**3GPP TSG RAN WG1 #106bis-e R1-210xxxx**

**e-Meeting, October 11th – 19th, 2021**

Source: Moderator (CATT)

Title: Moderator summary #1 on enhancements on beam management for multi-TRP

Agenda Item: 8.1.2.3

Document for: Discussion and Decision

1. Background

This document summarizes companies’ proposals in agenda 8.1.2.3. Only the essential issues with high company interests are listed in this summary. Other issues can be revisited at a later stage.

1. Beam measurement/reporting
   1. Issue 1.1: UE reporting of information related to Rx panel/antenna group

Views from company contributions on issue 1.1 are summarized as follows:

UE indicates if reported beams are associated to different RX spatial filters, or maximum number of supported layers corresponding to DL RS in a group, or whether two beams in a beam pair can be used for spatial multiplexing or diversity:

* **Alt-1**: whether beams are associated to different Rx filters/panels (Xiaomi, Qualcomm, Samsung, ETRI, Apple, CMCC)
* **Alt-2**: whether beams are received with spatial multiplexing or diversity (ZTE, Intel)
* **Alt-3**: maximum number of supported layer per DL RS in a group (MediaTek, Apple, Ericsson)

Companies are invited to provide their preferences and comments in the table below.

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| --- | --- |
| Company | Comments |
| Apple | To clarify, we think Alt3 needs to be merged into Alt1. Standalone Alt3 cannot be helpful to identify the maiximum rank, since both DL RSs may be received from one panel. |
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* 1. Issue 1.2: Support of L1-SINR report

Views from company contributions on issue 1.2 are summarized as follows:

* Support measurement of interference arising from the other beam in the reported beam group
* IMR resource assumption, e.g.
  + reuse CMR of other beam in the beam group (Nokia/NSB, Qualcomm, CATT)
  + explicit IMR configuration (TCL, DOCOMO, Nokia/NSB), including ZP and/or NZP IMR

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | We do not support L1-SINR since no performance gain is observed. |
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1. M-TRP Beam failure recovery
   1. Issue 2.1: Simultaneous configuration of cell-specific and TRP-specific BFR in a cell

Views from company contributions on issue 2.1 are summarized as follows:

* Support simultaneous configuration of cell-specific and TRP-specific BFR in a cell
  + Yes: CMCC, ITRI, TCL, Sony, LGE, NEC, FGI/APT, Lenovo/Moto
  + No: Qualcomm, Intel, DOCOMO, CATT, Spreadtrum
* Up to 2 BFD-RS sets can be configured per at least Scell: FGI/APT, CATT, Nokia/NSB, Ericsson, NEC

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | At current stage we do not see a problem to simultaneously configure cell-specific and TRP-specific BFR. Maybe we can revisit this issue after most of details for TRP-specific BFR is finished. |
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* 1. Issue 2.2: Update of explicit BFD-RS set

Views from company contributions on issue 2.2 are summarized as follows:

* Support to Introduce MAC-CE for updating explicit BFD-RS set: CATT, ZTE, Samsung, DOCOMO, vivo
* Support to associate TCI state for PDCCH with a BFD RS: OPPO, Apple

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
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* 1. Issue 2.3: Implicit BFD-RS set configuaration for CORESET with one TCI state

Views from company contributions on issue 2.3 are summarized as follows:

* The number of TCI states (X) in implicit BFD-RS determination
  + Alt-1 : 2 (Ericsson)
  + Alt-2 : The number of TCI states of CORESETs with CORESETPoolIndex = k (CATT)
* BFD-RS selection when the number of CORESETs with CORESETPoolIndex = k exceeds X
  + Alt-1: re-use or similar to the RLM-RS selection rule (Qualcomm, Huawei)
  + Alt-2: Up to UE implementation (Ericsson, Convida)
  + Alt-3 gNB implementation (no more than UE capability) (vivo)

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | We do not quite understand the first bullet. Some clarification may be needed.  For the second bullet, we support Alt1. |
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* 1. Issue 2.4: Association between BFD-RS set k and NBI-RS set j

Views from company contributions on issue 2.4 are summarized as follows:

To associate BFD-RS set k and NBI-RS set j:

* Alt-1: 1-to-1, fixed in spec (CATT, Intel, ITRI, vivo, Apple)
* Alt-2: 1-to-1, configurable (ZTE, ~~Apple,~~ Fujitsu, OPPO, Qualcomm, CMCC)
* Alt-3: 1-to-1, leave it to RAN2 (Convida, Nokia/NSB, ETRI)

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support Alt1. |
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* 1. Issue 2.5: PUCCH-SR resource selection rule for LRR feedback

Views from company contributions on issue 2.5 are summarized as follows:

PUCCH-SR resource selection rule for LRR:

* Alt 2.5.2 A: FGI/APT, Apple, TCL
* On PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, there is no consensus to adopt alt-1 or alt-2. PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 B: InterDigital, Spreadtrum, CATT, Fujitsu, Qualcomm, Xiaomi, Lenovo/Moto, vivo, OPPO
* On the PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, and at most one BFD RS set fails per CC, adopt alt 2 (e.g. association to failed BFD-RS set) if all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource, else PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 C: Samsung, NEC, CMCC, Xiaomi, CATT, Sony, Lenovo/Moto, vivo
* On the PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, and at most one BFD RS set fails per CC, adopt alt 1 (e.g. association to non-failed BFD-RS set) if all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource, else PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 D: Convida, Ericsson
* Revert the past agreement on supporting configuration of up to 2 PUCCH-SR resources. A UE can be configured up to 1 PUCCH-SR resource in a cell group.

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | We support Alt 2.5.2A and we can also compromise to send both PUCCH-SR resources with regard to reliability. Besides, we can also accept Alt 2.5.2D. |
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* 1. Issue 2.6: Number of activated spatial filters for PUCCH-SR resource

Views from company contributions on issue 2.6 are summarized as follows:

Whether PUCCH-SR resource can have 1 or 2 activated spatial filters

* Alt-1: Only 1 (Spreadtrum, Intel)
* Alt-2: up to 2; diversity (e.g. AI 8.1.2.1) when 2 spaial filters are activated (Xiaomi, FGI/APT, vivo)
* Alt-3: up to 2; filter selection when 2 spatial filters are activated (Qualcomm, LGE, Xiaomi, ETRI)

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support Alt2. We failed to see the necessity for enhancement like Alt1/3. Maybe we do not need to discuss the whole issue. |
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* 1. Issue 2.7: Content of MAC-CE related to SpCell when transmitted on msg3, msgA

Views from company contributions on issue 2.7 are summarized as follows:

Content of MAC-CE related to SpCell when transmitted on msg3, msgA:

* Alt-1: 1-bit SP field (reuse Rel-16 design) (DOCOMO, CATT, OPPO)
* Alt-2: Two bits corresponding to two TPRs of SpCell (ZTE)
* Alt-3: RAN2 issue (Nokia)

Companies are invited to provide their preferences and comments in the table below.

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| --- | --- |
| Company | Comments |
| Apple | Support Alt3. We noticed RAN2 agreed something related to MAC CE content in last RAN2 meeting. Whether to use 1-bit or 2-bit SP field seems to be a RAN2 issue. |
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* 1. Issue 2.8: Beam/power update for PUCCH after receiving gNB response

Views from company contributions on issue 2.8 are summarized as follows:

Support beam/power update for PUCCH after receiving gNB response.

* Introduce association between PUCCH and TRP, e.g. through BFD-RS set ID, CORESETPoolIndex, etc.
  + Support: ZTE, Lenovo/MoM, Fujitsu, Qualcomm, Sony, ETRI, CATT, DOCOMO
  + Not support: OPPO, MediaTek, vivo

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support, but CORESETPoolIndex may needed to be provided in SP/P PUCCH resource. |
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* 1. Issue 2.9: Beam/power update for PDSCH after receiving gNB response

Views from company contributions on issue 2.9 are summarized as follows:

Support beam/power update for PDSCH after receiving gNB response.

* + Yes: Samsung, OPPO
  + No: vivo

Companies are invited to provide their preferences and comments in the table below.

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| --- | --- |
| Company | Comments |
| Apple | Support. This operation is partly supported in PCell BFR. In addition, in the field, PDCCH and PDSCH always share the same beam, if PDCCH beam fails, PDSCH beam fails as well. |
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* 1. Issue 2.10: Association between CORESET(s) and failed BFD-RS set

Views from company contributions on issue 2.10 are summarized as follows:

To associate CORESET(s) with failed BFD-RS set

* Alt-1: Through CORESETPool index (Nokia, CATT, Sony, TCL, ZTE, Fujitsu, MTK, Lenovo/MoM, vivo, Qualcomm)
* Alt-2: Either by RRC signalling or MAC CE (Lenovo/MoM, Qualcomm)
* Alt-3: Through QCL-TypeD property of the CORESET (FutureWei)

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support Alt-1. But it should be for mDCI mode only. |
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* 1. Issue 2.11: SCS of the 28 symbols

Views from company contributions on issue 2.11 are summarized as follows:

The SCS of the 28 symbols is:

* Alt-1: reuse the same mechanism of Rel-16 SCell BFR (MTK, Fujitsu)
* Alt-2: the smallest SCS of the response receiving CC and the reported CC(s) in BFRQ. (Sony)
* Alt-3: the largest SCS of the response receiving CC and the CC with failed TRP. (QC)
* Alt-4: the smallest SCS of the response receiving CC and the cell(s) with one or more failed TRPs (Nokia, ZTE)
* Alt-5: the smallest of the SCS configurations of the active DL BWP for the PDCCH reception and of the active DL BWP(s) of all failed BFD-RS sets and/or cells indicated by BFR MAC-CE. (CATT)
* Alt-6: the smallest of the SCS configurations of the active DL BWP for the PDCCH reception and of the active DL BWP(s) of cell(s) (vivo)

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support Alt2, which is aligned with R16 |
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* 1. Issue 2.12: RACH based feedback

Views from company contributions on issue 2.12 are summarized as follows:

* Support CBRA based feedback on SpCell as a result of per-TRP beam failure: CATT, FGI/APT, Intel, LGE, Asustek, Nokia/NSB, OPPO, MediaTek, Lenovo/MoM, vivo
* Support CFRA based feedback on SpCell as a result of per-TRP beam failure: Lenovo/MoM, Nokis/NSB (if configured), LGE, OPPO, ASUSTek, MediaTek

Companies are invited to provide their preferences and comments in the table below.

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| Company | Comments |
| Apple | Support CBRA only. The overhead for CFRA is too large. |
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1. Previous agreements
   1. RAN1#102-e

**Agreement**

For L1-RSRP, consider measurement / reporting enhancement to facilitate inter-TRP beam pairing

* Option-1: Group-based reporting,
  + e.g., beam restriction to facilitate inter-TRP pairing.
* Option-2: Non-group-based reporting

**Agreement**

Evaluate and study at least but not limited to the following issues for multi-beam enhancement

* Issue 1: Consideration of inter-beam interference
* Issue 2: For group-based reporting, increased number of groups and/or beams per group
* Issue 3: UE Rx panel related beam measurement/report
  + NOTE: “UE panel” is used for discussion purpose only

**Agreement**

* Evaluate enhancement to enable per-TRP based beam failure recovery starting with Rel-15/16 BFR as the baseline.
* Consider following potential enhancement aspects to enable per-TRP based beam failure recovery
  + Issue 1: TRP-specific BFD
  + Issue 2: TRP-specific new candidate beam identification
  + Issue 3: TRP-specific BFRQ
  + Issue 4: gNB response enhancement
  + Issue 5: UE behavior on QCL/spatial relation assumption/UL power control for DL and UL channels/RSs after receiving gNB response

**Agreement**

Study Rel.17 enhancements on beam management for multi-TRPs with following priority

* High priority:
  + Beam measurement/reporting enhancement
  + Beam failure recovery for multi-TRP
* Low priority
  + Simultaneous reception of same type of channel/RS with different QCL-TypeD
  + Simultaneous reception of different type of channel/RS with different QCL-TypeD
  1. RAN1#103-e

Agreement

Down-select at least one of the following options for beam measurement/reporting enhancement to facilitate inter-TRP beam pairing in RAN1 #104-e

* Option 1: In a CSI-report, UE can report N>1 pair/groups and M>=1 beams per pair/group
  + Different beams in different pairs/groups can be received simultaneously
  + FFS: whether M is equal or can be different across different pair/group
* Option 2: In a CSI-report, UE can report N(N>=1) pairs/groups and M (M>1) beams per pair/group
  + Different beams within a pair/group can be received simultaneously
* Option 3: UE report M(M>=1) beams in N (N>1) CSI-reports corresponding to N report setting
  + Different beams in different CSI-reports can be received simultaneously
  + FFS: whether/how to introduce an association between different CSI-reports
  + FFS: whether/how to differentiate reported measurements for beams that are received simultaneously vs. beams that are not received simultaneously
    - whether/how to introduce an indication along with the CSI-reports to indicate whether the beams in different CSI-reports can be received simultaneously
* FFS: value of N and M in each option
* FFS: Association between different beams in above options and different TRP/UE panels
* FFS: Identify new use cases per option compared with R16 (including backhaul)
* FFS: whether different beams in different pairs/groups/reports can be received by same spatial filter per option

**Agreement**

* For M-TRP beam failure detection, support independent BFD-RS configuration per-TRP, where each TRP is associated with a BFD-RS set.
  + FFS: The number of BFD RSs per BFD-RS set, the number of BFD-RS sets, and number of BFD RSs across all BFD-RS sets per DL BWP
  + Support at least one of explicit and implicit BFD-RS configuration
    - With explicit BFD-RS configuration, each BFD-RS set is explicitly configured
      * FFS: Further study QCL relationship between BFD-RS and CORESET
    - FFS: How to determine implicit BFD-RS configuration, if supported
* For M-TRP new beam identification
  + Support independent configurat**i**on of new beam identification RS (NBI-RS) set per TRP if NBI-RS set per TRP is configured
    - FFS: detail on association of BFD-RS and NBI-RS
    - Support the same new beam identification and configuration criteria as Rel.16, including  L1-RSRP, threshold

Agreement

* Support TRP-specific BFD counter and timer in the MAC procedure
  + The term TRP is used only for the purposes of discussions in RAN1 and whether/how to capture this is FFS

Agreement

* Support a BFRQ framework based on Rel.16 SCell BFR BFRQ
  + In RAN1#104-e, select one from the following options
    - Option 1: Up to one dedicated PUCCH-SR resource in a cell group
      * A cell group refers to either MCG, SCG, or PUCCH cell group
      * FFS: number of spatial filters associated with the PUCCH-SR resources
      * FFS: How the SR configuration is done
    - Option 2: Up to two (or more) dedicated PUCCH-SR resources in a cell group
      * A cell group refers to either MCG, SCG, or PUCCH cell group
      * FFS: whether each PUCCH-SR resource is restricted to be associated to one spatial filter
      * FFS: How the SR configuration is done
  + FFS: Whether no dedicated PUCCH-SR resource can be supported in addition to Option 1 or Option 2
* Study whether and how to provide the following information in BFRQ MAC-CE
  + Index information of failed TRP(s)
  + CC index (if applicable)
  + New candidate beam index (if found)
  + Indication whether new beam(s) is found
  + FFS: whether/how to incorporate multi-TRP failure
  1. RAN1#104-e

**Agreement**

For beam measurement in support of M-TRP simultaneous transmission

* Support a single CSI-report consisting of N beams pairs/groups and M (M>1) beams per pair/group, and different beams within a pair/group can be received simultaneously
  + Support M = 2
  + Support extending the maximum value of N > 1, exact value FFS
  + N=1 and N=2
    - FFS: Other values larger than 2
    - FFS: Whether the UE could report beams are received with different RX beams
* Further study the support of option 1 and option 3
* The above applies at least for L1-RSRP
  + FFS: L1-SINR

**Agreement**

* For M-TRP BFR Support 1-to-1 association between each BFD-RS set and an NBI-RS set
  + FFS: Association details

**Agreement**

For M-TRP BFR

* Support 2 BFD-RS sets per BWP, and up to N resources per BFD-RS set
  + FFS: value of N (e.g. fixed in specification, or UE capability)
* FFS: number of BFD RSs across all BFD-RS sets per DL BWP (e.g. fixed maximum value or UE capability)

**Agreement**

For BFRQ of M-TRP BFR

* Option 3: Up to two dedicated PUCCH-SR resources in a cell group
* FFS: Whether PUCCH-SR for SCell can be reused for M-TRP
* Support BFRQ MAC-CE that can convey information of failed CC indices, one new candidate beam for the failed TRP/CC (if found), and whether new candidate beam is found
  + Support at least indication of a single TRP failure
    - FFS: whether/what information of failed TRP(s) is conveyed in the MAC-CE
    - FFS: whether/how to support indication of more than one TRP failure, corresponding BFR procedure, and applicable cell type (SCell vs. SpCell)
* FFS: UE behavior when TRP failure status is different across cells
* FFS: Whether PUCCH SR resource can be configured with 2 spatial relations
  1. RAN1#104b-e

**Agreement**

For beam reporting option 2

* On the maximum number of beam pairs/groups (N) that can be reported in a single CSI-report, discuss and down-select from the following two alternatives in RAN1#105-e:
  + Alt1: Support maximum value N = {1, 2}
  + Alt2: Support maximum value N = {1, 2, 3, 4}
* FFS: Introduce a UE capability Ncap on the maximum value of N in Rel.17
* On the number of beam pairs/groups (N) reported in a single CSI-report, discuss and down select between the following two alternatives in RAN1#105-e
  + Alt1: The value of N is fixed by RRC configuration
  + Alt2: The value of N is upper bounded by a maximum value Nmax configured by RRC, and dynamically selected/indicated by UE

**Agreement**

On CMR resource configuration for beam reporting option 2, adopt the following alternative:

* Two CMR resource sets or subsets, per periodic/semi-persistent CMR resource setting
  + FFS: extension to aperiodic CMR resource setting
* Each reported beam pair in a single CSI-report consists of M = 2 SSBRI / CRI values, where each SSB-RI / CRI points to a CMR resource in a different CMR resource set or subset.
* Decide in RAN1#104b-e whether to adopt “set” or “subset” in the above.

**Agreement**

* Support simultaneous configuration of cell-specific BFR and TRP-specific BFR in different CCs.
* FFS: whether cell-specific and TRP-specific BFR can be configured in the same CC.

**Agreement**

* Support S-DCI and M-DCI in TRP-specific BFR in Rel.17
  + S-DCI is low priority, M-DCI is high priority
  + Unified design for S-DCI and M-DCI should not be precluded due to the prioritization

**Agreement**

On BFD-RS of TRP-specific BFR

* BFD-RS resource number:
  + The total number of RSs in two BFR-RS sets per DL BWP is a UE capability
  + On the maximum number of RS per BFD-RS set, down-select from the following two alternatives in RAN1#105-e
    - Alt1: max value is 2
    - Alt2: max value is a UE capability, including possible candidate value of 1

**Agreement**

Adopt the following beam failure detection criteria for each BFD-RS set

* The physical layer in the UE assesses the radio link quality per BFD-RS set and indicates the BFD-RS set index to higher layers every X ms, if the hypothetical PDCCH BLER of all BFD-RS in the corresponding set of BFD-RS is higher than a threshold
  + X is max{minimal periodicity of BFD RS in the set, 2ms}

**Agreement**

A UE configured with TRP-specific BFR can be configured with 1 PUCCH-SR resource in a cell group

* NOTE: it has been agreed in RAN1#104-e that a UE can be configured with up to 2 PUCCH-SR resources in a cell group

**Agreement**

For the TRP specific BFR, for a UE configured with two PUCCH-SR resources in a cell group when beam failure is detected in a one or more CCs in one or more of BFD-RS sets configured in one or more of CCs,

* Down select one of the following PUCCH-SR resource selection rules when SR is triggered (or their combinations) for the study, without precluding other alternatives, in RAN1#105-e
  + Alt-1: PUCCH-SR resource associated with other/non-failed BFD-RS set, association details FFS
  + Alt-2: PUCCH-SR resource associated with failed BFD-RS set, association details FFS
  + Alt-3: Leave it up to UE implementation
* Note: PUCCH-SR resource is PUCCH resource carrying SR
* FFS: Whether two PUCCH-SR resources are under the same or different SR resource configuration or SR configuration (eventual decision may or may not happen in RAN1)

**Agreement**

On CMR resource configuration for beam reporting option 2, decide in RAN1#105-e whether to adopt “set” or “subset”:

* NOTE: the following has been agreed
  + Two CMR resource sets or subsets, per periodic/semi-persistent CMR resource setting
    - FFS : extension to aperiodic CMR resource setting if two CMR resource sets are supported
  + Each reported beam pair in a single CSI -report consists of M = 2 SSBRI/CRI values, where each SSBRI /CRI points to a CMR resource in a different CMR resource set or subset.
* FFS : bitwidth of each SSBRI/CRI determined based on the number of SSB/CSI-RS resources from the associated set/subset, or across two sets/subsets
  1. RAN1#105-e

**Agreement**

For CMR configuration for option 2, adopt

* Alt-1: “set”

**Agreement**

The bitwidth of each SSBRI/CRI is determined based on the number of SSB/CSI-RS resources in the associated CMR resource set

* FFS: specify the association between SSBRIs/CRIs in a reported group and CMR resource sets

**Agreement**

* For beam measurement/reporting option 2, the maximum number of beam groups in a single CSI-report is a UE capability and may take value from Nmax = {1,2,3,4} in Rel.17.
  + FFS: If UCI payload reduction for Nmax>=2 is needed and if so, how
* The number of beam groups (N) reported in a single CSI-report
  + Alt1: The value of N is configured by RRC signalling

**Agreement**

Select one of the following alternatives with possible modification in RAN1#106-e

* Alt 2.5.2 A:
  + On PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, there is no consensus to adopt alt-1 or alt-2. PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 B:
  + On the PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, and at most one BFD RS set fails per CC, adopt alt 2 if all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource, else PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 C:
  + On the PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured, and at most one BFD RS set fails per CC, adopt alt 1 if all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource, else PUCCH-SR resource selection is up to UE implementation.
* Alt 2.5.2 D:
  + Revert the past agreement on supporting configuration of up to 2 PUCCH-SR resources. A UE can be configured up to 1 PUCCH-SR resource in a cell group.
  1. RAN1#106-e

**Agreement**

For aperiodic report of beam reporting option 2,

* When associated with aperiodic resource setting, extend the existing RRC parameter *CSI-AssociatedReportConfigInfo* to be configured with two CMR resource sets where each may be configured with their corresponding QCL information.
  + FFS: Detailed association scheme
* When associated with periodic/semi-persist resource setting, the resource setting comprises two CMR resource sets.

**Conclusion**

There is no consensus to support M>2 beams per group for beam reporting option 2 in Rel.17.

**Agreement**

Support differential L1 RSRP reporting as a UCI reduction scheme for beam measurement/reporting option 2.

**Agreement**

Differential reporting across all beam groups in a CSI-report

* Including 1-bit indicator of the CMR set associated with the largest RSRP value in all groups
  + NOTE: best beam is assumed in the 1st group
  + 1-bit indicating CMR set with higher RSRP value (e.g. 0 indicating 1st SSBRI/CRI from 1st CMR set, 1 indicating 1st SSBRI/CRI from 2nd CMR set); UCI payload partitioning = 7/4 bits for 1st/2nd SSBRI/CRI in first beam group; 4 bits for all beams in other groups;

**Agreement**

For multi-TRP BFR, a single MAC-CE is used at least for BFRQ for all TRPs in all CCs in a cell group, which includes

* Indices of failed BFD-RS set (as an indication of failed TRP link)
* Indices of CC containing the failed TRP link
* An indicator whether a new candidate beam is identified in the NBI-RS set associated with the failed BFD-RS set, and an resource indicator representing the new candidate beam (if identified) based on the number of NBI-RS resources in the corresponding NBI-RS set.
* FFS: Content of MAC-CE related to SpCell when transmitted on msg3, msgA
* Note: MAC-CE signaling design details are up to RAN2
* The term “failed TRP link” is used here for discussion purposes only

**Agreement**

The maximum number of BFD-RS resources per set is a UE capability, including a possible candidate value of 1 in Rel.17.

**Agreement**

Support the following BFD-RS configurations in Rel.17 for UEs with one activated TCI state per CORESET:

* Implicit configuration:
  + M-DCI:
    - BFD-RS set k (k = 0, 1) is derived based on X TCI of CORESETs with CORESETPoolIndex = k
    - FFS: value of X (determined in spec or UE capability), and TCI selection rule when the number of CORESETs with CORESETPoolIndex = k exceeds X (e.g. reuse RLM RS selection rule)
* FFS: CORESETs with more than 1 activated TCI states

Possible Agreement

Support the following BFD-RS configurations in Rel.17 for UEs with one activated TCI state per CORESET:

* Explicit configuration: RRC configuration BFD-RS resources in BFD-RS set k, k = 0, 1
  + With reference to how UE selects the BFD-RS, it is the same as in Rel-15
  + FFS: CORESETs with more than 1 activated TCI states.

**Conclusion**

BFD-RS configurations in Rel.17 for UEs with one activated TCI state per CORESET via implicit configuration for S-DCI mTRP is not supported in Rel-17.

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