | 2] |  |  |  |  |
| [152 | 3 | 10,11,22,23 | 2] |  |  |  |  |
| [153 | 3 | 7,12,13 | 2] |  |  |  |  |
| [154 | 3 | 9,14,15 | 2] |  |  |  |  |
| [155 | 3 | 11,16,17 | 2] |  |  |  |  |
| [156 | 3 | 9,18,19 | 2] |  |  |  |  |
| [157 | 3 | 18,19,20 | 2] |  |  |  |  |
| [158 | 3 | 21,22,23 | 2] |  |  |  |  |

**Conclusion**

No consensus to support MAC CE based switching between Rel.15 DMRS ports and Rel.18 DMRS ports for PDSCH

**Agreement**

For Rel.18 eType1/eType2 DMRS ports with *maxLength*=1/2 for PDSCH/PUSCH, if Rel.18 eType1/eType2 DMRS ports is configured by RRC, the DCI size of antenna ports field in DCI format 1\_1/1\_2/0\_1/0\_2 is increased by at least 1-bit from Rel.17.

* Note: it does not preclude future possibility to support more than 1-bit, if RAN1 agree the necessity.

**Agreement**

For RAN1#112 agreement of the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 1 for PUSCH.

* Support row 7 for rank2, row1 for rank3, row 1 for rank4.

Table 7.3.1.1.2-9-X: Antenna port(s), transform precoder is disabled, *dmrs-Type*= eType1, *maxLength*=1, rank = 2

|  |  |  |
| --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| 7 | 2 | 9,11 |

Table 7.3.1.1.2-10-X: Antenna port(s), transform precoder is disabled, dmrs-Type= eType1, maxLength=1, rank = 3

|  |  |  |
| --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| 1 | 2 | 8-10 |

Table 7.3.1.1.2-11-X: Antenna port(s), transform precoder is disabled, dmrs-Type= eType1, maxLength=1, rank = 4

|  |  |  |
| --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| 1 | 2 | 8-11 |

**Agreement**

For two PTRS ports for partial/non-coherent PUSCH, PTRS-DMRS association for PUSCH with up to 8 layers is down selected from the following.

* Alt.1: The size of PTRS-DMRS association field is 4-bit in DCI format 0\_1/0\_2.

Table 1: PTRS-DMRS association for UL PTRS ports 0 and 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Value of MSB** | **DMRS port** | **Value of LSB** | **DMRS port** |
| 0 | 1st DMRS port which shares PTRS port 0 | 0 | 1st DMRS port which shares PTRS port 1 |
| 1 | 2nd DMRS port which shares PTRS port 0 | 1 | 2nd DMRS port which shares PTRS port 1 |
| 2 | 3rd DMRS port which shares PTRS port 0 | 2 | 3rd DMRS port which shares PTRS port 1 |
| 3 | 4th DMRS port which shares PTRS port 0 | 3 | 4th DMRS port which shares PTRS port 1 |

* Alt.2: The size of PTRS-DMRS association field is 2-bit in DCI format 0\_1/0\_2.
  + The CW with the higher MCS is selected in case of two CWs.
  + If the MCS is the same for two CWs, the PTRS port is associated with the first CW.

Table 2: PTRS-DMRS association for UL PTRS ports 0 and 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Value of MSB** | **DMRS port** | **Value of LSB** | **DMRS port** |
| 0 | 1st DMRS port which shares PTRS port 0 | 0 | 1st DMRS port which shares PTRS port 1 |
| 1 | 2nd DMRS port which shares PTRS port 0 | 1 | 2nd DMRS port which shares PTRS port 1 |

* Alt.3: The size of PTRS-DMRS association field is 2-bit in DCI format 0\_1/0\_2.
  + For PUSCH with rank 5-8, 2-bit of antenna ports field is reused in addition to 2-bit PTRS-DMRS association in DCI format 0\_1/0\_2, and total 4-bit is used for PTRS-DMRS association.

Table 1: PTRS-DMRS association for UL PTRS ports 0 and 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Value of MSB** | **DMRS port** | **Value of LSB** | **DMRS port** |
| 0 | 1st DMRS port which shares PTRS port 0 | 0 | 1st DMRS port which shares PTRS port 1 |
| 1 | 2nd DMRS port which shares PTRS port 0 | 1 | 2nd DMRS port which shares PTRS port 1 |
| 2 | 3rd DMRS port which shares PTRS port 0 | 2 | 3rd DMRS port which shares PTRS port 1 |
| 3 | 4th DMRS port which shares PTRS port 0 | 3 | 4th DMRS port which shares PTRS port 1 |

* Alt.4: The size of PTRS-DMRS association field is 2-bit in DCI format 0\_1/0\_2.

Table 2: PTRS-DMRS association for UL PTRS ports 0 and 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Value of MSB** | **DMRS port** | **Value of LSB** | **DMRS port** |
| 0 | 1st DMRS port which shares PTRS port 0 | 0 | 1st DMRS port which shares PTRS port 1 |
| 1 | 2nd DMRS port which shares PTRS port 0 | 1 | 2nd DMRS port which shares PTRS port 1 |

**Conclusion**

For MU-MIMO within a CDM group between Rel.15 DMRS ports and Rel.18 DMRS ports,

* For PUSCH, there is no restriction.

**Agreement**

For partial/non-coherent PUSCH with rank=5-8 transmission (i.e. non of the CWs is disabled) with one PTRS port, PTRS-DMRS association for PUSCH is the following.

* The size of PTRS-DMRS association field is 2-bit in DCI format 0\_1/0\_2.
  + The CW with the higher MCS is selected in case of two CWs.
    - Note: in case of PUSCH retransmission, the initial MCS is used for CW selection.
  + If the MCS is the same for two CWs, the PTRS port is associated with the first CW.

Table 7.3.1.1.2-25: PTRS-DMRS association for UL PTRS port 0

|  |  |
| --- | --- |
| Value | DMRS port |
| 0 | 1st scheduled DMRS port with the CW |
| 1 | 2nd scheduled DMRS port with the CW |
| 2 | 3rd scheduled DMRS port with the CW |
| 3 | 4th scheduled DMRS port with the CW |

**Conclusion**

For “The CW with the higher MCS” in RAN1#112 agreement of PTRS-DMRS association field for full-coherent PUSCH with rank=5~8 PUSCH with one port PTRS, following is clarified.

* Note: in case of PUSCH retransmission, the initial MCS is used for CW selection.

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is assigned with *>1* comb offsets, determine the mapping from the ports to comb offsets as follows:

* If =2, ports {1000, 1002, 1004, 1006} are mapped on the first comb offset, and {1001, 1003, 1005, 1007} on the second comb offset
* If =4, ports {1000, 1004} are mapped on the first comb offset, {1001, 1005} on the second comb offset, {1002, 1006} on the third comb offset, and {1003, 1007} on the fourth comb offset.

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is configured with comb and with maximum cyclic shifts per comb offset, the number of comb offset(s) and the cyclic shift locations are determined based on the one RRC configured cyclic shift location as follows:

* If , then 1 comb offset is used, otherwise 2 comb offsets are used.
* The 8 cyclic shift locations for the 8 ports are {) mod ) mod , reusing the existing equation in 38.211 6.4.1.4.2.

**Agreement**

For a SRS resource configured with comb offset hopping and/or cyclic shift hopping,

* If the repetition factor R = 1, within a slot, the time-domain hopping behavior depends on the OFDM symbol index of each symbol.
* If the repetition factor R > 1,
  + For cyclic shift hopping, within a slot, the time-domain hopping behavior depends on the OFDM symbol index of each symbol.
  + For comb offset hopping, within a slot, the time-domain hopping behavior depends on one of the following alternatives:
    - Alt1: The OFDM symbol index of the first symbol across the R repetitions.
    - Alt2: The OFDM symbol index of each symbol.
    - Alt3: The OFDM symbol index of each symbol or the first symbol across the R repetitions based on configuration, and FFS configuration details.

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and resource mapping based on TDM onto m ≥ 2 OFDM symbols in a slot and with TDM factor s, the s subsets of ports are mapped cyclically as {{1, 2, …, s}, …, {1, 2, …, s}} on the m OFDM symbols.

**Conclusion**

No consensus on enhanced per-TRP power control and/or power control of one SRS towards to multiple TRPs in Rel-18.

**Agreement**

For SRS comb offset hopping / cyclic shift hopping, support reinitialization at the beginning of every N radio frame(s), where N ≥ 1.

* FFS: N is fixed or configurable.

**Agreement**

For SRS comb offset hopping and/or cyclic shift hopping, for a SRS resource, the hopping pattern initialization ID determined by , where is a new ID for cyclic shift hopping and/or comb offset hopping.

* The range of the new ID is from 0 to 1023

**Agreement**

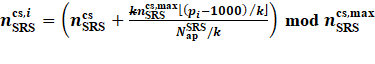
For a SRS resource configured with comb offset hopping, if the repetition factor R > 1, within a slot, the time-domain hopping behavior depends on the OFDM symbol index l' of each symbol or the first symbol across the R repetitions based on RRC configuration, and FFS configuration details.

* UE can indicate whether it supports one or both the options. Details to be discussed in UE feature.

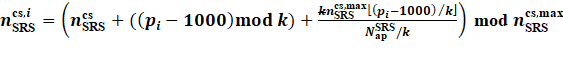
**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is assigned with comb 4 or comb 8, decide one of the following options:

* Option 1: the cyclic shift positions are completely aligned across the comb offsets on the same OFDM symbol.
  + For comb =4, . For comb =8, . For port , .



* Option 2: the cyclic shift positions are unaligned across the comb offsets on the same OFDM symbol for comb 4, and the cyclic shift positions are aligned on only 2 of the 4 comb offsets on the same OFDM symbol for comb 8.
  + For comb =4, . For comb =8, .  Example: For port , . FFS equation details.



* FFS: potential impact on PAPR, if any.

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and resource mapping based on TDM with TDM factor s, when the s subsets of ports are mapped onto m ≥ 2 OFDM symbols in a slot according to the pattern {{1, 2, …, s}, …, {1, 2, …, s}} (totally m/s groups of {1, 2, …, s}), the SRS transmissions within each of the m/s groups of {1, 2, …, s} use the same set of subcarriers. If consecutive groups of {1, 2, …, s} are configured as repetition, then the SRS transmissions of the consecutive groups use the same set of subcarriers.

* Note: applicable to the SRS resource with or without FH/RPFS.
* FFS the scenario where comb offset hopping is configured for the SRS resource.

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and with TDM factor s > 1, when the s subsets of ports are mapped onto m ≥ 2 OFDM symbols in a slot according to the pattern {{1, 2, …, s}, …, {1, 2, …, s}} (totally m/s groups of {1, 2, …, s}), and when the SRS transmission on a subset of the s OFDM symbols within a group of {1, 2, …, s} is dropped, study at least the following solutions:

* Whether or not a UE drops the SRS transmission on the rest of OFDM symbols within the group of {1, 2, …, s}, based on, for example, the usage, coherency, and/or repetition configuration.
* Whether or not a UE changes the transmission order of the subsets of ports.

**Agreement**

Whether SRS comb offset hopping can be combined with one of group / sequence hopping on a SRS resource depends on UE feature/capability design.

* FFS: Whether SRS cyclic shift hopping can be combined with one of group / sequence hopping on a SRS resource depends on UE feature/capability design.
* FFS: UE feature/capability design details.

Enhanced uplink transmission

**Agreement**

The codepoints of “SRS resource set indicator” in DCI for dynamic switching between STxMP SDM and sTRP transmission are interpreted and the SRI/TPMI fields are designed as follows:

* The codepoints 00 and 01 indicate sTRP transmission. 00 indicates the first SRS resource set and 01 indicates the second SRS resource set. For SRI/TPMI field design, down-select one from the following Alts:
  + Alt1: The DCI has two SRI fields and two TPMI fields. The first SRI field and first TPMI field are associated the first SRS resource set if codepoint = 00 or the second SRS resource set if codepoint = 01. The second SRI field and second TPMI fields are reserved.
  + Alt2: the DCI has only one SRI field and one TPMI field. The SRI and TPMI field are associated with the first SRS resource set if codepoint=00 or the second SRS resource set if codepoint = 01.
  + Alt3: The DCI has two SRI fields and two TPMI fields. The first SRI field and second SRI field are concatenated into one SRI field. The first TPMI field and second TPMI field are concatenated into one TPMI field. The concatenated SRI field and the concatenated TPMI field are associated with first SRS resource set if codepoint = 00 or the second SRS resource set if codepoint = 01.
    - FFS: If the concatenated bits are not sufficient, additional bits are appended to concatenated bits in order to support this feature
  + Alt4: the DCI has two SRI fields and two TPMI fields.
    - When the codepoint is 00, the first SRI field and first TPMI field are associated with the first SRS resource set. The second SRI field and second TPMI field are reserved.
    - When the codepoint is 01, the second SRI field and second TPMI field are associated with the second SRS resource set. The first SRI field and first TPMI field are reserved.
* The codepoints 10 indicate SDM transmission with the first and second SRS resource set.
  + The first SRI field and first TPMI field are associated with the first SRS resource set and they indicate the precoder(s)/rank/SRI for the first SRS resource set.
  + The second SRI field and second TPMI field are associated with the first SRS resource set and they indicate the precoder(s)/rank/SRI for the second SRS resource set.
* FFS: The codepoint 11 is reserved.

**Agreement**

The codepoints of “SRS resource set indicator” in DCI for dynamic switching between STxMP SFN and sTRP transmission are interpreted and the design of SRI/TPMI fields are as follows:

* The codepoints 00 and 01 indicate sTRP transmission. 00 indicates the first SRS resource set and 01 indicates the second SRS resource set.
  + For the design of SRI/TPMI fields, re-use the design that is decided for dynamic switching between STxMP SDM and sTRP transmission.
* The codepoint 10 indicates STxMP SFN transmission with the first and second SRS resource set.
  + The first SRI field and first TPMI field are associated with the first SRS resource set and they indicate the precoder(s)/rank/SRI for the first SRS resource set.
  + The second SRI field and second TPMI field are associated with the second SRS resource set and they indicate the precoder(s)/SRI for the second SRS resource set (the rank is indicated by the first SRI field for NCB or the first TPMI field for CB)
* FFS: The codepoint 11 is reserved.

**Agreement**

For STxMP PUSCH+PUSCH transmission in multi-DCI based system:

* The maximal number of layers of each PUSCH of PUSCH+PUSCH overlapping in time domain can be 1 or 2 subject to UE capability

**Agreement**

Enhance the Rel-17 group-based beam L1-RSRP reporting to support STxMP-based transmission and down-select one in RAN1#113 meeting:

* Alt1: In each reported pair of CRIs or SSBRIs, the UL Tx spatial filters determined from the reported pair of CRIs or SSBRIs can be applied simultaneously, and the reported pair of CRIs or SSBRIs can be received simultaneously.
* Alt2: In each reported pair of CRIs or SSBRIs, the UL Tx spatial filters determined from the reported pair of CRIs or SSBRIs can be applied simultaneously.
* Alt3:In each reported pair of CRIs or SSBRIs, UE indicates if the UL Tx spatial filters determined from the reported pair of CRIs or SSBRIs can be applied simultaneously, and/or if the reported pair of CRIs or SSBRIs can be received simultaneously. 
  + FFS: Introduce an indicator to support the above, and the number of bits and interpretation of each codepoint of the indicator

**Conclusion**

* RAN1 has no consensus to support the following in Rel-18:
* Configure different number of SRS resources in the two SRS resource sets for CB (if fullpowermode 2 is not configured)or NCB for single-DCI based STxMP transmission.
* For CB PUSCH, the two SRS resources indicated by two SRI fields for single-DCI based STxMP transmission can have different number of SRS ports.
* For the two SRS resource sets configured for multi-DCI based STxMP PUSCH+PUSCH in Rel-18,
* Legacy Rel-17 specification is reused with respect to the maximal number of SRS resources/ports in each set

FFS: whether/how to support two different configurations with regards to full power mode and antenna port coherencytypeamong SRS resource sets.

**Agreement**

For case that one PUCCH overlaps with two overlapped PUSCHs in multi-DCI based STxMP PUSCH+PUSCH, down-select one for the UCI multiplexing:

* Option 1: the UCI is multiplexed into the PUSCH associated with the same TRP. And among the PUSCHs associated with the same TRP, the legacy PUSCH priority order for UCI multiplexing is applied. FFS: determining the PUSCH associated with the same TRP.
* Option 2: the legacy PUSCH priority order for UCI multiplexing is first applied and if at last, there are two PUSCHs with the same start time in one same CC, the UCI is multiplexed in (FFS: one or two) of these two PUSCHs, and FFS which one PUSCH.
* Option 3:
  + When joint HARQ-ACK feedback is configured, the legacy PUSCH priority order for UCI multiplexing is first applied and if at last, there are two PUSCHs with the same start time in one same CC, the UCI is multiplexed in (FFS: one or two) of these two PUSCHs, and FFS which one PUSCH.
  + When separate HARQ-ACK feedback is configured, at least when the UCI includes HARQ-ACK, the UCI is multiplexed into the PUSCH associated with the same TRP. And among the PUSCHs associated with the same TRP, the legacy PUSCH priority order for UCI multiplexing is applied. FFS: determining the PUSCH associated with the same TRP.
    - FFS: When the UCI does not include HARQ-ACK (CSI and/or SR), whether to follow the same behavior as above, or to follow the behavior of the case that joint HARQ-ACK feedback is configured.
  + Note: Here using joint HARQ-ACK feedback and separate HARQ-ACK feedback is mainly for discussion purpose. FFS: whether to introduce a new RRC parameter to indicate that.
* FFS the impact of the following legacy restriction on the above options:  when separate HARQ feedback is configured, a PUCCH transmission triggered by DCI associated with one *coresetPoolIndex* cannot overlap in time with a PUSCH transmission triggered by DCI associated with another *coresetPoolIndex*.
* Note: each of the above options is applied to the system when the system is configured with multi-DCI based STxMP PUSCH+PUSCH.

**Conclusion**

For fully coherent uplink precoding by an 8TX UE, based on NR Rel-15 single panel DL Type I codebook (CodebookMode=1), there is no consensus to support any optional over-sampling ratio.

**Working Assumption**

For partially coherent uplink precoding by an 8TX UE, Ng=2,

* At least the following combinations of layer splitting are supported
  + FFS: For rank>4, all the layers for each CW is mapped to only one antenna group

|  |  |  |
| --- | --- | --- |
| **Rank** | **All layers in one Antenna Group** | **Layers split across 2 Antenna Groups** |
| 2 | (2,0), (0,2) |  |
| 2 |  | (1,1) |
| 3 | (3,0), (0,3) |  |
| 3 |  | (1,2), (2,1) |
| 4 | (4,0), (0,4) |  |
| 4 |  | (2,2) |
| 5 |  | (2,3), (3,2) |
| 6 |  | (3,3) |
| 7 |  | (3,4), (4,3) |

**Agreement**

To configure PUSCH transmission by an 8TX UE,

* Alt2: Max number of MIMO layers is RRC configured by extending the range of the legacy parameter *maxRank* and *maxMIMO-Layers* to 8

**Agreement**

To support dual CW PUSCH operation by an 8TX UE, if CBG-based transmission is configured, the DL principle for CBGTI DCI field is reused where,

* The first half of CBGTI field bits is used to indicate the transmission state of CBGs of the first transport block, while the second half of CBGTI field bits is used to indicate the transmission state of CBGs of the second transport block.
* The bit field may be configured to have a length of N bits that can support operation of N/2 CBGs , where N=[2, 4, 6 or 8].

**Agreement**

Framework for full power PUSCH transmission by an 8TX UE

* To support full power transmission with Mode0, Rel-16 Mode0 (fullPower ) is re-used.
  + FFS if any change is required in the specifications.
* **Working Assumption** To support full power transmission with Mode1, Rel-16 Mode1 (fullPowerMode1) is re-used.
  + FFS if more than one of the 8TX full coherent precoders is used ~~per rank~~.
* **Working Assumption** To support full power transmission with Mode2, Rel-16 Mode2 (fullPowerMode2) is re-used.
  + FFS definition of precoder groups (G0, G1, …)
  + FFS enhancements for SRS configuration

**Agreement**

For 8TX UE supporting dual CW PUSCH (Maximum number of layers configured for the UE is larger than 4)

* Alt1 – DL principle is reused for disabling transmission of a transport block, where
* The combination of IMCS = 26 and rvid = 1 indicated for a CW is used as an indication to disable (when transmission rank<=4) transmission of its corresponding TB
* The enabled transport block is mapped to the first CW.
* Note: When the transmission of a transport block is disabled, the number of layers is ≤ 4.
* Note: the first CW refers to the enabled CW.

**Agreement**

For partially coherent uplink precoding by an 8TX UE codebook, Ng=4, Alt1 is supported where

* Precoding design is based on Rel-15 UL 2TX codebook,
  + Full-coherent precoders are used
* Further study codebook size reduction

**Agreement**

For partially coherent uplink precoding by an 8TX UE codebook, Ng=4,

* The following rank and layer splitting cases are supported,

|  |  |  |
| --- | --- | --- |
| *Rank* | *All layers in one Antenna Group* | *Layers split across 4 Antenna Groups* |
| *1* | *(1,0,0,0), (0,1,0,0), (0,0,1,0), (0,0,0,1)* |  |
| *2* | *(2,0,0,0), (0,2,0,0), (0,0,2,0), (0,0,0,2)* |  |
| *2* |  | *Transmission by 2 of the 4 antenna groups:*  *(1,1,0,0), (1,0,1,0), (1,0,0,1)*  *(0,1,1,0), (0,1,0,1), (0,0,1,1)* |
| *4* |  | *(1,1,1,1)* |
| *4* |  | *Transmission by 2 of the 4 antenna groups:*  *(2,2,0,0), (2,0,2,0), (2,0,0,2)*  *(0,2,2,0), (0,2,0,2), (0,0,2,2)* |
| *8* |  | *(2, 2, 2, 2)* |

Note: Above is not relevant to how precoders are indicated.

**Agreement**

For non-coherent uplink precoding with rank≤8 by an 8TX UE, down-select from

* Alt1. – All 255 combinations from 8 non-coherent rank1 precoders are supported
* Alt2. – Only a subset of Alt1. is supported, striving for a substantial reduction in the number of precoders

**Agreement**

For partially coherent uplink precoding by an 8TX UE codebook, Ng=4,

* In addition to the previously agreed cases, down-select from the rank and layer splitting cases listed below

|  |  |  |
| --- | --- | --- |
| *Rank* | *All layers in one Antenna Group* | *Layers split across 4 Antenna Groups*  *(All possible permutations)* |
| *3* |  | *Transmission by 2 of the 4 antenna groups:*  *(2,1,0,0), (2,0,1,0), (2,0,0,1), (0,2,1,0), (0,2,0,1), (0,0,2,1),*  *(1,2,0,0), (1,0,2,0), (1,0,0,2), (0,1,2,0), (0,1,0,2), (0,0,1,2)*    *Transmission by 3 of the 4 antenna groups:*  *(1,1,1,0), (1,1,0,1), (1,0,1,1), (0,1,1,1)* |
| *4* |  | *Transmission by 3 of the 4 antenna groups:*  *(2,1,1,0), (0,2,1,1), (1,0,2,1), (1,1,0,2)*  *(1,2,1,0), (1,1,2,0), (0,1,2,1), (0,1,1,2), (1,0,1,2), (2,0,1,1), (2,1,0,1), (1,2,0,1)* |
| *5* |  | *Transmission by 3 of the antenna groups:*  *(2,2,1,0), (2,2,0,1), (2,0,2,1), (0,2,2,1),*  *(2,1,2,0), (1,2,2,0), (2,1,0,2), (1,2,0,2), (2,0,1,2), (1,0,2,2), (0,2,1,2), (0,1,2,2)*    *Transmission by 4 of the 4 antenna groups:*  *(1,1,2,1), (1,1,1,2), (2,1,1,1), (1,2,1,1)* |
| *6* |  | *Transmission by 3 of the 4 antenna groups:*  *(2,2,2,0), (2,2,0,2), (2,0,2,2), (0,2,2,2)*    *Transmission by 4 of the 4 antenna groups:*  *(2,1,2,1), (1,2,1,2), (1,2,2,1), (2,1,1,2), (2,2,1,1), (1,1,2,2* |
| *7* |  | *Transmission by 4 of the 4 antenna groups:*  *(2,1,2,2), {(2,2,2,1), (1,2,2,2), (2,2,1,2)* |

**Agreement**

For NCB-based 8TX PUSCH transmission with , where is the number of configured single-port SRS resources in a resource set,

* Support Option 2 where a legacy-based solution is used by extending the existing SRI indication tables to include NSRS=8 and lmax=8

**Agreement**

To support UCI multiplexing on PUSCH for transmission with rank>4 by an 8TX UE, UCI is always multiplexed only on one of the scheduled CWs

* Alt2: The CW with the higher MCS index (if MCS indices are the same, UCI is multiplex on the first CW)
  + Note: in case of PUSCH retransmission, the initial MCS is used for CW selection.

**Agreement**

For partially coherent 8TX precoding with Ng =2, the precoder is based on up to two full-coherent 4TX precoders. Down-select one of the following options for precoder indication,

* Option 3 – Up to two 4TX TPMIs are indicated,
  + When two TMPIs are indicated, the first is applied on one of antenna group, and the second is applied on the other antenna group,
  + FFS : details of TPMI indication when one antenna group is used
* Option 4 – A single 8TX TPMI is indicated
* Other options are not precluded

**Agreement**

For codebook -based 8TX PUSCH transmission, down-select from,

* Alt1
  + A fully-coherent UE (Ng =1) can be configured with precoders considered for at least one or more Ng cases, i.e., Ng =1, 2, 4, 8
    - FFS which combinations of Ng value(s), to be considered
  + A partially-coherent UE , with Ng =2 can be configured with precoders considered for at least one or more Ng cases, i.e., Ng =2, 4, 8
    - FFS which combinations of Ng value(s), to be considered
  + A partially-coherent UE , with Ng =4, can be configured with precoders considered for at least one or more  Ng cases, i.e., Ng= 4, 8
    - FFS which combinations of Ng value(s), if any, to be considered
  + A non-coherent UE , Ng =8, can only be configured with precoders considered for Ng = 8
* Alt2
  + A fully-coherent UE (Ng =1) can only be configured with precoders considered for one of Ng cases, i.e., Ng =1, 2, 4, 8
    - FFS which Ng value(s), to be considered
  + A partially-coherent UE , with Ng =2, can only be configured with precoders considered for one of Ng cases, i.e., Ng =2, 4, 8
    - FFS which Ng value(s), to be considered
  + A partially-coherent UE , with Ng =4, can only be configured with precoders considered for one of Ng cases, i.e., Ng =4, 8
    - FFS which Ng value(s), to be considered
  + A non-coherent UE , with Ng =8, can only be configured with precoders considered for Ng = 8
  + FFS whether/how the configuration can be done via RRC or MAC-CE.
* Alt3
  + A fully-coherent UE (Ng =1) can only be configured with precoders considered for Ng =1
  + A partially-coherent UE , with Ng =2, can only use precoders considered for Ng =2
  + A partially-coherent UE , with Ng =4, can only use precoders considered for Ng =4
  + A non-coherent UE , with Ng =8, can only use precoders considered for Ng = 8
* Other alternatives are not precluded

Note: For an 8TX UE, Ng =8 can represent a non-coherent UE.

**In RAN1#113, the following agreements were made.**

Multi-TRP enhancement

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], the UE shall apply both indicated joint/DL TCI states to the scheduled/activated PDSCH reception

* If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception
* If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold

**Agreement**

On unified TCI framework extension for S-DCI based MTRP:

* If a CORESET other than a CORESET with index 0 is associated only with USS sets and/or Type3-PDCCH CSS sets, the CORESET is configured by RRC to apply the first one, the second one, or both of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* If a CORESET other than a CORESET with index 0 is associated at least with CSS sets other than Type3-PDCCH CSS sets, the CORESET is configured by RRC to apply the first one, the second one, both, or none of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* For a CORESET with index 0:
  + If the CORESET is associated with SS#0 for Type 0/0A/2 CSS sets, the CORESET is configured by RRC to apply the first one, the second one, or none of the indicated joint/DL TCI state to PDCCH reception on the CORESET
  + Otherwise, the CORESET is configured by RRC to apply the first one, the second one, both, or none of the indicated joint/DL TCI states to PDCCH reception on the CORESET

Note: RAN1 already agrees to use RRC configuration to inform that the UE shall apply the first one, the second one, both, or none of the indicated joint/DL TCI states to a CORESET in S-DCI based MTRP.

Note: There is no consensus in RAN1 on whether to reuse the Rel-17 RRC parameter *followUnifiedTCIstate* as a part of above RRC configuration, and whether to reuse *followUnifiedTCIstate* is up to RAN2 design

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, when a 2-bit [TCI selection field] is configured by RRC to be present in a DCI format 1\_1/1\_2 in a DL BWP:

* If the DCI format 1\_1/1\_2 indicates codepoint "10" for the [TCI selection field], the UE shall apply both indicated joint/DL TCI states to PDSCH reception scheduled/activated by the DCI format 1\_1/1\_2 based on the Rel-16 rules for mapping legacy TCI states to PDSCH transmission occasions, CDM groups, or non-overlapping frequency domain resource allocations by replacing the first and the second indicated legacy TCI states with the first and the second indicated joint/DL TCI states, respectively
* The codepoint "11" of the [TCI selection field] is reserved

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, when two indicated joint/UL TCI states are applied to a PUSCH transmission

* For SDM and SFN based PUSCH Tx schemes, the UE shall apply the first indicated joint/UL TCI state to the PUSCH antenna port(s) associated with the first SRS resource set, and the second indicated joint/UL TCI state to the PUSCH antenna port(s) associated with the second SRS resource set, respectively.
* Note: The association between PUSCH antenna port(s) and an SRS resource set is discussed and defined in STxMP AI

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, when two indicated joint/UL TCI states are applied to a PUCCH resource/resource group:

* For TDM based PUCCH Tx scheme, the UE shall apply two indicated joint/UL TCI states to repetitions of the PUCCH transmission corresponding to the PUCCH resource/resource group based on the Rel-17 rules for mapping spatial settings to the repetitions by replacing the first and second spatial settings with the first and second indicated joint/UL TCI states, respectively.
* For SFN based PUCCH Tx scheme, the UE shall apply two indicated joint/UL TCI states to the PUCCH transmission corresponding to the PUCCH resource/resource group

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, the following two alternatives are supported for PDSCH-CJT applying both indicated joint TCI states (if the UE supports two indicated joint/DL states for PDSCH-CJT):

* Alt1: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA
* Alt2: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA except for QCL parameters {Doppler shift, Doppler spread} of the second indicated joint TCI state

Introduce a UE capability on which alternative(s) is supported, and either one of above alternatives can be configured by RRC according to the UE capability

Note: In Rel-18, RAN1 has no consensus to support Alt3

* Alt3: PDSCH DMRS port(s) is QCLed with the DL RS of the first indicated joint TCI state with respect to QCL-TypeA and QCLed with the DL RS of the second indicated joint TCI state with respect to QCL-TypeB

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, support the following:

* Using RRC configuration to indicate whether the first, second, or both of the indicated joint/DL TCI states is/are applied to PDSCH reception scheduled/activated by DCI format 1\_0
  + If not configured, the first indicated joint/DL TCI state is applied
  + Only when the UE is configured with PDSCH-CJT and the UE supports two joint TCI states for PDSCH-CJT or the UE is configured with PDSCH-SFN, the RRC configuration can indicate both indicated joint/DL TCI states are applied.
    - For PDSCH-CJT and PDSCH-SFN, if the RRC configuration indicates both indicated joint/DL TCI states are applied, the UE shall apply both indicated joint/DL TCI states to PDSCH reception scheduled/activated by DCI format 1\_0 on a search space other than Type0/0A/2 CSS on CORESET#0 (FFS: Other search space and/or CORESETs)

If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the offset between the reception of the scheduling DCI format 1\_0 and the scheduled/activated PDSCH reception

If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the offset between the reception of the scheduling DCI format 1\_0 and the scheduled/activated PDSCH reception is equal to or larger than a threshold

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, after NW response to TRP-specific BFR request to a BFD-RS set:

* If the BFD-RS set is the first BFD-RS set (), QCL assumption/spatial Tx filter/PL-RS corresponding to the first indicated joint/DL/UL TCI state for channel(s)/signal(s) applying the first indicated joint/DL/UL TCI state are updated according to the new beam (qnew) corresponding to the BFD-RS set.
* If the BFD-RS set is the second BFD-RS set (), QCL assumption/spatial Tx filter/PL-RS corresponding to the second indicated joint/DL/UL TCI state for channel(s)/signal(s) applying the second indicated joint/DL/UL TCI state are updated according to the new beam (qnew) corresponding to the BFD-RS set.

**Agreement**

On unified TCI framework extension for both S-DCI and M-DCI based MTRP operations, if a P/SP/AP SRS resource set for CB/NCB/AS or an AP SRS resource set for BM is configured to follow unified TCI state, an RRC configuration can be provided to the SRS resource set to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the SRS resource set

* For M-DCI based MTRP operation, the first and the second indicated joint/UL TCI states correspond to the indicated joint/UL TCI states specific to *coresetPoolIndex* value 0 and value 1, respectively.
* When two SRS resource sets for CB/NCB are configured, the UE does not expect the following
  + to be configured with the first indicated UL/joint TCI state which is to be applied to the second SRS resource set
  + to be configured with the second indicated UL/joint TCI state which is to be applied to the first SRS resource set
* For M-DCI based MTRP operation, if the RRC configuration is not provided to the SRS resource set and the SRS resource set is an AP SRS resource set triggered by PDCCH on a CORESET associated with a *coresetPoolIndex* value, the UE shall apply the indicated joint/UL TCI state specific to the *coresetPoolIndex* value to the SRS resource set

How to capture the above is up to the editor

**Agreement**

On unified TCI framework extension for M-DCI based MTRP, An RRC configuration can be provided to an aperiodic CSI-RS resource set or a CSI-RS resource in an aperiodic CSI-RS resource set to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set or to the CSI-RS resource in the aperiodic CSI-RS resource set, if the aperiodic CSI-RS resource set for CSI/BM is configured to follow unified TCI state

* The first and the second indicated joint/DL TCI states correspond to the indicated joint/~~U~~DL TCI states specific to *coresetPoolIndex* value 0 and value 1, respectively.
* Above applies at least if the offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in the aperiodic CSI-RS resource set is equal to or larger than a threshold (if the threshold is needed)
* Support of ‘per CSI-RS resource set’ or ‘per CSI-RS resource’ RRC configuration is up to UE capability

**Agreement**

On unified TCI framework extension for S-DCI based MTRP, if the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2:

* When the offset between the reception of the scheduling/activation DCI format 1\_0/1\_1/1\_2 and the scheduled/activated PDSCH reception is less than a threshold in FR2, the UE shall apply the first indicated joint/DL TCI state to the scheduled/activated PDSCH reception

**Conclusion**

There is no RAN1 consensus to support the following:

|  |
| --- |
| On unified TCI framework extension, the following cases for CA operation are supported:   * A set of BWP/CCs configured for common TCI state ID activation/update can include BWP/CC(s) operating in STRP and BWP/CC(s) operating in S-DCI based MTRP   + ~~FFS: How to support common TCI state ID activation/update for this case~~   + For the BWP/CCs in above set of BWP/CCs, TCI state ID activation/update MAC-CE can only be sent to a S-DCI based MTRP BWP/CC * A set of BWP/CCs configured for common TCI state ID activation/update can include BWP/CC(s) operating in STRP and BWP/CC(s) operating in M-DCI based MTRP   + ~~FFS: How to support common TCI state ID activation/update for this case~~ * For the BWP/CCs in above set of BWP/CCs, TCI state ID activation/update MAC-CE can only be sent to a M-DCI based MTRP BWP/CC * ~~a CC in the set of CCs operating in S-DCI/M-DCI based MTRP can be configured as the reference CC.~~ * For each CC in the above set of CCs, an RRC parameter is configured to the CC to indicate that the first, the second or both joint/DL/UL TCI states are applied to the CC.   Note: “A CC operates in STRP” for above means a CC in which only one joint/UL/DL TCI state is applied  Note: “A CC operates in S/M-DCI based MTRP” for above means a BWP/CC operates in Rel-18 unified TCI framework extension for S/M-DCI based MTRP operation |

**Agreement**

On unified TCI framework extension for S-DCI based PUSCH/PUCCH STxMP:

* The UE shall determine a first Tx power for PUSCH/PUCCH transmission occasion i based on the UL PC parameter settings for PUSCH/PUCCH, if any, and the PL-RS included in the first indicated joint/UL TCI state, and a second Tx power for the same PUSCH/PUCCH transmission occasion i based on the UL PC parameter settings for PUSCH/PUCCH, if any, and the PL-RS included in the second indicated joint/UL TCI state

**Agreement**

For associating TAGs to target UL channels/signals for multi-DCI based multi-TRP operation, the baseline feature is revised as follows:

* UE expects that the ~~[activated]~~ UL/joint TCI states ~~[~~of UL signals/channels~~]~~ associated to one CORESET Pool Index correspond to one TAG
* Association of TAG ID with UL/joint TCI state is via RRC configuration
  + Above does not impact the association of the indicated TCI states and coresetPoolIndex values as agreed in previous meetings in 9.1.1.1.

**Conclusion**

*There is no consensus on how to support multi-DCI based Multi-TRP operation with two TA enhancement when Rel-15/16 spatial relation framework is used.*

*Note: the previous agreement on supporting multi-DCI based Multi-TRP operation with two TA enhancement for Rel-15/16 spatial relation framework is reverted.*

**Agreement**

For intra-cell multi-DCI based Multi-TRP operation with two TA enhancement, down-select one of the following alternatives:

* Alt 1:  indicate TAG ID as part of TA command in RAR
* Alt 3:  divide SSBs into two groups, one for each TRP.    If a SSB associated to a RACH procedure belongs to the nth group (n=1,2), then the TA obtained via the RACH procedure corresponds to the nth TRP.

**Agreement**

* Proposed answer to Question Q1a in RAN2 LS R1-2304326:
  + *Apart from the agreements RAN1 has sent in LS R1-2302226 to RAN2 before, RAN1 has not agreed to any further restrictions on the association of serving cells and/or TRPs to the TAGs at this point. If RAN1 agrees to such restrictions, RAN1 will inform RAN2.*
* Proposed answer to Question Q1b in RAN2 LS R1-2304326:
  + *RAN1 has not reached consensus to increase the current number of TAGs per cell group.*
* Proposed answer to Question Q2 in RAN2 LS (R1-2304326):
  + *RAN1 confirms that when the TA timer associated to one TRP expires for a TAG associated with a TCI state, UL or DL operation associated to the another TRP is not impacted. This further depends on PTAG/STAG definition, which is up to RAN2 to decide.*
  + *Which UL or DL operation is impacted have not been discussed in RAN1.*

Final LS is in R1-2306249.

**Agreement**

For multi-DCI based Multi-TRP operation with two TA enhancement, for the case when the UE does not support UL STxMP transmission,

* for the baseline feature, the UE does not expect the two UL transmissions to overlap (i.e., scheduling restriction is applied to avoid overlap between the two UL transmissions)
* as an optional feature, the overlapping duration of the later of the two UL transmissions is reduced.
  + FFS: for the optional feature, whether or not the overlapping duration needs to be specified as 1 (in case 2) or 2 (in case 1) OFDM symbols where
    - Case 1 applies when UE is capable of supporting MRTD > CP, SCS=60 kHz and frequency range is FR1.
    - Case 2 applies in all other cases

CSI enhancement

**Agreement**

On the Parameter Combination of Type-II codebook refinement for CJT mTRP, for Rel-17 FeType-II based, the only following linkages (marked ‘x’) are supported:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **NTRP** | **combination** | **M=1** | | | **M=2** | |
| **=1/2** | **=3/4** | **=1** | **=1/2** | **=3/4** |
| 2 | {1/2,1/2} | x |  |  | x |  |
| {1/2,1}, {1,1/2} | x |  |  |  |  |
| {3/4,3/4} |  | x |  |  |  |
| {1,1} |  | x |  | x |  |
| 3 | {1/2, 1/2, 1/2} | x |  |  | x |  |
| {1/2, 1/2, 3/4}, and its permutations | x |  |  |  |  |
| {1/2, 1/2, 1}, and its permutations |  | x |  | x |  |
| {1, 1, 1} |  | x |  |  | x |
| 4 | {1/2, 1/2, 1/2, 1/2} | x |  |  |  |  |
| {1/2, 1/2, 1/2, 1} | x |  |  |  |  |
| {1/2, 1/2, 1, 1} |  | x | x | x |  |
| {1, 1, 1, 1} |  |  | x |  |  |

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, on PDSCH EPRE assumption for CQI calculation, the UE can assume that the PDSCH EPRE follows a commonly configured *powerControlOffset* value for all the *N* selected CSI-RS resources

* Note: For CSI calculation, the combined precoder across *N* selected (out of the configured *NTRP*) CSI-RS resources is normalized for each layer and the transmitted PDSCH across *N* selected (out of the configured *NTRP*) CSI-RS resources will be used in CSI calculation (up to the editor)
* Note: This doesn’t restrict how NW configures *powerControlOffset* for each CSI-RS resource in general. It pertains to UE assumption on CQI calculation for the CSI-RS resources used in the same CSI reporting setting for Rel-18 Type-II CJT

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding the CPU occupation: OCPU = X.NTRP where

* X≥1 when NTRP>1, is defined based on UE capabilities and determined by the UE
* FFS: Whether the supported value(s) of X are common or can depend on the value of NTRP, NL, total sum of {Ln}, and/or other CJT features (e.g. dynamic TRP selection)
* The legacy specification on CPU pools is fully reused
* Note: When NTRP=1 is configured, legacy OCPU applies, i.e. OCPU =1

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding Z/Z’:

* For NTRP=1: reuse legacy Z/Z’ values
* For NTRP>1, introduce two UE capabilities:
  + Capability 1: Reuse legacy Z/Z’ values
  + Capability 2: Legacy Z/Z’ values + r
    - The value(s) of r>0 can depend on the configured NTRP value
    - FFS: exact value(s) of r

Note: Since this pertains Type-II, the relevant values are Z2/Z2’

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding the counting of active resources, reuse legacy definition and resource counting mechanism for active resources

**Agreement**

On the Type-II codebook refinement for CJT mTRP, *for mode-1*, the selected value of each of the (*N* – 1) layer-common FD basis selection offset , assuming its full range of values, is indicated as follows:

* Basic feature: a -bit indicator
* Optional feature: a -bit indicator

**Agreement**

On the Type-II codebook refinement for CJT mTRP, *for mode-1*, the (*N* – 1) layer-common FD basis selection offset values are located in G1 of UCI part 2

**Agreement**

On the Type-II codebook refinement for CJT mTRP, *revert* the following working assumption:

* Working assumption: Alt3 is supported in addition to Alt1 (to be confirmed in RAN1#111)
  + (Alt3). One group comprises one polarization for one CSI-RS resource with a common phase reference across N CSI-RS resources (Cgroup,phase=1, Cgroup,amp=2N)
    - For each of the (2N–1) amplitude groups (other than the group associated with the SCI), the reference amplitude is reported

**Agreement**

For the Type-II codebook refinement for high/medium velocities based on Rel-17 FeType-II port selection codebook, the legacy Parameter Combinations are fully reused.

**Conclusion**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding CSI calculation and measurement, there is no consensus in supporting the following additional assumption on PDSCH EPRE assumption for CQI calculation:

* Alt 2: The assumed PDSCH EPRE of all the *K* CSI-RS resources follows the configured *powerControlOffset* value of one fixed CSI-RS resource, e.g. the first one

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding the CPU occupation: OCPU = Y.N4 [+4] when P/SP-CSI-RS is configured for CMR, or OCPU = Y.Kwhen AP-CSI-RS is configured for CMR

* Y≥1 is defined based on UE capabilities and determined by the UE, and can be different between P/SP-CSI-RS and AP-CSI-RS.
* FFS: Whether the supported value(s) of Y can depend on codebook parameter values
* The legacy specification on CPU pools is fully reused

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z/Z’

* For N4=1: reuse legacy Z’ values
* For N4>1, introduce two UE capabilities:
  + Capability 1: Reuse legacy Z’ values
  + Capability 2: Legacy Z’ values + r
    - The value(s) of r>0 can depend on the configured N4 value
    - FFS: exact value(s) of r

Note: Since this pertains Type-II, the relevant values are Z2/Z2’

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities,

* for AP CSI -RS, reuse legacy definition and counting mechanism for active resources
* for P/SP CSI-RS, one resource is counted as occupying *KP* ≥1 active resource(s)
  + TBD: the value of *KP* , e.g. N4, fixed value, or according to UE capability

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value, further down-select (by RAN1#113) from the following candidates:

* Alt1: N=2Q-1 where Q=5, s=1/3
* Alt3: N=2Q where Q=4, s=½

FFS: Whether further overhead reduction is needed for Y>1

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value, there is no consensus on supporting a configurable center threshold

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value, there is no consensus on supporting different schemes for different use cases. Therefore, only one scheme is supported

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of phase value, further down-select only one (by RAN1#113) from the following candidates (where denotes delay):

* Alt3. A given correlation phase value is quantized to based on the 4-bit (16-PSK) uniform quantization (full reuse of Rel-16 eType-II W2 phase quantization)
* Alt5. A given correlation phase value is quantized to based on the following size-16 alphabet:

FFS: Whether further overhead reduction is needed for Y>1

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, regarding the value of parameter Y, there is no consensus in supporting Y=7

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the value of parameter D, the value of D is explicitly configured by the NW via RRC signalling

* Note: this implies that dynamic change of delay for aperiodic TRS resource set is not supported

**Agreement**

For the Rel-18 TRS-based TDCP reporting, the normalized amplitude for the 1st delay is placed in UCI part 1.

* Note: This doesn’t imply that two-part UCI is utilized for TDCP reporting (which is aperiodic)

**Agreement**

For the Rel-18 TRS-based TDCP reporting,

* When Y>1 is supported and the value of Y is configured to be >1, the (Y–1) normalized amplitudes for the 2nd, …, and Yth delays are placed in UCI part 1 in the same location as the normalized amplitude for the first delay
* When phase reporting is supported and switched ON, the Y phases are placed in UCI part 1

**Agreement**

For the Rel-18 Type-II codebook refinement for CJT mTRP, regarding CSI calculation, the UE assumption on the transmitted PDSCH symbols across antenna ports extends the legacy CSI-RS port ordering as follows: (CSI-RS resource index 0, port index 0), (CSI-RS resource index 0, port index 1), …, (CSI-RS resource index 0, port index P-1), …, (CSI-RS resource index N-1, port index 0), (CSI-RS resource index N-1, port index 1), …, (CSI-RS resource index N-1, port index P-1)

**Agreement**

Previous agreement is revised as follows

*For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding the CPU occupation: OCPU = Y.N4 ~~[+4]~~ when P/SP-CSI-RS is configured for CMR, or OCPU = Y.K when AP-CSI-RS is configured for CMR*

* *Y≥1 is defined based on UE capabilities and determined by the UE, and can be different between P/SP-CSI-RS and AP-CSI-RS.*
* *FFS: Whether the supported value(s) of Y can depend on codebook parameter values*
* *The legacy specification on CPU pools is fully reused*
* *When N4=1, OCPU =4*
* *OCPU ≥ 4 when P/SP-CSI-RS is configured for CMR*

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities, the value of *KP* for P/SP-CSI-RS active resource counting is determined based on UE capability, where the candidate values are {1, 2, 4}.

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the *alphabet* for the quantization of wideband normalized amplitude value, support only (Alt3) N=2Q where Q=4, s=½

* Note: This does not preclude an “invalid” autocorrelation value report

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the *alphabet* for the quantization of phase value, (Alt3) a given correlation phase value is quantized to based on the 4-bit (16-PSK) uniform quantization (full reuse of Rel-16 eType-II W2 phase quantization)

**Agreement**

For the Rel-18 TRS-based TDCP reporting, regarding the value of parameter D,

* Dbasic = 1 slot
* Confirm the working assumption on the support for D=6
* Confirm the working assumption on the support for D=10 (only for >=30kHz SCS)

**Agreement**

For the Rel-18 TRS-based TDCP reporting, for a configured value of Y and a set of configured delay values {D1, …, DY}, for the n-th delay Dn (n=1, …, Y), the respective TDCP calculation is defined as wideband normalized correlation between two TRS symbols separated by Dn symbols

* Send a LS to RAN4 to solicit their inputs on whether additional description/definition is needed, e.g. averaging across RX ports. Final LS in R1-2306137.

**Conclusion**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding CSI calculation and measurement, there is no consensus on the following: a same *powerControlOffsetSS* value is also assumed for all the *K* configured CSI-RS resources comprising the CMR

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation with KTRS configured resource sets, there is no consensus on the following: the UE can assume commonly configured *powerControlOffsetSS* value for all the KTRS configured resource sets

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation, there is no consensus on supporting the following: joint use of P and AP-TRS resource sets for TDCP measurement and calculation is supported at least for Y=1 as a UE-optional feature

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, for TDCP measurement and calculation, there is no consensus on the following: the UE shall assume the same antenna port for the CSI-RS resources in all the resource sets

**Conclusion**

No consensus to support the following in Rel-18:

*On the Type-II codebook refinement for CJT mTRP, for mode-1 and for only Rel-17 FeType-II based, the following additional restriction on the values (range of values) of is RRC-configurable:*

* *Basic feature: for ,*
* *Optional feature: for ,*

*where and is determined/reported by UE with an indicator of bits.*

*Note: if the restriction above is not configured, the range of has the full range, i.e., for basic feature and for optional feature.*

**Agreement**

For the Rel-18 Type-II codebook refinement for high/medium velocities, regarding Z

* Based on the two UE capabilities agreed for Z’:
  + Capability 1:
    - For AP CSI-RS: Z=legacy Z+14.(K–1).m
    - For P/SP CSI-RS: Z= legacy Z+w where w>0
      * TBD: Value of w
  + Capability 2:
    - For AP CSI-RS: Z= legacy Z+14.(K–1).m + r
    - For P/SP CSI-RS: Z= legacy Z+w+r
    - Note: r corresponds to the agreed value for Z’ relaxation in previous agreement.

Note: Since this pertains Type-II, the relevant values are Z2/Z2’

**Agreement**

For the Rel-18 TRS-based TDCP reporting, when Y delay(s) are configured

* OCPU=(Y+1).X where X≥1 is defined based on UE capabilities and determined by the UE
  + FFS: Whether the supported value(s) of X can depend on the value of D, and whether phase reporting is switched ON
* Reuse legacy Z2/Z2’ values
* To count active resources used for TDCP reporting, reuse the legacy number counting mechanism for CSI-RS resources
  + UE reports the maximum number of active resources for TDCP in UE capability reporting.

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of wideband normalized amplitude value, there is no consensus on the need for further overhead reduction for Y>1

**Conclusion**

For the Rel-18 TRS-based TDCP reporting, regarding the quantization of phase value, there is no consensus on the need for further overhead reduction for Y>1

**Conclusion**

On the Type-II codebook refinement for CJT mTRP, there is no consensus in introducing other RRC-configured TRP selection restriction including configuring the value of N

Reference signal enhancement

**Conclusion**

For the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 1 for PDSCH, at least for S-TRP case, there is no consensus to support the following rows:

* Row 23 for 1CW.
* Row 4-7 for 2CW.
* Row 8-9 for 2CW.

**Agreement**

For the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 2 for PDSCH, at least for S-TRP case, support/remove the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data in RAN1#112bis-e agreement.

* For 1CW,
  + 1) Support row 8-11 for 1 CW.
    - For row 9-11 in one CW, introduce MU-MIMO restriction (i.e. UE does not expect to be multiplexed with other DMRS ports in the same CDM group).
  + 2) For row 24-30, 55-60, 69-80, down select from the following:
    - Alt.2-1: Support row 24-30 and row 55-60 without MU restriction. Remove row 69-80.
    - Alt.2-2: Support row 69-80 without MU restriction. Support row 24-30 with MU restriction. Remove row 55-60.
    - Alt.2-3: Support row 24-30 with MU restriction. Remove row 55-60 and 69-80.
    - Alt 2-4: Support row 69-80 without MU restriction. Remove row 24-30, 55-60.
    - Alt 2-5: Remove row 24-30, 55-60, 69-80 due to no consensus to support them.
    - Atl 2-6: Support rows 24-30 and rows 59-60 without MU restriction. Remove rows 69-80 and rows 55-58.
  + 3) For row 81-82:
    - Alt.3-1:
      * If RAN1 agree row 26-27 without MU restriction,
        + Support row 81-82 without MU restriction.
      * Else,
        + Remove row 81-82.
    - Alt.3-2: Remove 81-82.
  + 4) [Remove row 83.]
* For 2CW,
  + 5 [Remove row 0-3.]
  + 6) ~~Support row 20-23 if row 4-7 are supported for eType1~~ *~~maxLength~~*~~=1.~~ ~~Else,~~ remove row 20-23.
  + 7) Down select from the following:
    - Alt.7-1: Support row 8-19 and remove row 24-35.
    - Alt.7-2: Support row 24-35 and remove row 8-19.
    - Alt.7-3: Remove row 8-19 and 24-35.
  + 8) ~~Support row 36-37 if row 8-9 are supported for eType1~~ *~~maxLength~~*~~=1. Else,~~ remove row 36-37.

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 1 for PDSCH, at least for S-TRP case, support/remove the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data in RAN1#112bis-e agreement.

* For 1CW,
  + 1) [Support row 9-10 and row 20-23.]
  + 2) For row 33-34, 44-46, down select from the following:
    - Alt.2-1: Support row 33-34 and row 44-46.
    - Alt.2-2: Remove row 33-34 and row 44-46.
  + 3) For row 60-62, down select from the following:
    - Alt.3-1: Support row 60-62.
    - Alt.3-2: Remove row 60-62.
* For 2CW,
  + 4) For row 2-3.
    - Alt.4-1: Support row 2-3.
    - Alt.4-2: Remove row 2-3.
  + 5) [Support row 8-11.]
  + 6) Remove row 12.
  + 7) ~~Support row 13-20 if row 8-9 are supported for eType1~~ *~~maxLength~~*~~=1. Else,~~ remove row 13-20.

**Agreement**

For time density of PTRS of rank 5-8 PUSCH, support Alt.1:

* Alt.1: Reuse the existing RRC parameter of *timeDensity* in *PTRS-UplinkConfig* for both CWs.
  + The time density for an PTRS port is determined by the MCS for the associated CW.

**Working Assumption**

For > 4 layers PUSCH with Rel.15 Type1/Type2 DMRS ports and Rel.18 eType 1/eType 2 DMRS ports, for partial coherent UL codebook, support Alt.2:

* Alt.2: DMRS ports combination(s) for full/non-coherent UL codebook is reused.
  + The same DMRS port tables are used for full/partial/non-coherent UL codebook.

**Conclusion**

For MU-MIMO within a CDM group between Rel.15 DMRS ports and Rel.18 DMRS ports,

* 4) For PDSCH, between Rel.18 UE1 indicated with Rel-18 New ports (eType1: ports 1008-1015, eType2: ports 1012-1023) and Rel.18 UE2 indicated with Rel.15 DMRS ports in a CDM group, there is no consensus to support the following.
  + Alt.2: Rel.18 UE2 configured with Rel.15 DMRS ports can be signaled, to indicate that there may be another Rel.18 UE1 with Rel.18 New ports (eType1: ports 1008-1015, eType2: ports 1012-1023) in the same CDM group, so that the Rel.18 UE2 can assume FD-OCC length 4 for channel estimation of Rel.15 DMRS ports.
    - Dedicated UE capability is introduced.
    - The signaling is at least by RRC (FFS: whether to support DCI based signaling).

**Conclusion**

For MU-MIMO within a CDM group between Rel.15 DMRS ports and Rel.18 DMRS ports,

* 2) For PDSCH, there is no additional restriction between Rel.18 UE1 indicated with Rel-18 Legacy ports (eType1: ports 1000-1007, eType2: ports 1000-1011) and Rel.15-18 UE2 indicated with Rel.15 DMRS ports in a CDM group from Rel.17 spec.
  + Note1: MU-MIMO restriction in Rel.15-17 is applied to Rel.15-17 UE and Rel-18 UE configured with Rel-15 DMRS port(s)
  + Note2: MU-MIMO restriction in Rel.18 is applied to Rel.18 UE configured with Rel-18 DMRS port(s)

**Agreement**

Rel.18 eType1/eType2 DMRS is not applied to Msg.A PUSCH.

**Conclusion**

For 8Tx PUSCH, no consensus to support more than 2 ports PTRS for CP-OFDM.

**Agreement**

For Rel.18 eType 1/eType 2 DMRS with *maxLength*= 1/2 for PUSCH, additionally support the following rows.

Table 7.3.1.1.2-10-X: Antenna port(s), transform precoder is disabled, dmrs-Type= eType1, *maxLength*=1, rank = 3

|  |  |  |
| --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| Y | 2 | 0,2,3 |

Table 7.3.1.1.2-14-X: Antenna port(s), transform precoder is disabled, *dmrs-Type*= eType1, *maxLength*=2, rank = 3

|  |  |  |  |
| --- | --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** |
| Y | 2 | 0,2,3 | 1 |

Table 7.3.1.1.2-14-X: Antenna port(s), transform precoder is disabled, *dmrs-Type*= eType2, *maxLength*=1, rank = 3

|  |  |  |
| --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** |
| Y | 2 | 0,2,3 |

Table 7.3.1.1.2-22-X: Antenna port(s), transform precoder is disabled, *dmrs-Type*= eType2, *maxLength*=2, rank = 3

|  |  |  |  |
| --- | --- | --- | --- |
| **Value** | **Number of DMRS CDM group(s) without data** | **DMRS port(s)** | **Number of front-load symbols** |
| Y | 2 | 0,2,3 | 1 |

**Agreement**

For the antenna ports indication in Rel.18 eType2 DMRS ports with *maxLength* = 2 for PDSCH, at least for S-TRP case, support/remove the following rows of DMRS port combinations and Number of DMRS CDM group(s) without data in RAN1#112bis-e agreement.

* For 1CW,
  + 1) [Support row 9-10, 20-23].
  + 2) For row 42-47, 100-105, 129-152, down select or modify from the following:
    - Alt.2-1: Support row 42-47 and row 100-105 without MU restriction. Remove row 129-152.
    - Alt.2-2: Support row 129-152 without MU restriction. Support row 42-47 with MU restriction. Remove row 100-105.
    - Alt.2-3: Support row 42-47 with MU restriction. Remove row 100-105 and 129-152.
    - Alt 2-4: Support row 129-152 without MU restriction. Remove row 42-47, 100-105.
    - Alt 2-5: remove row 42-47, 100-105, 129-152 due to no consensus to support them.
    - Alt 2-6: Support row 42-47 and 103-105 without MU restriction, remove 100-102 and 129-152
  + 3) For row 67-68, 78-80:
    - Alt.3-1:
      * If RAN1 agree row 9-10, 20-23 without MU restriction
        + Support row 67-68, 78-80 without MU restriction.
      * Else,
        + Remove row 67-68, 78-80.
    - Alt.3-2: Remove 67-68,78-80.
  + 4) For row 153-158, down select from the following.
    - Alt.4-1: Support row 153-158 without MU restriction.
    - Alt.4-2: Remove row 153-158.
* For 2CW,
  + 5) [Remove row 0-5.]
  + 6) [Support row 10-13.]
  + 7) Down select from the following:
    - Alt.7-1: Support row 14-37 and remove row 46-69.
    - Alt.7-2: Support row 46-69 and remove row 14-37.
    - Alt.7-3: Remove row 14-37 and row 46-69.
  + 8) remove row 38-45.

**Agreement**

For 8Tx PUSCH, when the *ptrs-Power* configures 00, the factor () for partial coherent TPMIs is down selected from the following:

* Alt.1: , where is the number of PUSCH layers which are precoded coherently with the PUSCH layer where PTRS port *x* is associated with, *Qp* is the number of PTRS ports scheduled to the UE, and *L* is the total number of PUSCH layers.
* Alt.2:, where is the number of PUSCH layers which are precoded coherently with the PUSCH layer where PTRS port *x* is associated with, and *Qp* is the number of PTRS ports scheduled to the UE.

**Agreement**

The following MU-MIMO within a CDM group between Rel.15 DMRS ports and Rel.18 DMRS ports is not supported:

* 3) For PDSCH, between Rel.18 UE1 indicated with Rel-18 New ports (eType1: ports 1008-1015, eType2: ports 1012-1023) and Rel.15-17 UE2 indicated with Rel.15 DMRS ports in a CDM group.
  + UE does not expect such MU-MIMO within a CDM group
* FFS: 4) For PDSCH, between Rel.18 UE1 indicated with Rel-18 New ports (eType1: ports 1008-1015, eType2: ports 1012-1023) and Rel.18 UE2 indicated with Rel.15 DMRS ports in a CDM group.
  + UE does not expect such MU-MIMO within a CDM group

**Working Assumption**

For the antenna ports indication in Rel.18 eType1 DMRS ports with *maxLength* = 2 for PDSCH, at least for S-TRP case, for case 2) in RAN1#113 agreement,

* For 1CW,
  + 2) For row 24-30, 55-60, 69-80, support at least row 73-80 without MU restriction. Support row 24-30 with MU restriction (UE does not expect to be coscheduled with another UE in the same CDM group). Remove row 55-60.
    - FFS: for row 69-72

**Agreement**

For SRS comb offset hopping / cyclic shift hopping reinitialization periodicity of N radio frame(s):

* N = 128

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and with TDM factor s > 1, the UE splits a linear value of SRS transmission power equally across the SRS ports configured on each OFDM symbol, if the UE is capable of transmitting at per OFDM symbol with 8/s ports, where is specified in the current specifications.

* Note: This may be captured in the specification in a few different but equivalent ways, and it is up to the editor to decide.

**Conclusion**

There is no consensus on the support of the following feature in RAN1:

*For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’ and resource mapping based on TDM, support TDM factor s = 4.*

**Agreement**

For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is assigned with comb 4 on 2 comb offsets (=4, ) or comb 8 on 4 comb offsets (=8, ), the cyclic shift positions are completely aligned across the comb offsets on the same OFDM symbol.

* For port , .

**Agreement**

Support configuring a subset of comb offsets when comb offset hopping is configured, and configuring a subset of cyclic shifts when cyclic shift hopping is configured.

* The subset configuration applies to all the port(s) in the SRS resource, and all the port(s) in the SRS resource has (have) the same hopping offset value on an OFDM symbol.
* This is a UE-optional feature.

**Agreement**

For SRS cyclic shift hopping, support finer time-delay-domain granularity, e.g., , where can be randomly chosen from at each SRS transmission.

* Note: The finer granularity above only applies to the cyclic shift offsets when cyclic shift hopping is enabled.

If a subset for cyclic shifts is configured, this feature cannot be configured.

Above is a UE optional feature.

**Agreement**

SRS comb offset hopping / cyclic shift hopping can be configured for aperiodic SRS.

**Agreement**

Whether SRS cyclic shift hopping can be combined with one of group / sequence hopping on a SRS resource depends on UE feature/capability design.

**Agreement**

SRS comb offset hopping and cyclic shift hopping can be configured for a SRS resource at the same time as a separate UE capability. No joint hopping scheme is supported.

Enhanced uplink transmission

**Agreement**

For the codepoints 00 and 01 of “SRS resource set indicator” in DCI for dynamic switching between STxMP SDM and sTRP transmission, support Alt1:

* Alt1: The DCI has two SRI fields and two TPMI fields. The first SRI field and first TPMI field are associated the first SRS resource set if codepoint = 00 or the second SRS resource set if codepoint = 01. The second SRI field and second TPMI fields are reserved.
* This design is also applied to the codepoints 00 and 01 of “SRS resource set indicator” in DCI for dynamic switching between STxMP SFN and sTRP transmission.

**Agreement**

Introduce an additional RRC parameter for the max number of PTRS ports for STxMP SDM scheme.

**Agreement**

To enhance the Rel-17 group-based beam L1-RSRP reporting to support STxMP-based transmission, support the system to configure the UE to report one of the followings:

* Alt1: For each reported pair of CRIs or SSBRIs, the UL Tx spatial filters determined from the reported pair of CRIs or SSBRIs can be applied simultaneously, and the reported pair of CRIs or SSBRIs can be received simultaneously.
* Alt2: For each reported pair of CRIs or SSBRIs, the UL Tx spatial filters determined from the reported pair of CRIs or SSBRIs can be applied simultaneously.
* Supporting Alt1 and/or Alt2 is subject to UE capability

**Agreement**

For case that one PUCCH overlaps with two overlapped PUSCHs in multi-DCI based STxMP PUSCH+PUSCH, support the following revised Option 3:

* (Revised) Option 3:
  + When joint HARQ-ACK feedback is configured or when the UCI does not include HARQ-ACK, the legacy PUSCH priority order for UCI multiplexing is first applied and if at last, there are two PUSCHs with the same start time in one same CC, the UCI is multiplexed in the PUSCH associated with CORESET pool index value 0
  + When separate HARQ-ACK feedback is configured, when the UCI includes HARQ-ACK, the UCI is multiplexed into the PUSCH associated with the same TRP. And among the PUSCHs associated with the same TRP, the legacy PUSCH priority order for UCI multiplexing is applied.
    - The PUSCH and PUCCH associated with same CORESETPoolIndex are associated the same TRP.
    - For a PUCCH including HARQ-ACK, the UE does not expect this PUCCH to overlap with PUSCH(s) with different CORESETPoolIndex value but not overlap with a PUSCH with the same CORESETPoolIndex value.

**Agreement**

Confirm the following WA:

**Working Assumption (RAN1 112)**

For dynamic switching between STxMP SDM scheme and Strp transmission, support the following:

* For Strp transmission: The maximal number of layers of Strp transmission is configured by the maxRank (or Lmax) as in current spec (i.e., Option 1)
* For SDM scheme: configure one single maximal number of layers (separate from maxRank (or Lmax) for Strp) that is applied to the first SRS resource set and the second SRS resource set, separately (i.e., Alt1)
* FFS: Whether/How to enable that the total number of used PUSCH antenna ports for the SDM and Strp is the same.
  + Note: This corresponds to the case that digital ports are shared between the panels
  + Note: RAN1 supports both implementations that digital ports are shared or separate among panels

**Conclusion**

There is no consensus on the following:

|  |
| --- |
| To enable that the maximal total number of used PUSCH antenna ports for the STxMP SDM/SFN and sTRP is the same, for CB-based PUSCH, **down-select between Alt1 and Alt2** **by RAN1#114**:   * Alt1: The codebook subsets for sTRP and STxMP SDM/SFNtransmission can be separate.   + If maxRank = 1 for SDM/SFN schemes and the legacy codebook subset (for sTRP) is configured as “*fullyAndPartialAndNonCoherent*” or “*PartialAndNonCoherent*”:     - For 4-port SRS: Only TPMIs associated with “*partialAndNonCoherent*” can be indicated.     - For 2-port SRS: Only TPMIs associated with “nonCoherent” can be indicated   + If maxRank = 2 for SDM/SFN schemes and the legacy codebook subset (for sTRP) is configured as “*partialAndNonCoherent*” or “*fullyAndPartialAndNonCoherent*”     - FFS: In addition to the TPMIs associated with “*nonCoherent*” for 1-layer or 2-layers, only TPMIs associated with “*partialAndNonCoherent*” for 1-layer with 4-port SRS can be indicated.   + FFS: Subject to UE capability, the non-zero elements in the precoders indicated by two TPMI fields should not correspond to same or overlapping precoder row index(es).     - For example: when maxRank=2 and the legacy codebook subset (for sTRP) is configured, as “partialAndNonCoherent” or “fullyAndPartialAndNonCoherent”, for 2-layer transmission with 4-port SRS, TPMI 0 and TPMI 1 cannot be indicated in the same DCI while TPMI 0 and TPMI 5 can be indicated in the same DCI. * Alt2: The gNB configures SRS resources with different number of ports in one SRS resource set for sTRP transmission and STxMP SDM/SFN transmission. For example, the gNB configures one 4-port SRS resource (for sTRP transmission) and one 2-port SRS resource (for STxMP SDM/SFN transmission) in one SRS resource set * Note: This is an optional UE feature and related UE capability details will be discussed in UE feature session. * If one Alt is down-selected at last:   + SRS resources from different SRS resource sets for CB/NCB cannot be transmitted in the same OFDM symbol     - introduce an inter-set guard period of symbols subject to UE capability between two SRS resource sets for CB/NCB, where UE does not transmit any other signal on any symbol within the inter-set guard period.     - FFS: whether existing rules for simultaneous transmission of other uplink channels in the same or different CCs need to be enhanced     - Subject to UE capability, introduce a guard period of symbols between two contiguous PUSCH transmissions if associated SRS resource set(s) is/are changed     - Note: The values of and can be discussed in UE feature session, which can be 0 or greater than 0. * FFS: Support the UE to report whether it recommends the same or different maximal total number of used PUSCH antenna ports for the STxMP SDM/SFN and sTRP in RRC   + The RRC design is up to RAN2 |

**Agreement**

For codebook-based 8TX PUSCH transmission, Alt3 is supported, where

* A fully-coherent UE (Ng =1) can only be configured with precoders considered for Ng =1
* A partially-coherent UE, with Ng =2, can only use precoders considered for Ng =2
* A partially-coherent UE, with Ng =4, can only use precoders considered for Ng =4
* A non-coherent UE, with Ng =8, can only use precoders considered for Ng = 8

**Agreement**

To support CBG-based transmission for dual CW PUSCH operation, the range N=2, 4, 6, or 8 is confirmed for the CBGTI bit field.

**Agreement**

For non-coherent uplink precoding by an 8TX UE, support Alt1.,

* Alt1. – All 255 combinations from 8 non-coherent rank1 precoders are supported

**Agreement**

For partially coherent uplink precoding by an 8TX UE, Ng=4,

* The following rank and layer splitting cases are supported,

|  |  |  |
| --- | --- | --- |
| *Rank* | *All layers in one Antenna Group* | *Layers split across 4 Antenna Groups*  *(All possible permutations)* |
| *3* |  | *Transmission by 2 of the 4 antenna groups:*  *(2,1,0,0), (2,0,1,0), (2,0,0,1), (0,2,1,0), (0,2,0,1), (0,0,2,1),*    *Transmission by 3 of the 4 antenna groups:*  *(1,1,1,0), (1,1,0,1), (1,0,1,1), (0,1,1,1)* |
| *5* |  | *Transmission by 3 of the antenna groups:*  *(2,0,2,1), (0,2,2,1),*    *Transmission by 4 of the 4 antenna groups:*  *(1,1,2,1)* |
| *6* |  | *Transmission by 3 of the 4 antenna groups:*  *(2,2,2,0), (2,0,2,2)*    *Transmission by 4 of the 4 antenna groups:*  *(2,1,2,1)* |
| *7* |  | *Transmission by 4 of the 4 antenna groups:*  *(2,1,2,2)* |

**Agreement**

Confirm the Working Assumption with revision,

*For partially coherent uplink precoding by an 8TX UE, Ng=2,*

* *At least the following combinations of layer splitting are supported*
  + *FFS: For rank>4, all the layers for each CW is mapped to only one antenna group*

|  |  |  |
| --- | --- | --- |
| **Rank** | **All layers in one Antenna Group** | **Layers split across 2 Antenna Groups** |
| 2 | (2,0), (0,2) |  |
| 2 |  | (1,1) |
| 3 | (3,0), (0,3) |  |
| 3 |  | (1,2), (2,1) |
| 4 | (4,0), (0,4) |  |
| 4 |  | (2,2) |
| 5 |  | [(2,3), (3,2)] |
| 6 |  | (3,3) |
| 7 |  | [(3,4), (4,3)] |

*The part in square brackets is still Working Assumption*

*Note: At least one permutation will be selected in RAN1#114.*

**Conclusion**

In Rel-18, there is no consensus to support CG transmission with dual CW PUSCH by an 8TX UE.

**Agreement**

For dual CW PUSCH transmission by an 8TX UE, PHY layer priority indicator (if configured) is applied on both codewords.

**Agreement**

For full power PUSCH transmission by an 8TX UE, confirm the Working Assumption for Mode1 with updates:

* *To support full power transmission with Mode1, Rel-16 Mode1 (fullPowerMode1) is re-used.*
  + *~~FFS if more than one of the 8TX full coherent precoders is used.~~*
  + *FFS: identification of precoders per rank / per Ng*

**Agreement**

For codebook design of an 8TX partial-coherent UE, configured with an 8-port SRS resource

* For when Ng=2, following convention for assumption of port coherency scheme is used
  + Alt 2: two coherent groups of {0,1,4,5} and {2,3,6,7}
* For when Ng=4, following convention for assumption of port coherency scheme is used
  + Alt 1: four coherent groups of {0,4}, {1,5}, {2,6}, and {3,7}

**Agreement**

For full power PUSCH transmission by an 8TX UE, confirm the Working Assumption for Mode2 with updates:

* To support full power transmission with Mode2, Rel-16 Mode2 (fullPowerMode2) is re-used.
  + ~~FFS~~ definition of precoder groups (G0, G1, …)
  + ~~FFS~~ enhancements for SRS configuration

**Agreement**

For an 8TX UE, Option 1 is supported,

* Option 1 – Subject to its capability, an 8TX UE may report more than one Ng value, based on which, gNB may RRC configure UE with a codebook corresponding to only one of the supported Ng values.

**Agreement**

For indication of a fully-coherent precoder (rank and precoder) for PUSCH transmission by an 8TX UE, up to 7 bits are used.

* Number of bits could depend on the configured max rank

**Agreement**

For an 8TX UE, there is a single UL-SCH indicator in a scheduling DCI (i.e., formats 0\_1, 0\_2).

* FFS whether/how to support CSI-only PUSCH when rank>4.

#### 2.1.2 Remaining Open issues

Multi-TRP enhancement

* Remaining specification details on extension of Rel-17 unified TCI framework, including:
  + Indication of multiple DL and UL TCI states focusing on multi-TRP use case, using Rel-17 unified TCI framework
  + UL beam indication for, if specified, PUCCH/PUSCH to facilitate simultaneous multi-panel UL transmission, where unified TCI framework extension is assumed, considering single DCI and multi-DCI based multi-TRP operation
    - For the case of multi-DCI based multi-TRP operation, only PUSCH+PUSCH, or PUCCH+PUCCH is transmitted across two panels in a same CC.
* Remaining specification details on power control for UL single DCI for multi-TRP operation where unified TCI framework extension is assumed
* Remaining specification details on Two TAs for UL multi-DCI for multi-TRP operation

CSI enhancement

* Remaining specification details on CSI reporting enhancement for high/medium UE velocities by exploiting time-domain correlation/Doppler-domain information to assist DL precoding, targeting FR1, including:
  + Rel-16/17 Type-II codebook refinement, without modification to the spatial and frequency domain basis
  + UE reporting of time-domain channel properties measured via CSI-RS for tracking
* Remaining specification details on Rel-16/17 Type-II codebook refinement for CJT mTRP and its associated CSI reporting, targeting FDD FR1 and up to 4 TRPs, assuming ideal backhaul and synchronization as well as the same number of antenna ports across TRPs

Reference signal enhancement

* Remaining specification details on DMRS enhancement to increase the number of orthogonal DMRS ports for downlink and uplink MU-MIMO (without increasing the DM-RS overhead), only for CP-OFDM.
* Remaining specification details on DMRS enhancements for support of more than 4 layers SU-MIMO PUSCH.
* Remaining specification details of SRS enhancement to manage inter-TRP cross-SRS interference targeting TDD CJT via SRS capacity enhancement and/or interference randomization
* Remaining specification details on SRS enhancements to enable 8 Tx UL operation

Enhanced uplink transmission

* Remaining specification details on UL precoding indication for PUSCH to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability, focusing on FR2 and multi-TRP, assuming up to 2 TRPs and up to 2 panels, targeting CPE/FWA/vehicle/industrial devices (if applicable):
  + No new codebook is introduced for multi-panel simultaneous transmission
  + The total number of layers is up to four across all panels and total number of codewords is up to two across all panels, considering single DCI and multi-DCI based multi-TRP operation.
* Remaining specification details on UL transmission for 8TX UE, including;
  + SRI, and TPMI (including codebook) enhancements to enable 8 Tx UL operation to support 4 and more layers per UE in UL targeting CPE/FWA/vehicle/Industrial devices
  + Consideration of coherence assumption, full/non-full power modes
  + Potential additional specification support to enable two codewords for rank > 4

## 2.2 RAN2

#### 2.2.1 Agreements

**RAN2#121b-e (April 2023)**

* From RAN2 perspective, per TRP UE-initiated RACH procedure is not supported.
* We will send LS to R1 asking questions. Offline drafting the LS, including the following aspects

- the possible groupings and related operation for 2TAs

- other aspects based on offline comments/company contributions

Working assumption:

* Revise the legacy unified TCI state activation/deactivation MAC CE by adding a “CORESET Pool ID” field to support mDCI based mTRP operation.

**RAN2#122 (Incheon, Korea, May 2023)**

* Configure one TAT per TAG to support two TAs for a serving cell, i.e., in this case 2 TAGs are configured for the serving cell.
* RAN2 confirm the following working assumption as an agreement:

Revise the legacy unified TCI state activation/deactivation MAC CE by adding a “CORESET Pool ID” field to support mDCI based mTRP operation.

* For sDCI based mTRP operation using unified TCI state framework, introduce the new MAC CE, with the following high level design principles:
  + - If the signaling type of the unified TCI state configuration is configured by RRC (i.e. either joint DL/UL TCI state or separate DL/UL TCI state), it applies to both TRP (i.e., as configured by RRC for both TRPs).

The following information can be indicated by the MAC CE (for joint DL/UL TCI mode):

* + - if the unified TCI state is for one of the TRPs (i.e., 1st or 2nd) or for both TRPs,
    - if the indicated TCI codepoint consists of one TCI state, whether the indicated TCI state(s) is for the first or second TRP(s)

FFS for the separate DL/UL TCI mode.

#### 2.2.2 Remaining Open issues

* Remaining MAC specification details on Two TAs for UL multi-DCI for multi-TRP operation
* MAC CE design details for single-DCI based multi-TRP operation
* Other potential MAC issues based on RAN1 progress
* RRC parameters for RAN1/RAN4 features

## 2.3 RAN3

n/a

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

## 2.4 RAN4

#### 2.4.1 Agreements

**RAN4#106bis-e, April 17 – April 26 2023, Electronic**

The following agreements and conclusions were made in RAN4 #106bis-e:

1. **RF related:**

**Reply LS on configured Tx power for STxMP in FR2 was approved in R4-2306657.**

**WF on UE RF requirements for STxMP was approved in R4-2306629.**

<UE architecture assumption>

* It is useful to establish a common view of the UE hardware architectures for STxMP discussion
* Detailed UE architecture assumption can be further discussed at the later stage when RAN4 discusses STxMP requirements with clearer work scope

<Configured power per panel (per TCI state)>-

* Relaxation factor can be added based on the study outcome of the configured power and requirements for STxMP
* RAN4 will further study how to improve the proposed per-TCI state configured power as proposed in RAN4#107, and if necessary while considering the following issues. Other solutions are not precluded
  + Whether/how to improve the per panel configured power to make it clearer for the two-panel transmission
  + Solution to differentiate the per-beam power for different TCI-state
* It is expected that RAN4 waits for RAN1 updates regarding per-TCI power control before confirming the concept of the configured power for STxMP

<UE RF requirements for STxMP>

* Max EIRP and Max TRP should be based on the legacy requirements
* Clarification of EIRP for STxMP can be discussed if it is necessary to consider the sum of the EIRP of all respective beams in a certain direction based on the contribution to the next meeting
* RAN4 focuses on the new configured power for STxMP power control while considering the relevant requirements, e.g., Min peak EIRP (PPowerclass) and MPR (MPRf,c,k), and its testability issues raised in RAN4#106bis-e
  + Legacy requirements can be starting point
  + Further discussions are required for how to address the testability issue, e.g., relaxation factor and TE enhancements
* In addition to the requirement needed for the output power configuration, other requirements, e.g., spherical coverage and beam correspondence, can be discussed when the requirements of peak EIRP and MPR per panel are clear enough in RAN4
* RAN4 needs further study of the MPE scenario for the CPE/FWA/vehicle/industrial devices (if applicable) with its use case of STxMP

1. **RRM related:**

**WF on R18 NR MIMO RRM requirements was approved in R4-2306362.**

**Issue 1-2-3: Do you think there are RRM impacts by SRS enhancement for CJT?**

**Agreement:**

* Keep the agreement in RAN4#106 meeting
  + RRM requirements impacts
    - Objective 4 (enhancements of CSI acquisition for C-JT)
      * No RRM requirements impact

**Issue 1-3-1: Do you think there are RRM impacts by UL precoding indication for multi-panel transmission?**

**Agreement:**

* No RRM impacts by UL precoding indication for multi-panel transmission.

**Issue 2-1-2: MTTD requirements applicability**

**Agreement:**

* RAN4 to discuss the MTTD requirement with two TAGs only for mDCI.

**Issue 2-1-6: TA adjustment accuracy**

**Agreement:**

* RAN4 not to consider TA adjustment relaxation when 2 TA commands are used.

**Issue 3-1-2: For extension of Rel-17 unified TCI framework, whether to support sDCI and mDCI?**

**Agreement:**

* Both sDCI and mDCI based MTRP are considered for extension of Rel-17 unified TCI framework for multi-TRP.

**Issue 3-1-3: For extension of Rel-17 unified TCI framework, whether to support intra-cell mTRP and inter-cell mTRP scenarios?**

GTW agreements:

* Agreements
  + Consider both intra-cell and inter-cell mTRP scenarios
    - FFS if inter-cell mTRP scenario would apply for simultaneous reception based mTRP scheme

**Issue 3-1-8: Whether to enhance TRP-specific BFR requirements?**

**Agreement:**

* Postpone the discuss until there is more RAN1 conclusion.

**The following agreements and conclusions were made in RAN4 #107:**

1. **RF related:**

**WF on UE RF requirements for NR MIMO evolution was approved in R4-2310268.**

<Agreement>: Pcmax/Pumax for STxMP

* RAN4 agreed to define ‘per-panel’ configured transmitted power for STxMP power control.
* Total number of panels for ‘per-panel’ Pcmax should be two
* FFS whether to introduce new inequation for ‘per-panel’ Pumax
* ‘per-panel’ to be replaced in final spec language, FFS how to define per-panel ‘k (k=0,1)’ for PCMAXf,c,k considering following options
  + Per TCI state
  + Per TCI pool
  + Per SRS resource set
  + Others based on RAN1 updates are not precluded

<Agreement>: Other UE RF requirements

* For STxMP UE architecture, the ability to steer two UL beams independently is a minimum capability. Other than that, it should be left to UE implementation
* FFS whether/how to define ‘per-panel’ MPR/A-MPR
* FFS whether/how to handle the testability issue

<Agreement>: RAN4 work scope

* RAN4 agreed to consider ‘per-panel’ configured transmitted power (clause 6.2X.4) for WI completion

1. **RRM related:**

**WF on NR MIMO evolution RRM requirements was approved in R4-2310178.**

**LS on MTTD for multi-DCI multi-TRP with two TAs was approved in R4-2310174.**

**Issue 1-2-1: Whether to specify RRM requirements for Rel-17 Full slot SRS transmission?**

Conclusion: No consensus to specify RRM requirements for Rel-17 Full slot SRS transmission feature in the scope of Rel-18 MIMO evolution WI

**Issue 1-3-1: RRM impacts by simultaneous multi-panel UL transmission?**

* Agreements
  + No other RRM requirements required for simultaneous multi-panel UL transmission except potential timing requirements in topic 2 and enhanced unified TCI framework in topic 3, the proposals are suggested to submit in topic #2& topic #3 accordingly. No further discussion in topic #1.

**Issue 2-1-1: What is the assumption on M1/M2 for MTTD for UE not capable of supporting RTD>CP?**

* Agreements
  + If UE supports STxMP
    - The MTTD between multiple TRPs can be defined as (CP + M1) for FR1 and (CP + M2) for FR2, M1=1.6us and M2=0.5 us

**Issue 2-1-2: DL reference timing**

* Agreements
  + For UL timing requirements, RAN4 to specify requirements to support two downlink reference timings.
  + FFS how to capture it in spec. based on RAN1/RAN2 progress of the definition of TA commands.

**Issue 3-1-1: For eUTCI, whether to support intra-cell mTRP and inter-cell mTRP scenarios?**

* Agreements
  + Consider both intra-cell and inter-cell mTRP scenarios
    - FFS if inter-cell mTRP scenario would apply for simultaneous reception based mTRP scheme in FR2

**Issue 3-1-2: For eUTCI, whether to support simultaneous reception in mTRP?**

* Agreements
  + Define eUTCI RRM requirements to support simultaneous reception in mTRP for FR1

#### 2.4.2 Remaining Open issues

1. **RF related**

* ‘Per-panel’ configured transmitted power (PCMAX) for STxMP

1. **RRM related**

* Whether to specify RRM requirements for TDCP reporting?
* Whether to reuse legacy SRS switching RRM requirements for 8TX UL?
* How to handle overlapping UL transmissions in TDM manner?
* Whether to introduce TAG management for multi-TRP with 2 TAs
* Whether to introduce RRM requirements for eUTCI if UE can support sTxMP?
* Whether/How to specify TCI state switching requirements for eUTCI?

## 2.5 RAN5

n/a

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

n/a

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

n/a

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template