**3GPP TSG RAN WG1 #106bis-e R1-211xxxx**

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

Source: Moderator (CATT)

Title: Moderator summary #2 on enhancements on beam management for multi-TRP

Agenda Item: 8.1.2.3

Document for: Discussion and Decision

1. Background

This document summarizes the remaining issues on enhancements of beam management for multi-TRP.

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

***FL Proposal 1.1: gNB configures/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***
	+ ***Alt-1a: gNB configures UE to report beams are associated with same and/or different RX spatial filters***
* ***Alt-2: whether beams are received with spatial multiplexing or diversity***
	+ ***Alt-2a : gNB configures UE to report beams for spatial multiplexing or diversity.***
* ***Alt-3: maximum number of supported layer per DL RS in a group***

Companies’ views on issue 1.1 are listed as follows:

* Alt-1: Xiaomi, Qualcomm, Samsung, ETRI, Apple, CMCC, Huawei, HiSilicon, Ericsson (2nd preference) , InterDigital
	+ Alt-1a: Nokia/NSB, DOCOMO
* Alt-2: ZTE, Intel, Sony
	+ Alt-2a: DOCOMO
* Alt-3: Apple (suggest to merge Alt-1 and 3), Ericsson, ZTE
* Discuss this issue after there is a conclusion of MP-UE in AI8.1.1: MediaTek, Futurewei, LGE, InterDigital(2nd preference)
* Alt-1~3 are not supported: OPPO

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 1.2: Support of L1-SINR report

***FL Proposal 1.2: Support L1-SINR for beam reporting option 2***

* ***IMR resource assumptions:***
	+ ***Alt-1: reuse CMR of other beam in the beam group***
	+ ***Alt-2: explicit IMR configuration, including ZP and/or NZP IMR***

Companies’ views on issue 1.2 are listed as follows:

* Support L1-SINR: DOCOMO, Futurewei, Huawei, HiSilicon, TCL, Sony, Intel
	+ Alt-1: Nokia/NSB, CATT, Huawei, HiSilicon
	+ Alt-2: TCL, DOCOMO, Nokia/NSB, Lenovo/MotM, Huawei, HiSilicon, Qualcomm, ZTE, Samsung, LGE, Ericsson, ETRI, InterDigital
* Not support L1-SINR: vivo, OPPO, MediaTek, Apple

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

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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

***FL Proposal 2.1:***

* ***Support simultaneous configuration of Rel-15/16 BFR and TRP-specific BFR in a cell***
* ***Up to 2 BFD-RS sets can be configured per CC (including Scell and SpCell)***

Companies’ views on issue 2.1 are listed as follows:

* Support:
* Not support:

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

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* 1. Issue 2.2: Update of explicit BFD-RS set

***FL Proposal 2.2: Support to update explicit BFD-RS set via MAC-CE.***

Companies’ views on issue 2.2 are listed as follows:

* Support: CATT, ZTE, Samsung, DOCOMO, vivo, Convida, CMCC, TCL, InterDigital
* Not support: Spreadtrum, Nokia/NSB, Futurewei, Qualcomm, LGE, Ericsson, Intel, Lenovo/MotM

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

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* 1. Issue 2.3: Implicit BFD-RS set configuration for CORESET with one TCI state

***FL Proposal 2.3: For implicit configuration of BFD-RS set for M-DCI***

* ***The number of TCI states (X) in implicit BFD-RS determination***
	+ ***Alt-1: X=min(2, the number of TCI states of CORESETs with CORESETPoolIndex = k)***
	+ ***Alt-2: X=the number of TCI states of CORESETs with CORESETPoolIndex = k***
* ***TCI state selection when X exceeds the UE capability on the maximum number of BFD-RS resources per set***
	+ ***Alt-1: re-use or similar to the RLM-RS selection rule***
	+ ***Alt-2: Up to UE implementation***
	+ ***Alt-3: gNB implementation (no more than UE capability)***

***Note: it’s agreed in previous meeting that BFD-RS set k (k = 0, 1) is derived based on X TCI of CORESETs with CORESETPoolIndex = k***

Views from companies on issue 2.3 are summarized as follows:

* The number of TCI states (X) in implicit BFD-RS determination
	+ Alt-1 :
	+ Alt-2 :
* ***TCI state selection when X exceeds the UE capability on the maximum number of BFD-RS resources per set***
	+ Alt-1:
	+ Alt-2:
	+ Alt-3:

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

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* 1. Issue 2.4: Association between BFD-RS set k and NBI-RS set j

***FL Proposal 2.4: To associate BFD-RS set k and NBI-RS set j***

* ***Alt-1: 1-to-1, fixed in spec***
* ***Alt-3: 1-to-1, leave it to RAN2***

Companies’ views on issue 2.4 are listed as follows:

* Alt-1: Apple, vivo(if NBI-RS set(s) is configured), MediaTek, DOCOMO, Lenovo/MotM, NEC, CMCC, HW, Samsung, LGE, TCL, Sony, Intel
* Alt-2: HW
* Alt-3: FGI/APT, ZTE, DOCOMO(2nd), Nokia/NSB, Futurewei, HW(2nd), QC(2nd), LGE, Ericsson, ETRI, Qualcomm

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

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* 1. Issue 2.5: PUCCH-SR resource selection rule for LRR feedback

In GTW session, the following agreement has been reached:

**Agreement**

Support to configure an association between a BFD-RS set on SpCell and a PUCCH-SR resource / SR configuration for per TRP BFR.

* FFS: Configure an association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration for per TRP BFR

A UE capability signaling is introduced for indicating the support of this association. Above applies only for multi-DCI case.

We can continue to discuss further details on the association between a BFD-RS set and a CC. The following FL proposal is listed for discussion:

***FL Proposal 2.5: For the rule of PUCCH-SR resource selection, down select one out of the following alternatives.***

* ***Alt-1:***
* ***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:***
* ***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.***

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

* Alt-1:
* Alt-2:

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

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* 1. Issue 2.6: Number of activated spatial filters for PUCCH-SR resource (low priority)

Base on discussion in round 1, the following alternatives are listed for further discussion.

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

* Alt-1: only 1
* Alt-2: up to 2; diversity (e.g. AI 8.1.2.1) when 2 spatial filters are activated
* Alt-3: up to 2; filter selection when 2 spatial filters are activated
* Alt-4: no need to discuss

Views from companies on issue 2.6 are summarized as follows:

* Alt-1:
* Alt-2:
* Alt-3:
* Alt-4:

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

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* 1. Issue 2.7: Content of MAC-CE related to SpCell when transmitted on msg3, msgA (low priority)

Views from companies 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)
* Alt-2: Two bits corresponding to two TPRs of SpCell
* Alt-3: RAN2 issue

Views from companies on issue 2.7 are summarized as follows:

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

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

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* 1. Issue 2.8: Beam/power update for PUCCH after receiving gNB response

***FL Proposal 2.8: 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.***

***Note: the term TRP is used only for the purposes of discussions***

Companies’ views on issue 2.8 are listed as follows:

* Support: Apple, FGI/APT, ZTE, Lenovo/MoM, Fujitsu, Qualcomm, Sony, ETRI, CATT, DOCOMO, NEC, Xiaomi, CMCC, TCL, Sony, InterDigital, Qualcomm, Intel, [Ericsson], Lenovo/MotM
* Not support: vivo, OPPO, MediaTek, Convida, LGE

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

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* 1. Issue 2.9: Beam update for PDSCH after receiving gNB response

***FL Proposal 2.9: After receiving gNB response, the UE assumes the QCL assumption of PDSCH associated with the failed TRP to be the latest reported qnew.***

Companies’ views on issue 2.9 are listed as follows:

* Support:
* Not support:

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

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* 1. Issue 2.10: Association between CORESET(s) and failed BFD-RS set

***FL Proposal 2.10: To associate CORESET(s) with failed BFD-RS set***

* ***For implicit BFD-RS set configuration for M-DCI***
	+ ***Through CORESETPool index***
* ***For explicit BFD-RS configuration***
	+ ***Through CORESETPool index for M-DCI***
	+ ***For S-DCI***
	+ ***Alt1: Support association configuration between TCI state and BFD-RS set for S-DCI***
	+ ***Alt2: Support association configuration between CORESET and BFD-RS set for S-DCI***

Companies’ views on issue 2.10 are listed as follows:

* Support:
* Not support:

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

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* 1. Issue 2.11: SCS of the 28 symbols

***FL Proposal 2.11: SCS of the 28 symbols is the smallest SCS of the response receiving CC and the cell(s) with one or more failed TRPs.***

Companies’ views on issue 2.11 are listed as follows:

* Support:
* Not support:

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

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* 1. Issue 2.12: RACH based transmission

The following agreement has been reached in GTW session:

**Agreement**

***FL proposal 2.12-1: RACH-based transmission can be triggered on a SpCell at least in the following scenarios***

* ***Scenario 1: When beam failure is detected on all BFD-RS sets on the SpCell***
* ***FFS: other scenarios***
	+ ***Scenario 2: at least one TRP fails on SpCell***
	+ ***Scenario 3: at least one pre-defined TRP fails on SpCell***
	+ ***Scenario 4: at least one TRP fails and no PUCCH-SR is configured, and no UL grant is available***
	+ ***Scenario 5: If MAC-CE based reporting does not work (details FFS)***
	+ ***Scenario 6: When no PUCCH-SR is configured***

Regarding issue 2.12, in this round of discussion, we can focus on the following possible agreement:

**Possible Agreement**

***For RACH-based fallback, only CBRA is supported.***

Companies’ views on the above possible agreement are listed as follows:

* Support:
* Not support:

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

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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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