**3GPP TSG RAN WG1 #108-e R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

Source: Moderator (CATT)

Title: Moderator summary #1 on enhancements of 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: Support of L1-SINR report
      1. **Round 1**

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

* Support L1-SINR report
  + Yes: QC, LGE, CMCC, Xiaomi, Lenovo, Motorola Mobility, Intel, TCL, Sony
  + No: OPPO, Apple, MediaTek, Nokia/NSB

Based on views of majority companies, the following proposal is suggested.

***FL Proposal 1.1: Support L1-SINR for beam reporting option 2***

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | This does not seem to be an issue for maintanence phase. |
| LGE | Support. |
| Lenono | Support |
| ZTE | Support |
| Samsung | Support |
| MediaTek | Same view with Apple |
| DOCOMO | Support |
| CMCC | Support |
| Xiaomi | Support but share same concern with Apple |
| Sony | Support |
| Ericsson | This is not an essential correction. Better not to agree new UE features in maintenance phase. |
| Nokia/NSB | Share view with Apple. At least, the Proposal should be clearer with further detail. We can discuss it in the later release. |
| Qualcomm | To our understanding, the group based report with L1-SINR is already in R17 spec. The proposal is to make it work, i.e. how to identify/report two beams with good L1-SINR considering cross-beam interference, whose benefit has been proved by sim results. So to our understanding, it is not new feature but to make an existing feature to work in R17.  214:  For L1-SINR reporting, if the higher layer parameter *nrofReportedRS* in *CSI-ReportConfig* is configured to be one, the reported L1-SINR value is defined by a 7-bit value in the range [-23, 40] dB with 0.5 dB step size, and if the higher layer parameter *nrofReportedRS* is configured to be larger than one, or if the higher layer parameter *groupBasedBeamReporting* is configured as 'enabled', the UE shall use differential L1-SINR based reporting, where the largest measured value of L1-SINR is quantized to a 7-bit value in the range [-23, 40] dB with 0.5 dB step size, and the differential L1-SINR is quantized to a 4-bit value. |

* 1. TPs related to beam measurement/reporting
     1. **Round 1**

TPs from company contributions are summarized as follows:

**TP 2.2.1-1 (from ZTE) {**38.214: 5.1.6.1.2 CSI-RS for L1-RSRP and L1-SINR computation}

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| If a UE is configured with a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *repetition* set to 'on', the UE may assume that the CSI-RS resources, described in Clause 5.2.2.3.1, within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter, where the CSI-RS resources in the *NZP-CSI-RS-ResourceSet* are transmitted in different OFDM symbols. If *repetition* is set to 'off', the UE shall not assume that the CSI-RS resources within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter. When the higher layer parameter *groupBasedBeamReporting-r17* in *CSI-ReportConfig* is configured, the UE expects to be configured with the same value of *repetition* in different CSI Resource Sets.  <Unchanged part omitted> |

**TP 2.2.1-2 (from ZTE) {**38.214: 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology}

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| --- |
| <Unchanged part omitted>  When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16*. When the higher layer parameter *groupBasedBeamReporting-r17* in *CSI-ReportConfig* is configured, the UE expects to be configured with the different value(s) of CSI-RS triggering offset in different CSI Resource Sets. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP and *minimumSchedulingOffsetK2* for any UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'typeD' in the corresponding TCI states, the CSI-RS triggering offset is fixed to zero. The aperiodic triggering offset of the CSI-IM follows offset of the associated NZP CSI-RS for channel measurement.  <Unchanged part omitted> |

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

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| --- | --- |
| Company | Comments |
| Apple | We are not sure why this is needed, some clarification could be needed. |
| LGE | Similar view with Apple. |
| Lenovo | Similar view with Apple. |
| ZTE | In our views, there are two CSI-RS resource sets for group based reporting.   * + Regarding RRC parameter *Repetition*   Since the all resources in the multiple resource sets are used for measuring the channel quality, this function used to make the resource sets are transmitted with the same or different downlink spatial domain transmission filter should keep the same. The parameter repetition of each set should be configured with the same value. If not, what’s the UE behavior of reporting SCRI-RSRP if one set with Repetition = on, but the other ‘off’?   * + Regarding RRC parameter *aperiodicTriggeringOffset*   In our views, in the mTRP scenario, different offset should be configured for each set to avoid collision in the same slot. |
| OPPO | Regarding TP 2.2.1-1, in our understanding there seems no need to add such constraint and whether same or different *repetition* value can be configured should be up to NW. And if *repetition* set as ON in legacy beam reporting, a UE doesn’t have to report any CRI, but just refine its Rx beam when Tx beam is fixed.  Regarding TP 2.2.1-2, we feel there should be more discussion on whether the UE can measure two AP CMR resource sets (from different TRPs) in the same slot. Assuming UE with single Rx beam, if the two CMRs are not overlapped (e.g. TDMed or FDMed) within a slot, it seems okay for UE to carry out Option 2 of group-based beam reporting. |
| Samsung | We prefer to restrict the same setting of *repetition* for the two CSI-RS resources sets configured for the MTRP group based beam reporting. |
| MediaTek | We prefer to restrict the same setting of *repetition* for the two CSI-RS resources sets configured for the MTRP group based beam reporting. |
| vivo | Similar view with OPPO. |
| DOCOMO | For TP 2.2.1-1, even if one set is configured with repetition ON and the other is with repetition OFF, it still works. Hence, it is not needed. But we can also accept it as it simplies the configuration.  For TP 2.2.1-2, more discussion is needed. |
| CMCC | TP 2.2.1-1: Support.  TP 2.2.1-2: We are open to have a further discussion. |
| Xiaomi | For TP 2.2.1-1, if two sets are configured with different setting of *repetition*, and with reportQuantity set to ‘none’, it still works.  For TP 2.2.1-2, further discussion is needed. |
| Mod | For TP 2.2.1-1, further discussion is needed for the following alternatives   * Alt 1: adopt TP2.2.1-1 from ZTE * Alt 2: restrict the same setting of repetition for the two CSI-RS resources sets configured for the MTRP group based beam reporting * Alt3: TP 2.2.1-1 is not needed   For TP 2.2.1-2, based on the discussion and suggestion from OPPO above, let’s start from the following proposal.  ***FL Proposal 1.2: When aperiodic CSI-RS is used with aperiodic reporting and the higher layer parameter groupBasedBeamReporting-r17 in CSI-ReportConfig is configured, UE expects that the CMRs in different CSI Resource Sets are not overlapped in time domain.*** |
| Apple | We do not think the proposal is necessary. |
| Ericsson | Regargin the first TP (2.2.1-1), we think this issue can be handled by network implementation as commented by OPPO. So, we see no need for the restriction in the TP to be captured in 38.214.  For the second issue related to TP (2.2.1-2), it is related to whether simultaneous reception of aperiodic CSI-RS is possible or not for a UE with two Rx panels. Isn’t the whole point of introducing *groupBasedBeamReporting* enhancement in Rel-17 to have the possibility to simultaneously receive transmission from multiple TRPs using multiple panels? Then, we feel further discussion is needed before this kind of restriction is captured in 38.214. |
| Lenovo | Similar view with Ericsson. |
| Nokia/NSB | Alt 3 for TP2.2.1-1.  For proposal 1.2, we are fine with the proposal.  In addition, we can further discuss about configuring different *aperiodicTriggeringOffset* for AP CSI-RS. |
| Qualcomm | For TP 2.2.1-1, it seems no need for such restriction. Both sets can have different repetition values and can work to our understanding, e.g. 1 resource per set  For TP 2.2.1-2, it seems also no need for such restriction. UE can measure two FDMed CSI-RS resources with different Rx beams if supporting group based report. |

* 1. Other issues of beam measurement/reporting
     1. **Round 1**

In addition to the above issues, the issues listed in the following table are also raised by some companies.

|  |  |  |
| --- | --- | --- |
| Issues | Companies | Views |
| Beam measurement/reporting option 1 & 3 | Sony | Support beam measurement/reporting option 1. |
| CMR configuration | MTK | Clarify how to determine the 1st CMR set and 2nd CMR set for periodic and semi-persistent CSI resource setting |
| DCM, vivo | For aperiodic CMR resource configuration, default beam of AP CSI-RS resource should be clarified. |
| LGE | Support gNB to dynamically indicate CMR resource set(s) for a CSI trigger state configured with two CMR resource sets. (switching between STRP and MTRP, reduce DCI overhead) |
| ZTE | * Repetition from different sets should be configured with same value. * AperiodicTriggeringOffset from different sets can be configured with different value(s). |
| Others | QC | UE reports throughput related metric per reported beam group, including sum of CQI, capacity, mutual info. |
| intel | A UE is not expected to receive downlink signals/channels or transmit uplink signals/channels in a time overlapping manner with a beam pair combination that it has not reported within a certain interval of time |
| Apple | The beams in a beam pair reported in a group-based beam report instance can be simultaneously received by UE within an effective time window. The duration of the effective window can be reported by UE capability. |

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think the definition of “simultaneous reception” needs to be clarified. UE is not able to always simultaneously receive two beams. |
| ZTE | We think that due to the introduction of ‘UE capability value set’ for BM 8.1.1 in RAN1#107, we need to consider the combination between ‘group based report’ and ‘UE capability value set’. |
| Samsung | Some clarifications on the “first” and “second” CMR sets seem needed. |
| MediaTek | In current spec 214, the definition of the first and second resource sets is clear for AP CSI-RS. However, it is unclear for P/SP CSI-RS.  **TS 38.214 CR (R1-2112949) 5.2.1.4.1 Resource Setting configuration**  \*\*\* Unchanged text is omitted \*\*\*  For aperiodic CSI, and for periodic and semi-persistent CSI resource settings, if *groupBasedBeamReporting-r17* is configured, each trigger state configured using the higher layer parameter *CSI-AperiodicTriggerState* is associated with one or multiple *CSI-ReportConfig* where each *CSI-ReportConfig* is linked to periodic or semi-persistent, setting(s):  - When one Resource Setting is configured, the Resource setting is given by *resourcesForChannelMeasurement* for L1-RSRP measurement. In such a case, the number of configured CSI Resource Sets in the Resource Setting is S=2  For aperiodic CSI, and for aperiodic CSI resource settings, if *groupBasedBeamReporting-r17* is configured, each trigger state configured using the higher layer parameter *CSI-AperiodicTriggerState* is associated with *resourcesForChannel* and *resourcesForChannel2*, which correspond to first and second resource sets, respectively, for L1-RSRP measurement.  \*\*\* Unchanged text is omitted \*\*\*  Note that the definition of the first and second resource sets is needed when the reporting of the 1-bit resource set indicator and the order of CRI /SSBRI.  **TS 38.212 CR (R1-2112941) 6.3.1.1.2 CSI only**  …  where the 1-bit resource set indicator, with value of 0 or 1, indicates the 1st or the 2nd channel measurement resource set respectively, from which CRI or SSBRI #1 of 1st resource group is reported from; and all remaining resource groups, if reported, follow the same mapping order as the 1st resource group where CRI or SSBRI #1 of all remaining resource groups is reported from the indicated channel measurement resource set. For all reported resource groups, CRI or SSBRI #1 and CRI or SSBRI #2 are reported from different channel measurement resource sets.  \*\*\* Unchanged text is omitted \*\*\* |
| vivo | We think the default beam of aperiodic CSI-RS resource needs to be clarified. |
| DOCOMO | We support to discuss default beam of AP CSI-RS resource for aperiodic CMR resource configuration.  We’re also open to discuss the ‘UE capability value set’ related issue mentioned by ZTE. |
| CMCC | We support to discuss the ‘UE capability value set’ related issue. |
| Sony | We support beam measurement/reporting option 1. By the definition of Option 1, it aligns well with UL multi-panel beam selection which was concluded in Rel.16 and being processed in Rel.17. Since the Tx beams are reported from each UE antenna panel, it seems convenient that the UL beam indication can be conducted with specific panel ID and it seems to be well aligned with the newly defined unified TCI for either DL and UL usage. |
| Ericsson | We have the following comments:  Do not support beam measurement/reporting option 1.  Do not discuss default beam for AP CSI-RS.  Do not discuss throughput related metric per reported beam group.  The above are not an essential corrections, but rather enhancements which should not be further discussed in maintenance phase. |
| Nokia/NSB | We support MTK’s proposal for the clarification of 1st and 2nd CMRs.  For default beam of AP CSI-RS resources, it is unclear the usecase. Measuring L1-RSRP for single fixed beam-pair doesn’t make sense. AP-CSI-RS is more applicable for CSI acquision  No further discussion on the other issues. |
| Qualcomm | Fine to discuss MTK’s proposal. No need to discuss other issues |

1. M-TRP beam failure recovery
   1. Issue 2.1: Simultaneous configuration of cell-level BFR and TRP-specific BFR
      1. **Round 1**

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

* Support simultaneous configuration of cell-level and TRP-specific BFR: TCL
* Not support simultaneous configuration of cell-level and TRP-specific BFR: QC, Intel, CMCC, OPPO, Spreadtrum (obaservation), CATT
  + A UE can be configured with either “Rel-15/16 BFD” or “TRP-specific BFD” on one BWP or CC: QC, CMCC, Intel, CATT, LGE
  + A UE can be configured with either one BFD-RS set or two BFD-RS sets on one BWP or CC: FutureWei, Intel, CATT:

Based on views of majority companies, the following proposal is suggested.

***FL Proposal 2.1: Simultaneous configuration of cell-level and TRP-specific BFR is not supported***

* ***A UE can be configured with either “Rel-15/16 BFD” (i.e., 1 BFD-RS set per BWP) or “TRP-specific BFD” (i.e. 2 BFD-RS sets per BWP) on one BWP or CC.***

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think this can be a UE capability |
| LGE | Our view is incorrectly captured so revise it. Support FL proposal. |
| ZTE | Not our first preference, but we can live with this proposal. |
| OPPO | Support the FL proposal in principle.  To step further down, we suggest to confine the configuration of either “Rel-15/16 BFD” or “TRP-specific BFD” on one CC. Otherwise, there could be cases that within a CC, Rel-15/16 BFD configured on one BWP and TRP-specific BFD configured on another BWP. Different BFD mechanisms might be dynamically switch along with BWP switch. It seems to be not well aligned with the spirit of this proposal for reducing UE’s BFD overhead. |
| Samsung | Fine with the FL’s proposal. |
| MediaTek | Fine with the proposal |
| Spreadtrum | Support |
| vivo | Fine with the FL’s proposal. |
| DOCOMO | Support.  Suggest following revision of the main bullet.  ***FL Proposal 2.1: Simultaneous configuration of cell-level and TRP-specific BFR on one BWP is not supported.*** |
| CMCC | Support. DOCOMO’s update is fine to us. |
| Xiaomi | Fine with the FL Proposal 2.1. |
| Mod | This proposal is updated as follows according to the discussion and suggestion above.  ***Updated FL Proposal 2.1: Simultaneous configuration of cell-level and TRP-specific BFR on one BWP is not supported.*** |
| Sony | We are fine with FL Proposal 2.1 |
| Apple | To preclude concurrent configuration, we think this should be in per CC level, since BWP switching does not reset BFD counter. |
| Ericsson | Do not see a need to introduce this restriction. |
| Nokia/NSB | Support the proposal. |
| Qualcomm | Support FL’s proposal 2.1 |

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

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

* Support to configure BFD-RS set by RRC signaling: CMCC, DCM, Lenovo, Motorola Mobility, LGE
* Support to introduce MAC-CE for updating explicit BFD-RS set: ZTE, OPPO, Apple, Samsung, DCM, TCL
* Not support explicit BFD-RS configuration for Rel-17 MTRP BFR: MTK

Based on views of majority companies, the following proposal is suggested.

***FL Proposal 2.2: Support to configure/update explicit BFD-RS set by***

* ***Alt-1: RRC signaling only***
* ***Alt-2: RRC signaling and MAC CE signaling***

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think we should minimize ASN.1 impact. Thus, we suggest we consider the third alternative that BFD RS set is configured by MAC CE. |
| LGE | Support Alt-1. Explicit BFD-RS has been designed for UE-specifically Beamformed CSI-RS and no need to change the principle. In addition, explicit BFD is mainly for S-DCI M-TRP operation which was agreed as lower priority than M-DCI M-TRP. It seems no need to further optimize this. |
| Lenovo | Support Alt-1. |
| ZTE | We share the same views with Apple that only MAC-CE seems sufficient. If having RRC-only solution, we have to experience the serious timeline issue. |
| OPPO | Support the FL proposal.  If down-selection between Alt-1 and Alt-2 can be made, we would prefer Alt-2, due to the flexibility of updating the RRC configured BFD RS. Otherwise, after every recovery of BFR event, NW has to re-configure the explicit BFD RS for UE to monitor the link quality. The RRC reconfiguration (L3 signalling) seems not desirable from the latency perspective of BFR which is mainly based on L1/L2 signalling. |
| Samsung | Support Alt-2. Frequent RRC reconfiguration of BFD RSs may be needed so that the RRC configured BFD RSs could correspond to the RS(s) in active TCI state(s) for CORESET(s). This makes RRC configuration/signaling-only solution quite limiting. Alt-2 can provide more flexibility by using MAC CE (when necessary) to update the RRC configured BFD RSs. |
| MediaTek | Support Alt1 |
| Spreadtrum | Support Alt-1. The optimization is not essential. |
| Vivo | Support Alt-1. |
| DOCOMO | We prefer Alt-2 from the two alts. Noted that we have agreed to support explicit BFD-RS set configuration. |
| CMCC | We think Alt-1 is supported by default. We can also accept Alt-2. |
| Xiaomi | Support FL Proposal 2.2 and slightly prefer Alt 1. |
| Mod | Views form companies are summarized in the following updated proposal:  ***Updated FL Proposal 2.2: Support to configure/update explicit BFD-RS set by***   * ***Alt-1: RRC signaling only*** * ***Alt-2: RRC signaling and MAC CE signaling*** * ***Alt-3: MAC CE signaling only***   As also mentioned by some companies, we have agreed to support explicit BFD-RS set configuration. So, if we can’t reach consensus on this proposal, RRC configuration is supported by default. |
| Apple | We have different understanding with moderator. If we cannot reach consensus on detail for one feature, by default, such operation is not supported. |
| Ericsson | MAC CE signaling is an optimization which should be avoided in maintenance phase. Note that RAN2 already has a lot of open issues to work on for Rel-17 feMIMO, and we don’t think a new MAC CE should be agreed at this point. So we do not support Alt-2 nor Alt-3.  As commented by the moderator, we have already agreed to support explicit BFD-RS sets by configuration which essentially is Alt-1. |
| Lenovo | Support Alt1. Similar view with Ericsson. |
| Nokia/NSB | Support Alt2. |
| Qualcomm | Support Alt2 |

* 1. Issue 2.3: Beam/power update for PUCCH after receiving gNB response
     1. **Round 1**

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

* Support to update spatial relation info. And power control parameter of PUCCH: QC, ZTE, DCM, CMCC, OPPO, Lenovo, Motorola Mobility, TCL, Fujitsu, Sony, CATT
  + Support to configure the association between PUCCH resource and BFD-RS set: DCM, ZTE, QC, CMCC, Intel, Fujitsu, Sony, TCL, Xiaomi
  + Support to update spatial relation info. And power control parameter of PUCCH resources in PUCCH resource group: OPPO, LGE, QC

Based on views of majority companies, the following proposal is suggested.

***FL Proposal 2.3: Support beam/power update for PUCCH after receiving Gnb response.***

* ***Introduce association between PUCCH and TRP***

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think TRP should be replaced by CORESETPoolIndex, and only P/SP PUCCH needs such operation. |
| LGE | PUCCH esource group introduced in Rel-16 can easily enable updating a number of PUCCH resources with lower signaling overhead. So, we propose to introduce association between PUCCH resource group and TRP(BFD-RS set or CORESET pool index). |
| Lenovo/MotM | Support it and the PUCCH resource shall include those PUCCH resources activated with two beams in S-DCI based M-TRP. |
| ZTE | Support the FL proposal. In our views, PUCCH-related beam and power control update should be supported for facilitating TRP-specific uplink recovery as in Pcell and Scell BFR procedure. |
| OPPO | Configuring association between PUCCH resource and TRP has also been discussed a lot in Rel-16 but not supported. We hesitate to introduce to new association in Re-17 just for the feature of resetting the beam of PUCCH, which seems not be a essential feature. Thus, we can live with reusing the exiting configuration, i.e., PUCCH resource group supported in Rel-16 to support resetting beam of PUCCH. |
| Samsung | Support the FL’s proposal on the association between PUCCH resources and BFD RS sets. |
| MediaTek | No need |
| Spreadtrum | Support |
| DOCOMO | Support |
| CMCC | Support |
| Xiaomi | Support the FL Proposal 2.3 |
| Sony | Support |
| Ericsson | This is not an essential correction. It it too late to introduce such enhancements in Rel-17. So, we do not support the proposal. |
| Nokit/NSB | Support the proposal. |
| Qualcomm | Support the proposal. Btw, all channels including PUCCH will be reset to the new beam in case of unified TCI. So it should be extended to here |

* 1. Issue 2.4: Beam update for PDSCH after receiving gNB response
     1. **Round 1**

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

* Update QCL of PDSCHs after receiving BFR response: OPPO, Samsung, vivo

Based on views of majority companies, the following proposal is suggested.

***Updated FL Proposal 2.4: After receiving gNB response, the UE assumes that***

* ***The QCL assumption of PDSCH associated with the failed TRP link is updated to the latest reported qnew.***

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

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| --- | --- |
| Company | Comments |
| Apple | Support |
| LGE | Not support. There is no clear benefit and it kills gNB flexibility to dynamically indicate TCI state for PDSCH. Intended behavior can be achieved without any spec modification, e.g., via no TCI field in DCI or via allocating PDSCH within *timedurationforQCL*. |
| Lenovo/MotM | Not supported. Similar view with LGE. |
| ZTE | Support. |
| OPPO | Support the FL proposal. |
| Samsung | Support the FL’s proposal. |
| DOCOMO | Not needed. |
| CMCC | Not needed, but we can accept it. |
| Xiaomi | Not needed and share same view as LGE. |
| Sony | Not support. It seems not necessary in our view. a) the recovered PDCCH can provide TCI state for PDSCH to follow or b) legacy default beam rules can be applied. |
| Ericsson | Do not support. We tend to agree with comments from LGE. This is not an essential correction. |
| Nokia/NSB | Not support. Scheduling new MAC-CE seems enough. The condition to apply default QCL is unclear. |
| Qualcomm | Support FL’s proposal 2.4. Btw, all channels including PDSCH will be reset to the new beam in case of unified TCI. Some principle should be extended to here |

* 1. Issue 2.5: Beam update for CORESETs in S-DCI
     1. **Round 1**

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

* Update of CORESETs for explicit BFD-RS set configuraiton of S-DCI
* Support association configuration between CORESET and BFD-RS set: Intel, CMCC, Samsung, DCM
* Not necessary to define beam resetting behavior for UE operating with single-DCI-based MTRP operation: vivo
* QCL assumptions of CORESETs follow gNB configuration (e.g., activation of TCI state for a CORESET or parameter tci-StatesPDCCH-ToAddList): CATT

Based on views of majority companies, the following proposal is suggested.

***FL Proposal 2.5: For S-DCI, after receiving gNB response, the UE assumes that***

* ***The QCL assumption of CORESETs associated with the failed BFD-RS sets is updated to the latest reported qnew.***

Companies’ views on issue 2.8 are listed as follows:

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| Company | Comments |
| Apple | In our view, we need to define the association between CORESET and failed BFD RS set first. |
| Lenovo | Support it and same view with Apple that an association between CORESET and BFD-RS set should be built first. |
| ZTE | We are open to further consider S-DCI, and for progress, we may need to consider the association between PUCCH and BFD-RS sets, which can be reused for S-DCI operation. |
| OPPO | In our understanding, for S-DCI multi-TRP BFR, the CORESETs associated with failed BFD RS set should be recovered. But the association between S-DCI CORESETs and BFD RS set is not clear. In other words, a UE under S-DCI operation (without *CORESETPoolIndex* configured) is not aware of which CORESET(s) are associated with the failed TRP. Hence, we think this issue should be further discussed before we agree the unknown behavior of recovery. |
| Samsung | For sDCI, association between CORESETs and BFD RS sets are needed so that the corresponding CORESETs (if failed) can be recovered. |
| MediaTek | No need |
| Spreadtrum | In our understanding, we should firstly discuss whether/how to introduce the association between CORESET and BFD-RS set, then discuss the issue. Othersie, the behavior is not clear. |
| Vivo | We suggest simplying the BFR procedure of sDCI-based MTRP scenarios. UE only indicate the failure event in BFR MAC CE based on the explicitly configured BFD-RS. Other enhancements like TRP-specific NBI-RS configuration, beam resetting and association between CORESETs and BFD-RS sets is not needed. The subsequent recovery is up to the network implementation. |
| DOCOMO | Support. And agree with Apple. |
| CMCC | Support association configuration between CORESET and BFD-RS set. |
| Xiaomi | Agree that we need to introduce the association between CORESETs and BFD RS set first. |
| Ericsson | This is not an essential correction. Such enhancements should be avoided in maintenance phase. |
| Nokia/NSB | We share view with OPPO and Samsung. Support determining the association between CORESET and failed BFD-RS set. The explicitly configured BFD-RS still have to be periodic CSI-RS resources that correspond to the PDCCH beams i.e. UE can determine the CORESETs based on the RS indicated by the active TCI states and the associated BFD-RS set for the explicitly configured BFD-RS |
| Qualcomm | Support, and fine to define the association between CORESET and failed BFD RS set first |

* 1. TPs related to M-TRP beam failure recovery
     1. **Round 1**

TPs from company contributions related to other issues of M-TRP BFR are summarized as follows:

**TP 3.6.1-1 (from Apple)** Endorse the following text proposal on implicit BFD RS selection

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| 6 Link recovery procedures <unrelated part omitted>  If the UE is not provided by *failureDetectionResourcesToAddModList* for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided or for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two coresetPoolIndex values 0 and 1 for the first and second CORESETs, or is not provided coresetPoolIndex value for the first CORESETs and is provided coresetPoolIndex value of 1 for the second CORESETs, respectively. If there are two RS indexes in a TCI state, the set , or , or includes RS indexes configured with *qcl-Type* set to 'typeD' for the corresponding TCI states. If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the set includes RS indexes in the RS sets associated with the two TCI states. The UE expects the set to include up to two RS indexes. The UE expects the set or the set to include up to a number of RS indexes indicated by *capabilityparametername*. If a number of active TCI states for PDCCH receptions in the first or second CORESETs is larger than , the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets associated with the active TCI states for PDCCH receptions in the first or second CORESETs corresponding to search space sets according to an ascending order for monitoring periodicity. If more than one first or second CORESETs correspond to search space sets with same monitoring periodicity, the UE determines the order of the first or second CORESETs according to a descending order of a CORESET index. The UE expects single port RS in the set , or , or . The UE expects single-port or two-port CSI-RS with frequency density equal to 1 or 3 REs per RB in the set , or , or . |

**TP 3.6.1-2 (from Ericsson)** Adopt Text Proposal 1 in Clause 6 of TS 38.213 V17.0.0.

|  |
| --- |
| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of Text Proposal 1 for 38.213 Clause 6 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  **6 Link recovery procedures**  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged Text Omitted \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  The UE expects the set or the set to include up to a number of RS indexes configured by higher layer parameter *numBFD-RSImplicit,* subject to UE capability.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of Text Proposal 1\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**TP 3.6.1-3 (from Ericsson)** Adopt Text Proposal 2 in Clause 6 of TS 38.213 V17.0.0.

|  |
| --- |
| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of Text Proposal 2 for 38.213 Clause 6 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  **6 Link recovery procedures**  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged Text Omitted \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  Instead of the sets and , for each BWP of a serving cell, the UE can be provided respective two sets and of periodic CSI-RS resource configuration indexes by *failureDetectionResourcesToAddModList* and *failureDetectionResourcesToAddModList2* and corresponding two sets and of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList1* and *candidateBeamRSList2*, respectively, for radio link quality measurements on the BWP of the serving cell. The set is associated with the set and the set is associated with the the set .  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged Text Omitted \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  If the UE is not provided by *failureDetectionResourcesToAddModList* for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided by *failureDetectionResourcesToAddModList* or by *failureDetectionResourcesToAddModList2* for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two coresetPoolIndex values 0 and 1 for the first and second CORESETs, or is not provided coresetPoolIndex value for the first CORESETs and is provided coresetPoolIndex value of 1 for the second CORESETs, respectively.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* End of Text Proposal 2 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**TP 3.6.1-4 (from DCM)** Adopt following TP for TS 38.213.

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| --- |
| 6 Link recovery procedures […]  If the UE is not provided by *failureDetectionResourcesToAddModList*, but provided , for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided or , but provided and , for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two coresetPoolIndex values 0 and 1 for the first and second CORESETs, or is not provided coresetPoolIndex value for the first CORESETs and is provided coresetPoolIndex value of 1 for the second CORESETs, respectively. If there are two RS indexes in a TCI state, the set includes RS indexes configured with *qcl-Type* set to 'typeD' for the corresponding TCI states. If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the set includes RS indexes in the RS sets associated with the two TCI states. The UE expects the set to include up to two RS indexes. The UE expects the set or the set to include up to a number of RS indexes indicated by *capabilityparametername*. If a number of active TCI states for PDCCH receptions in the first or second CORESETs is larger than , the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets associated with the active TCI states for PDCCH receptions in the first or second CORESETs corresponding to search space sets according to an ascending order for monitoring periodicity. If more than one first or second CORESETs correspond to search space sets with same monitoring periodicity, the UE determines the order of the first or second CORESETs according to a descending order of a CORESET index. The UE expects single port RS in the set , or , or . The UE expects single-port or two-port CSI-RS with frequency density equal to 1 or 3 REs per RB in the set , or , or . |

**TP 3.6.1-5 (from Huawei, HiSilicon)** Capture the missed agreement on RACH based BFR as shown in TP #1.

|  |
| --- |
| < Start of text proposal 38.213 v17.0.0 Section 6>  < Unchanged parts are omitted >  For serving cells associated with sets and , and with sets and , the UE can provide in a second PUSCH MAC CE index(es) for cell(s) with and/or having radio link quality worse than Qout,LR, the index(es) of those and/or , and indication(s) of presence of and of index(es) , if any, from corresponding sets and/or for the serving cells.  For SpCell associated with sets and , and with sets and , when both and have radio link quality worse than Qout,LR, the UE can trigger RACH procedure for beam failure recovery*.*  < Unchanged parts are omitted >  < End of text proposal 38.213 v17.0.0 Section 6> |

**TP 3.6.1-6 (from Xiaomi)** Adopt the following TP to 38.213

|  |
| --- |
| **-------------------------- Start of Text Proposal for TS 38.213 --------------------------**  **<Unchanged parts omitted>** 6 Link recovery procedures …  For the PCell or the PSCell and for sets and , after 28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* where a UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI, the UE assumes same antenna port quasi-collocation parameters as the ones associated with index for PDCCH monitoring in a CORESET with index 0.  For the PCell or the PSCell and for sets and , or sets , and , if BFR MAC CE [11, TS 38.321] is provided in Msg3 or MsgA of contention based random access procedure, and if a PUCCH resource is provided with *PUCCH-SpatialRelationInfo*, after 28 symbols from the last symbol of the PDCCH reception that determines the completion of the contention based random access procedure as described in clause 5.1.5 of [11, TS38.321], the UE transmits the PUCCH on a same cell as the PRACH transmission using  …  **<Unchanged parts omitted>**  **-------------------------- End of Text Proposal for TS 38.213 --------------------------** |

**TP 3.6.1-7 (from Spreadtrum)** Suggest to adopt the following text proposal in 38.213.

|  |
| --- |
| ------------------------------------------Start of Text Proposal#1 for TS 38.213-------------------------------------- 6 Link recovery procedures A UE can be provided, for each BWP of a serving cell, a set of periodic CSI-RS resource configuration indexes by *failureDetectionResourcesToAddModList* and a set of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList* or *candidateBeamRSListExt* or *candidateBeamRSSCellList* for radio link quality measurements on the BWP of the serving cell. Instead of the sets and , for each BWP of a serving cell, the UE can be provided respective two sets and of periodic CSI-RS resource configuration indexes and corresponding two sets and of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList1* and *candidateBeamRSList2*, respectively, for radio link quality measurements on the BWP of the serving cell. The set is associated with the set and the set is associated with the ~~the~~ set .  ------------------------------------------End of Text Proposal#1 for TS 38.213-------------------------------------- |

**TP 3.6.1-8 (from LGE)** Adopt the following change for Rel-17 M-TRP BFR.

|  |
| --- |
| 6. Link recovery procedures  A UE can be provided, for each BWP of a serving cell, a set of periodic CSI-RS resource configuration indexes by *failureDetectionResourcesToAddModList* and a set of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList* or *candidateBeamRSListExt* or *candidateBeamRSSCellList* for radio link quality measurements on the BWP of the serving cell. Instead of the sets and , for each BWP of a serving cell, the UE can be provided respective two sets and of periodic CSI-RS resource configuration indexes and corresponding two sets and of periodic CSI-RS resource configuration indexes and/or SS/PBCH block indexes by *candidateBeamRSList1* and *candidateBeamRSList2*, respectively, for radio link quality measurements on the BWP of the serving cell. The set is associated with the set and the set is associated with the the set .  If the UE is not provided by *failureDetectionResourcesToAddModList* for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided or for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two *coresetPoolIndex* values 0 and 1 for the first and second CORESETs, or is not provided *coresetPoolIndex* value for the first CORESETs and is provided *coresetPoolIndex* value of 1 for the second CORESETs, respectively. If there are two RS indexes in a TCI state, the set includes RS indexes configured with *qcl-Type* set to 'typeD' for the corresponding TCI states. If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the set includes RS indexes in the RS sets associated with the two TCI states. The UE expects the set to include up to two RS indexes. If the UE is provided or , the UE expects the set or the set to include up to a number of RS indexes indicated by *capabilityparametername*. If the UE is not provided or , and if a number of active TCI states for PDCCH receptions in the first or second CORESETs is larger than , the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets associated with the active TCI states for PDCCH receptions in the first or second CORESETs corresponding to search space sets according to an ascending order for monitoring periodicity. If more than one first or second CORESETs correspond to search space sets with same monitoring periodicity, the UE determines the order of the first or second CORESETs according to a descending order of a CORESET index. The UE expects single port RS in the set , or , or . The UE expects single-port or two-port CSI-RS with frequency density equal to 1 or 3 REs per RB in the set , or , or .  - unchanged part is omitted - |

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Except for TP 3.6.1-1/7, we do not think other TPs are needed. But we are open to discuss. |
| LGE | For apple’s TP: OK.  For Ericsson’s first TP: not needed. there is no such higher layer parameter. And this sentence is applicable only when BFD RSs are configured explicitly.  For Ericsson’s second TP: OK.  For DOCOMO’s TP: not essential.  For Huawei’s TP: OK in principle  For Xiaomi’s TP: not needed.  For Spraedtrum’s TP: OK.  For LGE’s TP: OK. |
| Lenovo | For TP 3.6.1-1: ok.  For TP 3.6.1-2: not needed. There is no such RRC parameter.  For TP 3.6.1-3: ok.  For TP 3.6.1-4: ok.  For TP 3.6.1-5: ok.  For TP 3.6.1-6: not needed.  For TP 3.6.1-7: ok.  For TP 3.6.1-8: ok. |
| ZTE | TP 3.6.1-1: Okay,  TP 3.6.1-2: We may need to have further discussion before approving.  TP 3.6.1-3: Not support. It's relevant to issue 2.2, and in our views, only MAC-CE based signaling for BFD-RS is needed.  TP 3.6.1-4: We are fine  TP 3.6.1-5: Not support. It is incorrect for triggering condition, and in our views, it should be specified in 38.321.  TP 3.6.1-6: Support.  TP 3.6.1-7: Support.  TP 3.6.1-8: Fine. But if not updated, it seems no ambiguous. |
| MediaTek | 3.6.1-1: Ok  3.6.1-2: Need further discussion  3.6.1-3: Need further discussion (issue 2.2)  3.6.1-4: Seems not necessary, but we are ok  3.6.1-5: Can be captured in RAN2 spec  3.6.1-6: Seems not necessary  3.6.1-7: Ok  3.6.1-8: Ok |
| Spreadtrum | TP 3.6.1-1: ok  TP 3.6.1-2: No such RRC signaling, but fine to have further discussion  TP 3.6.1-3: ok  TP 3.6.1-4: seems not neccessary  TP 3.6.1-5: ok  TP 3.6.1-6: seems not necessary  TP 3.6.1-7: ok  TP 3.6.1-8: ok |
| Vivo | TP 3.6.1-1: Ok.  TP 3.6.1-2: We think it needs to have further discussion.  TP 3.6.1-3: Ok.  TP 3.6.1-4: We think it should be discussed in maintenance on Rel-15 first.  TP 3.6.1-5: share similar view with ZTE.  TP 3.6.1-6: We think it needs to have further discussion, since the UE bahavior after receiving the BFRR which corresponds to both failed TRPs has not been discussed and determined.  TP 3.6.1-7: Ok.  TP 3.6.1-8: Ok. |
| DOCOMO | TP 3.6.1-1: ok.  TP 3.6.1-2: Not support.  TP 3.6.1-3: ok  TP 3.6.1-4: ok. Otherwise, UE does not know whether it should determine one BFD-RS set or two BFD-RS sets. Re vivo’s comment, we donot think it should be discussed in Rel-15 as UE doesnot need to distinguish whether to determine one or two BFD-RS set in Rel-15.  TP 3.6.1-5: Not support. Should be in RAN2 spec.  TP 3.6.1-6: ok  TP 3.6.1-7: ok  TP 3.6.1-8: ok |
| CMCC | TP3.6.1-1: OK  TP3.6.1-2: Need further discussion  TP3.6.1-3: OK  TP3.6.1-4: OK  TP3.6.1-5: Prefer to capture in TS38.321  TP3.6.1-6: Not needed.  TP3.6.1-7: OK  TP3.6.1-8: OK |
| Xiaomi | TP 3.6.1-1: ok  TP 3.6.1-2: not support. No such higher layer parameter  TP 3.6.1-3: ok  TP 3.6.1-4: fine  TP 3.6.1-5: covered by TP 3.6.1-6  TP 3.6.1-6: ok. It intends to capture RACH based BFR when two BFD-RSs sets fail on the PCell or the PScell.  TP 3.6.1-7: ok.  TP 3.6.1-8: fine |
| Ericsson | TP 3.6.1-1: Ok  TP 3.6.1-2: Support. Note there is a guidance from RAN2 in the LS R1-2001513 “**Avoid defining functionality that has no RRC configuration but is dependent on capability bits.**”. In the current spec text, the number of RS indexes included in the BFD RS set(s) is purely up to UE capability parameter *capabilityparametername.* This seems to violate the above guidance from RAN2. This is why we propose an explicit configuration parameter.  TP 3.6.1-3: Support. This is related to Issue 2.2 and assumes explicit BFD-RS set configuration by RRC only. This TP can be discussed after resolving Issue 2.2.  TP 3.6.1-4: Seems not essential, but we can live with it.  TP 3.6.1-5: can be captured in RAN2 specs.    TP 3.6.1-6: seems not necessary.  TP 3.6.1-7: Ok.  TP 3.6.1-8: ok. |
| Qualcomm | TP 3.6.1-1: fine  TP 3.6.1-2: fine  TP 3.6.1-3: fine  TP 3.6.1-4: no need. We have the RRC parameter for max implicit BFD RS # per set, which can tell it is mTRP or sTRP BFR  TP 3.6.1-5: fine  TP 3.6.1-6: no need  TP 3.6.1-7: fine  TP 3.6.1-8: no need, already implied by spec |

* 1. Other issues of BFR
     1. **Round 1**

In addition to the above issues, the issues listed in the following table are also raised by some companies.

|  |  |  |
| --- | --- | --- |
| Issues | Companies | Views |
| Implicit BFD-RS set configuration | QC | In absence of QCL-TypeD RS, the single QCL source RS in the TCI state can be the implicit BFD RS. |
| NBI-RS set | MTK | NW should always configure NBI-RS set for each BFD-RS set in MTRP BFR |
| vivo | Support to optionally configure TRP-specific NBI-RS |
| PUCCH-SR | DCM | Two dedicated PUCCH-SR resources can be configured, only when SpCell is configured with per-TRP BFR. |
| OPPO, DCM | Whether to support association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration |
| MTK | * An association between a BFD-RS set on SpCell and a PUCCH-SR resource can be configured by RRC * When one single PUCCH-SR resource is configured in a cell group, UE can trigger the PUCCH-SR resource if beam failure is detected in any of BFD-RS sets on any CC configured with MTRP BFR * When two PUCCH-SR resources are configured in a cell group but not associated with BFD-RS sets on SpCell, UE can trigger any one of the PUCCH-SR resources if beam failure is detected in any of BFD-RS sets on any CC configured with MTRP BFR |
| ZTE | Clarify that the PUCCH-SR for BFR should be at least on SpCell as Rel-16 and it is optional to be on PUCCH-SCell |
| Apple | If multiple PUCCH-SRs are triggered, legacy SR multiplexing/dropping rule can be reused. |
| If there is no new beam found (when one TRP fails) | Nokia, Nokia Shanghai Bell | * UE is not required to monitor PDCCH on the CORESET(s) associated with failed BFD-RS set and falls back to single TRP operation. |
| vivo, ZTE | Support to deactivate TRP through MAC CE. |
| If there is no new beam found (when two TRP fail) | vivo | Support update QCL assumption of all CORESETs and scheduled PDSCH by the spatial filter as for the last PRACH transmission simultaneously |
| Inter-cell BFR | DCM | * For per-cell BFR, SSB associated with additional PCI can be configured as NBI-RS. * For per-TRP BFR, SSB associated with additional PCI can be configured as NBI-RS in the NBI-RS set associated with corresponding CORESETPoolIndex. |
| Apple | Support to configure non-serving cell SSB for candidate beam detection. |
| Threshold | QC | The threshold Qout,LR for TRP specific BFD can reuse the existing default value of rlmInSyncOutOfSyncThreshold for cell level BFD. |
| Apple | Support to configure cell-specific candidate beam detection RSRP threshold. |
| Others | QC | In presence of PDCCH repetition, the 28 symbols start from the last repetition. |
| Xiaomi | RACH-based BFRQ will be triggered if the beam failure of the second TRP is detected before receiving the response from gNB during the BFRQ procedure of the first TRP. |
| Apple | For sDCI mode, UE should not be required to always keep TRP-specific BFR when it switches to sTRP mode. UE may maintain the BFD counter and timer within a time window in case it switches back to sDCI mode. |
| Lenovo, Motorola Mobility | The priority of positive LRR of TRP-specific BFR is higher than positive SR. |
| Lenovo, Motorola Mobility | Further study the priority of positive LRR of TRP-specific BFR and positive LRR of SCell BFR considering whether PCell/PSCell is configured with TRP-specific BFR. |

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think we should discuss whether TRP-specific BFR is allowed for inter-cell mTRP, which is relevant to UE feature discussion and could require potential ASN.1 change, e.g. to configure non-serving cell SSB for candidate beam detection. |
| Lenovo | The priority of positive LRR of TRP-specific BFR should be clarified. |
| ZTE | We want to highlight that UE behavior for the case that there is no new beam found (when one TRP fails) should be discussed with high priority. |
| Vivo | Similar view with ZTE. Besides, we think the UE behavior for the case of there is one or no new beam found when both TRPs fail in SpCell or SCell should also be discussed with high priority. |
| DOCOMO | We think following two issues have high priority.  -Whether support association configuration between a SR configuration for per-TRP BFR and TRP on an SCell.  -Whether support SSB associated with additional PCI to be configured as NBI-RS (in case of per-cell BFR and per-TRP BFR) |
| Qualcomm | The following issues are more critical to our understanding   * Clarification on association between PUCCH-SR and BFD-RS (MTK) * Extend mTRP BFR to inter-cell mTRP (DCM, Apple) * Priority of positive LRR (Lenovo) |

1. Simultaneous reception of signals with different QCL-typeD assumptions
   1. Issue 3.1: Simultaneous reception of signals with different QCL-typeD assumptions

As shown below, in #102e meeting, it’s agreed the study of simultaneous reception of signals with different QCL-type D assuptions is with low priority.

**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

Furthermore, the following statement was captured in the Chairman note of #102e meeting.

**In RAN1#102-e, the following combinations of physical channels were discussed but there was no consensus among the companies whether or not to study further in future meetings**

Study simultaneous reception of the same type of channels/RS with different QCL-TypeD assumption, including at least the following combinations:

* PDCCH+PDCCH, CSI-RS + CSI-RS

Study simultaneous reception of different types of channels with different QCL-TypeD assumptions, including at least the following combinations:

* SSB+PDCCH/PDSCH, PDCCH+PDSCH, PDCCH+CSI-RS, PDSCH+CSI-RS

Other combinations of channels/RS are not precluded.

In the contribution of this meeting, the following companies show their interests in this issue: QC, DCM, Apple, Sony.

Regarding this issue, companies are invited to provide their preferences and comments in the table below.

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We think we can discuss the simultaneous reception for some new cases in R17, e.g. SSB from NSC + other signal |
| DOCOMO | We support to discuss simultaneous reception for at least a part of combinations. |
| Nokia/NSB | We are open to discuss, and also pending to RAN4 RRM/demod discussion.  For Apple’s comment, we need to clarify RAN1 and RAN4 scope. It seems more RAN4 issue.  For PDCCH+PDCCH, due to no DMRS multiplexing is supported, UE complexity should be evaluated..  We don’t prefer supporting for simultaneous reception of data and reference signals. |

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.

* 1. RAN1#106b-e

**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.

**Agreement**

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

**Agreement**

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

* Alt-1: 1-to-1, fixed in spec
* Whether NBI-RS configuration is mandatory is separate discussion

**Conclusion**

Design of MAC-CE related to SpCell when transmitted on msg3, msgA is up to RAN2.

**Agreement**

For the case of all CORESETs with 1 activated TCI state per CORESET , after 28 symbols from receiving the BFR response, the QCL assumption of all CORESETs  associated with CORESETPoolIndex  k (k=0,1) is updated by the RS resource associated with the latest reported new candidate beam (if found) associated with the failed BFD -RS set k (k=0,1) in the MAC-CE for TRP -specific BFR

* The above applies to Scell and SpCell
* The above applies for the multi-DCI case

**Agreement**

SCS of the 28 symbols is the smallest SCS of the active DL BWP for the response reception CC and of the active DL BWP (s) of the CC(s) with the failed TRP link(s) reported in BFR MAC CE.

**R1-2110576** Summary of enhancements on beam management for multi-TRP (Round 3) Moderator (CATT)

**Agreement**

For RACH-based transmission, at least when all BFD-RS sets fail in SPCell, CBRA is supported

* 1. RAN1#107-e

**Conclusion**

For per-TRP BFR, no further restriction will be introduced on the spatial relation configuration of a PUCCH-SR resource.

**Agreement**

For implicit BFD RS configuration, if number of TCI states for CORESETs associated with a *CORESETPoolIndex* exceeds the UE capability on maximum number of BFD-RS resources per set, re-use the RLM-RS selection rule.

**Agreement**

On the PUCCH-SR resource/SR configurations selection rule when SR is triggered and 2 PUCCH-SR resource/SR configurations are configured, the UE triggers the PUCCH-SR resource/SR configuration that is associated with failed BFD-RS set.

**Agreement**

Regarding whether the two dedicated PUCCH-SR resources are corresponding to one *schedulingRequestId* or two *schedulingRequestId*

* Alt3: Leave it to RAN2

**Agreement**

Regarding how to differentiate Rel-15/16 and Rel-17 group-based beam reporting procedure,

* Alt-1 (explicit): to introduce a RRC parameter groupBasedBeamReportingR17, e.g. groupBasedBeamReportingR17

**Agreement**

On RACH -based transmission on a SpCell , the support of additional scenarios triggering RACH -based transmission on SpCell, if any, is up to RAN2.

**Conclusion**

For beam reporting option 2, there is no consensus on supporting the following alternatives in Rel-17:

* Alt-1: gNB configures UE whether to report beams associated with same or different RX spatial filters.
* Alt-2: UE informs to NW whether the reported beams in a beam group are associated with same or different RX spatial filters.
* Alt-3: UE informs to NW whether the reported beams in a beam group are associated with same or different RX spatial filters.
  + Maximum number of supported layers per RX spatial filter is signaled to gNB by UE capability signaling.

**Conclusion**

TRP -specific BFR for the case of CORESET with 2 TCI states is not supported in Rel-17.

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