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

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

Source: Moderator (CATT)

Title: Moderator summary #3 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
      1. **Round 1**

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

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

* **Alt-1**: whether beams are associated to different Rx filters/panels (Xiaomi, Qualcomm, Samsung, ETRI, Apple, CMCC, Huawei, HiSilicon)
  + Alt-1a: gNB configures UE to report beams are associated with same and/or different RX spatial filters (Nokia/NSB, DCM)
* **Alt-2**: whether beams are received with spatial multiplexing or diversity (ZTE, Intel, Sony)
  + Alt-2a : gNB configures UE to report beams for spatial multiplexing or diversity (DCM).
* **Alt-3**: maximum number of supported layer per DL RS in a group (MediaTek, Apple, Ericsson, ZTE)

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

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| Company | Comments |
| Apple | To clarify, we think Alt3 needs to be merged into Alt1. Standalone Alt3 cannot be helpful to identify the maiximum rank, since both DL RSs may be received from one panel. |
| vivo | We prefer Alt-1. |
| ZTE | We can also support Alt-3.  Besides, we also identify some remaining issues while two RS sets are configured for group based report procedure. For instance, whether Repetition, aperiodicTriggeringOffset for two sets should be configured with same value or not, and how to handle the corresponding CPU calculation of CSI. We prefer to have some further discussion. |
| OPPO | We do not support any of these 3 alts. The information all these three Alts shall belong to part of the CSI measurement and reporting. In Option 2, the UE reports one group of 2 Tx beams that can be received simultaneously. How/whether/how many layers the channel when these two Tx beam are used simulatenaouls shall be measured in mTRP CSI reporting, not here. |
| MediaTek | In AI 8.1.1 MP-UE, there is a similar discussion on UE can inform the max number of supported UL layers per SSBRI/CRI to NW by using a “logical index”. We see Alt-1 and Alt-3 can be supported by the same mechanism as well. We prefer to discuss issue 1.1 after there is a conclusion of MP-UE in AI 8.1.1. |
| DOCOMO | gNB knows the traffic type and overall scheduling information, so that gNB knows what type of two beams are needed from UE. In that case, gNB can configure the Rx panel/antenna related hypothesis for beam measurement, e.g., whether the two beams in each beam group are associated to different Rx filters/panels or whether the two beams in each beam group are for spatial multiplexing or diversity, and UE measures and reports the beam groups according to gNB’s indication.  Hence, we think above Alts should be configured by gNB, not reported by UE. |
| Xiaomi | We prefer Alt-1, which is benefit for gNB to apply the appropriate transmission scheme. |
| Spreadtrum | Not support Alt-1, it should be up to UE’s implementation.  Alt-3 belongs to CSI measurement and report not beam reporting. |
| CMCC | Support Alt-1. We think it would be helpful for gNB scheduling. |
| Nokia/NSB | We prefer gNB configuration of the reporting constraint for beams. UE indication only without gNB selecting constraint requires unnecessary overhead. gNB may select the preferred option by configuration while the same function of Alt-1 can be supported by Alt-1a if gNB configure both same and different RX spatial filter.  **Alt-1a** : gNB configures UE to report beams are associated with same and/or different RX spatial filters. |
| Futurewei | We shared same view as MediaTek that the discussion on this issue should wait for decision from AI 8.1.1. |
| Huawei, HiSilicon | Prefer Alt-1 |
| Qualcomm | Prefer Alt-1. For Alt-3, to our understanding, # of layers may not be accurately estimated by beam report. |
| DOCOMO2 | We share similar view as Nokia to support gNB configuration of the reporting constraint for reported beams. Hence, we can support Alt-1a and we also added Alt-2a above.  **Alt-2a** : gNB configures UE to report beams for spatial multiplexing or diversity. |
| LGE | Not support. We share the exactly same view with MediaTek and Futurewei. |
| TCL | We prefer Alt-1, where gNB can schedule flexibly. |
| Sony | Supportive to Alt.2.  Whether the DL channel can be used for spatial multiplexing or Tx diversity can be observed by UE. It could be helpful information for NW to make scheduling decisions in multi-TRP scenario.  As for Alt.1, whether different panels/Rx filter used by UE is somehow up to UE implementation. Potential benefits seem not clearly identified.  As for Alt.3, we tend to think that the function of maximum number of layer reporting can be fulfilled by CSI reporting (including Rank value). |
| Mod | Based on views of companies, the following proposal is summarized for further discussion:  ***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 |
| Ericsson | our first preference is Alt-3. But we can accept Alt-1 also for sake of progress. |
| InterDigital | We support Alt-1. We are also fine with waiting for conclusions from AI8.1.1. |
| Qualcomm | Support Proposal 1.1 with preference for Alt-1 |
| Intel | we think UE will have measurements for both types (same or different panel, spatial mux or diversity) – so gNB indication is needed so UE can report appropriate pairs. for Alt-1, it should be clarified that this indication is interpreted by gNB that simultaneous PDSCH reception (multi-TRP or spatial multiplexing) is possible due to this beam pair – this should be clarified. |

* + 1. **Round 2**

***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 |
| NTT DOCOMO | We’re generally fine with the FL proposal 1.1.  But if the main bullet says ‘gNB configures/UE indicates’, we’re fine to remove Alt-1a and Alt-2a. |
| ZTE | We support the FL proposal in principle. A clear agreement of listing candidates will be beneficial for subsequent discussion. But, it seems that the similar candidates are both mentioned in main and sub-bullets. It may be redundant, and we can simplify the main bullet. |
| OPPO | Do not support the proposal because none of the Alt1~3 works. They are propose something that has no metric and all those related information would have to be measured and determined again in CSI measurement and report.  Alt1: no matter what UE reports for each group of beams, the gNB would have to measure the CSI of the channel with those beams to obtain the real CSI information.  Alt2: whether one channel condition can support diversity or spatial multiplexing can only be determined during CSI measurement, not in L1-RSRP beam measurement.  Alt3: the number of layer or rank can only be measured and determined in CSI measurement. |
| Apple | We support Alt 1, and we have concern for Alt 1a, which is like gNB to control UE panels.  In addition, we do not need to wait for decision from 8.1.1, since the index in 8.1.1 is for UE power saving purpose instead of simultaneous reception. |
| Mod | Based on comment from ZTE, the main bullet is simplified. According to the preferences of companies, the proposal is updated as follows.  ***Updated FL Proposal 1.1: For group-based beam reporting, gNB configures/UE indicates***   * ***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*** |
| Huawei, HiSilicon | Continue to support Alt-1. |
| Sony | Support in principle.  One minor wording suggestion would be that in the main bullet we don’t need to repeat what has been captured in each alternative. That way the main bullet looks even more neat and avoid any misalignment with each alternative. |
| Xiaomi | Support the updated proposal 1.1 in principle. We also suggest to remove Alt-1a since gNB configures in the main bullet. In addition, we prefer UE indicates to gNB configures because of more scheduling flexibility. |
| CMCC | Support the updated proposal. Agree with Xiaomi’s update. |
| vivo | Support the latest FL proposal, and the same minor wording suggestion as Xiaomi. |
| MediaTek | Not support the updated FL Proposal 1.1 due to “gNB configure”in the main bullet and Alt-1a. UE panels can be controlled by gNB. |
| Nokia/NSB | Propose following update. gNB may configure UE with same/different/both RX filters, and if same or different are configured, UE shall report only beam group follows the constraint without increase of UCI overhead. If both is configured, UE includes 1 bit per beam group to indicate if same RX filters or different RX filters.  **Proposal** : For group-based beam reporting, gNB configures   * UE to indicate if beams of a group are assicated with different Rx filters/panels, or * UE to select beams of a group assoicated with same or different Rx filters/panels, |
| Samsung | We are fine with the latest FL proposal. We prefer to do the downselection this meeting. It has been discussed for several meetings already. |
| LGE | We still prefer to wait and discuss this issue after there is a conclusion of MP-UE in AI 8.1.1. In AI 8.1.1, there is a discussion regarding association between UE panel and a CSI-RS and/or SSB index as below proposal. If the below proposal is supported, gNB can be easily be aware of whether the reported beams in a group is received with same/different Rx panel(s).  **Proposal 4.A**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection,   * Support the UE reporting a list of UE capability values   + FFS: Whether the UE capability values comprises the number of SRS ports, number of UL transmission layers, coherence type, TPMI, or number of SRS resources within one SRS resource set   + FFS: Whether the list of UE capability values can be common across a set of BWPs/CCs * The correspondence between a CSI-RS and/or SSB resource index and the reported list of UE capabilities is determined by the UE (analogous to Rel-15/16) and is informed to NW in a beam reporting instance   + FFS: Whether and how to define the timeline for applying the correspondence   + FFS: How to inform the correspondence to NW in the reporting instance   + FFS: What type of beam reporting instance is considered, e.g. L1-RSRP/L1-SINR/BFRQ * Support multiple codebook –based SRS resource sets with different maximum number of SRS ports |

* + 1. **Round 3**

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

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| --- | --- |
| Company | Comments |
| Mod | Let’s try this simplified version. Based on the views collected so far, compared with Alt-2 and 3, there are more proponents for Alt-1. So, can we take Alt-1?  ***Updated FL Proposal 1.1: for group-based beam reporting gNB configures UE:***   * ***Alt-1: to report beams are associated with same and/or different RX spatial filters*** |
| Huawei, HiSilicon | Support updated FL proposal. |
| ZTE | It is indeed not our preference, but we can live with that. |
| NTT DOCOMO | Support updated FL Proposal 1.1. |
| Ericsson | We have a question on the sub-bullet. Note that there are only two beams in a beam group. Then there are two possibilities:  (1) the two beams are associated with the same Rx spatial filter  (2) the two beams are associated with different Rx spatial filters  but Alt-1 in the subbullet seems to imply that we can also have the possibility of  (3) the two beams are associated with same and different Rx spatial filters  How is (3) possible? Could the proponents clarify this? |
| MediaTek | Even our preference is Alt3, but we are okay to Alt1 only if the operation is decided by UE and informed to NW, instead of controlled by NW. Also, we share similar view with Ericsson, two beams can be either associate with the same or different Rx spatial filters, thus “and” should be removed from the proposal.  ***Updated FL Proposal 1.1: for beam reporting option 2, UE informs to NW:***   * ***Alt-1: whetehr the reported beams in a beam group are associated with same or different RX spatial filters*** |

* 1. Issue 1.2: Support of L1-SINR report
     1. **Round 1**

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

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

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

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| --- | --- |
| Company | Comments |
| Apple | We do not support L1-SINR since no performance gain is observed. |
| Vivo | We don’t support L1-SINR since it can not reflect inter-beam interference. |
| ZTE | If IMR is explicitly configured, we observer significant gains through implicitly reporting low-interference beam. Some results can be found in our contribution R1-2108873. |
| OPPO | It is not feasible to support L1-SINR for opition 2 due to the ifficulty of calculating mutual intereference.  If the IMR resource assumption is to resue the CMR of other beam, then the problem is we will meet a chicken-or- the egg problem: before UE calculates the L1-SINR, the UE does not know which two Tx beams shall be placed in one beam group. But before the UE knows which two Tx beams are in one beam group, the UE does not how to calculate the L1-SINR.  If the IMR resource is based on explicit IMR configruaiton, the issue is the inter-beam interference is not considered and the calculation of L1-SINR does not provide much valid information. |
| MediaTek | Not support L1-SINR |
| DOCOMO | Considering that group-based beam reporting has been supported for L1-SINR in Rel-16, it is also preferred to support group-based beam reporting option 2 for L1-SINR in Rel-17, which reflects inter-beam interference better. Explicit IMR configuration can be configured for each CMR, like CSI measurement configuration for NCJT. |
| Nokia/NSB | At least explicit IMR configuration can be supported analogous to Rel-16. |
| Futurewei | We support L1-SINR for Option 2. |
| Huawei, HiSilicon | Similar view as DOCOMO. Support both options on IMR resource assumption. |
| Qualcomm | We actually prefer explicit IMR. In fact, we are not clear on how reusing CMR works, since the same CMR cannot be simultaneously measured with two different beams by UE for signal and interference. Our proposal is to have multiple candidate beam pairs for UE to measure, and each beam in each candidate pair has explicit configured CMR and IMR to compute the corresponding L1-SINR.  **Proposal: For L1-SINR based group report, gNB configures multiple candidate beam groups, among which UE reports beam group(s) such that the two beams per group can be received simultaneously.**   * **The corresponding CMR/IMR per beam in each candidate group should be configured such that the reported L1-SINR per beam reflects cross-beam interference from the other beam in the group.**   + **To compute L1-SINR for gNB beam 1 of two gNB beams in a group, CMR is from gNB beam 1, IMR is from gNB beam 2, and both are measured by UE Rx beam for gNB beam 1.**   + **Similar configuration is used to compute L1-SINR for gNB beam 2 in the same group.**   In addition, please find sim results to compare L1-RSRP based and L1-SINR based beam group selection, as discussed in last meeting. The 50%ile throughput gain is substantial and confirms the intuition for considering cross-beam interference.  Summary of UE throughput gain of L1-SINR based beam group selection vs. L1-RSRP based beam group selection   * 5%ile gain: 51.9% * 50%ile gain: 56.7% * 95%ile gain: 11.3%  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | 5% Percentile  - L1-RSRP | 5% Percentile  - L1-SINR | 50% Percentile  - L1-RSRP | 50% Percentile  - L1-SINR | 95% Percentile  - L1-RSRP | 95% Percentile  - L1-SINR | | **UE Tput (Mbps)** | **2.3853** | **3.6236** | **10.2755** | **16.1090** | **24.5854** | **27.3659** | | **UE Tput Gain [%]** | **NA** | **51.9%** | **NA** | **56.7%** | **NA** | **11.3%** |   Throughput CDF comparison across all Ues in all runs  cid:image002.png@01D7BC4F.01DD2F30  SL sim assumptions   |  |  | | --- | --- | | Channel model | Indoor hotspot | | BW | 100 MHz | | Carrier frequency | 28 GHz | | Cell deployment | Single cell | | Cell radius | 20 m | | TRP deployment per cell | 2 co-located TRPs mounted on the ceiling | | Average UE # per cell | 40 | | L1-RSRP based beam group selection criterion for each UE | Two different beams from two TRPs with minimum L1-RSRP maximized | | L1-SINR based beam group selection criterion for each UE | Two different beams from two TRPs with minimum L1-SINR maximized | | Sim runs | 5 runs, each run has random UE drop in a single cell |   Comparison of UE throughput for each run and across all runs   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **UE Tput**  **(Mbps)** | 5% Percentile  - L1-RSRP | 5% Percentile  - L1-SINR | 50% Percentile  - L1-RSRP | 50% Percentile  - L1-SINR | 95% Percentile  - L1-RSRP | 95% Percentile  - L1-SINR | | Cell 1 | 1.8806 | 3.3091 | 11.1537 | 14.1318 | 18.6254 | 68.4791 | | Cell 2 | 3.3090 | 7.5681 | 15.6673 | 16.8646 | 27.4773 | 26.1319 | | Cell 3 | 3.9699 | 0.4647 | 8.2700 | 19.8489 | 24.6015 | 29.7328 | | Cell 4 | 2.5348 | 1.5828 | 9.6630 | 13.6672 | 26.5490 | 26.1244 | | Cell 5 | 0.8643 | 6.8035 | 10.0601 | 17.4436 | 21.2381 | 26.8734 | | **All Cells** | **2.3853** | **3.6236** | **10.2755** | **16.1090** | **24.5854** | **27.3659** | | **All Cells Gain [%]** | **NA** | **51.9%** | **NA** | **56.7%** | **NA** | **11.3%** |   Comparison of UE SINR per beam for each run and across all runs   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **SINR**  **(dB)** | 5% Percentile  - L1-RSRP | 5% Percentile  - L1-SINR | 50% Percentile  - L1-RSRP | 50% Percentile  - L1-SINR | 95% Percentile  - L1-RSRP | 95% Percentile  - L1-SINR | | Cell 1 | -3.8400 | -1.1600 | 9.1500 | 12.2500 | 29.9000 | 28.5200 | | Cell 2 | -4.2600 | -2.5200 | 9.3500 | 13.4750 | 29.9000 | 28.9200 | | Cell 3 | -7.1900 | -5.2900 | 5.6000 | 11.3500 | 26.2400 | 29.9000 | | Cell 4 | -5.5000 | -8.3000 | 8.8000 | 13.3000 | 26.4000 | 25 | | Cell 5 | -4.9900 | -0.2950 | 9.0250 | 14.5000 | 22.5700 | 29.9000 | | **All Cells** | **-5.2000** | **-3.1750** | **9** | **13.3000** | **29.6550** | **29** | |
| Samsung | Support L1-SINR for at least explicit IMR configuration. |
| LGE | Support L1-SINR based report at least with explicit IMR configuration. |
| TCL | Since L1-SINR based beam report is supported in Rel-16, we prefer to extend the explicit IMR resource assumption in Rel-17. |
| Sony | With the simulation from QC, we are even more confident that L1-SINR based beam reporting would result in non-marginal performance.  As for IMR, we are supportive to explicit IMR configuration on ZP and/or NZP IMR resources which is quite analogous to Rel.16. |
| Mod | Based on views of companies, the following proposal is listed for further discussion:  ***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 |
| ETRI | Having a similar view with DOCOMO, we support L1-SINR at least with explicit IMR configuration (prefer Alt-2). |
| Ericsson | Support L1-SINR, and we prefer the IMR to be configured explicitly. |
| InterDigital | Support Alt-2 to provide group-based L1-SINR reporting similar to Rel-16. |
| Qualcomm | Support Proposal 1.2 with preference for Alt-2 |
| Intel | Support Proposal 1.2, quick question to Qualcomm on this comment “the same CMR cannot be simultaneously measured with two different beams by UE for signal and interference” – if the two UE beams are from 2 active panels e.g. 2 Rx ports from panel-1 and 2 Rx ports from panel-2, we are thinking that UE will measure signal power from panel-1 and interference power from panel-2. In other words UE does not use both panels to measure either signal or interference (perhaps this is a key difference from L1-RSRP measurement). |
| Apple | We also do not support L1-SINR.  We noticed in R1-1907290, Qualcomm showed the following simulation results. If the intra-cell inter-beam interference is such small, we are wondering why the performance gain from inter-cell inter-beam interference aware based mTRP can be obtained. |
| Qualcomm | To Intel: To my understanding, the scheme you mentioned seems to let gNB to transmit CMR via a single gNB beam #1, and ask UE to measure this CMR via Rx beam #1 and #2 on panel #1 and #2 for signal part for gNB beam #1 and interference part for gNB beam #2, respectively. If so, such simultaneous measuring two resources with different QCL may exist in current spec at least for beam report and may need advanced UE capability to support. We think one QCL one time should still be the baseline capability in R17. But we are open to the advanced UE capability if any company can support. So explicit IMR can be baseline, and reusing CMR could be FFS or even UE optional if any company can support.  To Apple: Thanks for revisiting our study in R16. Please let me clarify the difference. The above quoted results are in the context of MU MIMO. The observation is that the cross beam/UE interference is insignificant if we can find two Ues with sufficiently large angular separation to pair. However, the scenario in R17 is for single UE group-based report. Picking two widely separated beams may not achieve good performance, since the beam signal strength may also degrade when the angular separation is increased. We may not see this in MU case as long as we have enough widely distributed Ues to pick. The observation from the SU group report results is that the optimized beam pair can achieve substantial gain by maximizing the minimum SINR of the two beams. My understanding is that the two selected beams  provide the best tradeoff between signal strength and cross-beam interference. If my memory is correct, the L1-SINR discussion in R16 MB is mainly for a UE served by a single TRP, and companies never investigated when a UE is served by mTRP with group report as in R17. |

* + 1. **Round 2**

***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, Sony,CMCC
* 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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| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support FL proposal 1.2, and prefer Alt-2. |
| ZTE | We suggest to go with majority views, i.e., Alt-2. |
| OPPO | We do not support proposal 1.2. Just as we explained in previous round, either Alt-1 or Alt-2 does not work.  If the IMR resource assumption is to resue the CMR of other beam, then the problem is we will meet a chicken-or- the egg problem: before UE calculates the L1-SINR, the UE does not know which two Tx beams shall be placed in one beam group. But before the UE knows which two Tx beams are in one beam group, the UE does not how to calculate the L1-SINR.  If the IMR resource is based on explicit IMR configruaiton, the issue is the inter-beam interference is not considered and the calculation of L1-SINR does not provide much valid information. |
| Apple | We did not observe performance gain for L1-SINR.  In addition, the proposal here is not clear to us. Is the intention to support ZP+NZP IMR? |
| Huawei, HiSilicon | Prefer Alt-1, and can support both Alt-1 and Alt-2. |
| Sony | Support the FL proposal.  And we share similar with ZTE that we could even step further to go with the majority view (I,e. Alt-2), since we don’t have too time left for down-selection. |
| CMCC | Support the proposal. Added our preference in the list. |
| Vivo | Do not support the Flproposal. |
| MediaTek | Do not support the Flproposal |
| LGE | Support the proposal. |

* + 1. **Round 3**

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| Company | Comments |
| Mod | @ vivo, OPPO, MediaTek, Apple: according to companies’ views collected in the first week, it’s clear that majority companies support L1-SINR with at least explicit IMR configuration. What’s more, according to the evaluation results provided by QC, notable gain with L1-SINR reporting can be observed. So, to make progress, can we go with majority?  @OPPO: I wonder why “inter-beam interference is not considered and the calculation of L1-SINR does not provide much valid information”? More detailed clarification could be helpful to us all.  @Apple: “***including ZP and/or NZP IMR***” doesn’t mean supporting interference measurement based on combined ZP+NZP IMR resources in one reporting. To our understanding, it means both ZP and NZP IMR can be utilized for interference measurement purpose, while depending on configuration, either ZP or NZP IMR can be used in one reporting.  The proposal is updated based on majority view.  ***FL Proposal 1.2: Support L1-SINR for beam reporting option 2***   * ***IMR resource assumptions:***    + ***Alt-2: explicit IMR configuration, including ZP and/or NZP IMR*** |
| Huawei, HiSilicon | Though we prefer to reuse the other beam in the reported beam group as IMR, we can accept the FL proposal. |
| ZTE | Support. BTW, to be honest, ‘SINR measurement based on both ZP and NZP IMR’ is not supported in R16, and we can remove ‘and’ herein. |
| NTT DOCOMO | Support. And agree with ZTE to remove ‘and/’. |
| Lenovo/MotM | Support. |
| Ericsson | Support FL proposal. |

1. M-TRP Beam failure recovery
   1. Issue 2.1: Simultaneous configuration of cell-specific and TRP-specific BFR in a cell
      1. **Round 1**

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

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | At current stage we do not see a problem to simultaneously configure cell-specific and TRP-specific BFR. Maybe we can revisit this issue after most of details for TRP-specific BFR is finished. |
| FGI/APT | We support the second bullet in general. But we suppose it can be applied for not only Scell but also Pcell/PSCell. |
| Vivo | For the procedure of BFR, we don’t support simultaneous configuration of cell-specific and TRP-specific BFR in a cell.  For the configuration of BFR-RS, we share similar view with FGI/APT. |
| ZTE | Based on the latest RAN2 agreement, the simultaneous operation of cell-specific and TRP-specific BFR has been supported. How to handle the configuration may be up to RAN2 also. In general, we also think that we may further review this issue in the maintanance session after the L1/MAC/RRC details have been stable. |
| OPPO | The definition of “simulatenous configuraiotn of cell-specific and TRP-specific” is not clear.  If it means “configuring BFD-RS for both cell-specific and TRP-specific and the UE detects beam failure for both cell-specific and TRP-specific”: then we do not support. That is not reasonable for pratical implemention. |
| DOCOMO | If TRP-specific BFR is configured, i.e., two BFD-RS sets are configured, there is no need to configure an extra BFD-RS set for cell-specific BFR. |
| Lenovo/MotM | For the first bullet, we support it.  For the second bullet, we also support it in general, but we prefer to include Pcell/PSCell as well. |
| NEC | Similar view with OPPO that definition of “simulatenous configuration of cell-specific and TRP-specific” should be clarified.  If it’s the procedure, does RACH based fallback + TRP specific BFR mean simultaneous configuration? And regarding the level of a cell, we think both of cell specific BFR and TRP specific BFR should be supported, there may be cases that one BWP with single-TRP (then cell specific BFR) and another BWP with multi-TRP (then TRP specific BFR).  And regarding the BFD RS configuration, we share similar view with DoCoMo that up to 2 BFD RS sets are sufficient. |
| Xiaomi | During the discussion of last RAN1 meeting, we are trying to clear the definition of “simultaneous configuration of cell-specific and TRP-specific”, but it is not agreed. We support the second bullet that up to 2 BFD-RS sets can be configured per at least Scell, Which means one BFD-RS for each TRP is configured. And if both BFD-RS sets are failed, that means Scell is failed. In this case, we suggest to update the first bullet as below:  Up to 2 BFD-RS sets can be configured per at least Scell, and cell specific BFR happens when both BFD-RS sets are failed. |
| CMCC | In our view, RACH based fallback + TRP specific BFR procedure can be “simulatenous configuration of cell-specific and TRP-specific” .  For SpCell, if both TRP are failed, the transmission of PUCCH-SR may not be successful. Therefore, for SpCell, cell-specific and TRP-specific BFR can be configured in the same CC. |
| Nokia/NSB | Cell-specific BFR is implicitly configured, and it can be triggered if all TRPs are failed.  Also, in this case, if CFRA is configured, CFRA is performed. (related issue with Issue 2.12)  We don’t see need for separate BFD-RS set configuration i.e. up to 2 BFD-RS sets are configured. Cell specific BFR can be initiated by UE if both TRPs fail (and e.g. no candidates can be indicated) |
| Futurewei | We are open to support simultaneous configuration of cell-specific and TRP-specific BFR in a cell and if configured, two BFD-RS sets are enough. |
| Convida | Regarding first bullet, it would be good clarify. Does it imply that the UE simultaneously performs cell-specific and TRP-specific BFD and BFR? This doesn’t seem meaningful. Or is the intention to configure cell-specific BFR parameters for fallback to RACH within the TRP-specific BFD/BFR procedure? If so, is the scope just SpCell? In that case, it would perhaps be better to say that some RACH-related parameters are configured for the per-TRP BFR procedure?  Regarding the second bullet, it would be good to clarify what it adds compared to the following agreement from RAN1#104-e:  **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) |
| Huawei, HiSilicon | We assume the 2nd bullet is also for simultaneous configuration of cell-specific and TRP-specific BFR in a cell. In that case, we can support the two bullets together. To be specific, cell-specific and TRP-specific BFR can be configured to operate simultaneously, but with up to two BFD-RS sets; when one BFD-RS set is detected with beam failure, TRP-specific BFR is triggered, if both BFD-RS sets are detected with beam failure, cell-specific BFR is triggered. |
| Qualcomm | We support no simultaneous config for simplicity. Otherwise, we need to clarify the following issues if allowing simultaneous config   1. Can BFD RS be independently configured for cell-level and TRP-level BFRs, e.g. BFD RSs can be completely independent? 2. If Yes for Q1    1. If one TRP fails and corresponding TRP level BFR is ongoing, can UE further trigger cell level BFR if it is detected later? If can, how to handle the ongoing TRP level BFR?    2. If a cell fails and corresponding cell level BFR is ongoing, can UE further trigger TRP level BFR if it is detected later? If can, how to handle the ongoing cell level BFR?   We suggest to clarify the interaction between the two BFRs before making the decision. |
| Samsung | Share a similar view that the context of simultanous configuration of cell-specific and TRP-specific is unclear. One understanding is that if both TRPs fail within a certain period of time, the cell-specific BFR is initiated instead of two separate TRP-specific BFRs. Clarifications are needed regarding this issue. We support the second bullet in principle. |
| LGE | From BFD perspective, second bullet is fine for us, as well as for SpCell.  But,but,nd bullet is fine for us. from BFRQ perspective, cell-specific and TRP-specific configuration can be simultaneously configured as discussed in Issue 2.12, e.g., cell-specific BFRQ can be triggered when both BFD-RS sets are failed in SpCell. |
| TCL | We support the second bullet in principle. To be specific, when one of the two TRPs fails, TRP-specific BFR is triggered; when both TRPs fails, cell-specific BFR is triggered. |
| Sony | It seems the word “simultaneously” is causing clarity issues, since it may refer to a very short duration, let’s say in symbol or slot level. In our view, it can be clarified as “cell-specific BFR and TRP-specific BFR can be both configured to a cell”.  In addition, we are fine to set up to 2 BFD RS sets when both cell-specific and TRP-specific BFR are configured. UE could reuse the two TRP-specific BFD RS sets for cell-specific BFD purpose. |
| Mod | Acording to the discussion above, companies have different undertanding on simultaneous configuration of cell-specific BFR and TRP-specific BFR in the same CC. To facilitate further discussion on this issue, a common understanding on the definition of “cell-specific BFR” and “TRP-specific BFR” needs to be reached first.  To our understanding, this depends on the number of BFD-RS sets, e.g. a CC with a single BFD-RS set is configured in “cell-specific BFR”, while a CC configured with two BFD-RS sets is configured with TRP-specific BFR. For a CC with a single BFD-RS set, the BFD-RS set may be used to monitor BFR in both TRPs (as in Rel.15/16). It is also possible the single BFD-RS set monitors beam failure of one out of the two TRPs, or even a few CORESETS of a single TRP. This corresponds to a deployment where the NW is not intended to monitor beam quality for the other TRP, or not all CORESETs.  Then on whether a CC can be configured with both cell-specific and TRP-specific BFR on the same CC, the use case does not appear strong to us. Besides, it is our understanding that cell-specific BFR and TRP-specific BFR refer to the whole BFR procedures (e.g. BFD-RS determination, failure event report, gNB response and beam overwriting). If cell-specific BFR and TRP-specific BFR are configured simultaneously, it is unclear whether NW/UE should be prepared to enable two sets of BFR procedures, including all internal steps, separately. Although it certainly can be discussed, our current preference is to avoid this duplicated design unless strong benefits can be observed.  On bullet 2, it seems that most of companies agree to have up to BFD-RS sets per at least SCell. And some companies suggest to apply this limit also to PCell and/or PSCell. So, we have the following FL proposal 2.1 for further discussion.  ***FL Proposal 2.1: A UE is configured with either “cell-specific” BFR (i.e., 1 BFD-RS set) or “TRP-specific BFR” (i.e. 2 BFD-RS sets) on one CC. Up to 2 BFD-RS sets can be configured per CC.***  Companies’ views on issue 2.1 are listed as follows:   * Support: ETRI, InterDigital, QC, Intel, CATT * Not support: Ericsson |
| ETRI | Support. |
| Ericsson | Do not support latest update from moderator.  R15/16 BFR is not the same as RACH-based fallback: Rel-16 specifies Scell BFR, which does not (necessarily) rely on RACH.  The best interpretation we can make is that “cell-specific BFR” is the same as Rel-15/16 BFR. If it’s not, then it’s a new feature.  From a specification point of view, features are independent, and RAN1 should not put limitations in its specifications that forbid combinations of the Rel-15/16 BFR and Rel-17 TRP-specific BFR features. The current formulation by the latest moderator proposal only allows one or the other. So we don’t support the current formulation.  We suggest the following modifications to the previous version of the proposal:   * Support simultaneous configuration of ~~cell-specific~~ Rel-15/16 BFR and TRP-specific BFR in a cell * Up to 2 BFD-RS sets can be configured per ~~at least Scell~~ CC (including Scell and SpCell) |
| InterDigital | Support FL’s proposal. |
| Qualcomm | Support Proposal 2.1. If allowing them to be configured simultaneously, we may need to clarify rules for their interaction/relation on BFD and BFR procedure, as questions raised before. It could be more. |
| Intel | We generally support FL proposal 2.1 because we think that per-TRP BFR would include R15/16 BFR features. |
| Lenovo/MotM | We support Ericsson’s modified version of proposal. |

* + 1. **Round 2**

***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: Support
* Not support:

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | We can support the 2nd bullet. We suggest removing the 1st bullet. |
| ZTE | We can support the above FL proposal. |
| OPPO | We do not support the proposal because “***simultaneous configuration***” is not clear. |
| Convida | We do not support the proposal either.  It would be good to clarify the procedure first, before deciding what to configure. |
| Apple | Maybe we can defer the decision, it seems the two bullets are not aligned. |
| Mod | Let’s try to restart from the following version which is revised from FL proposal in round 1 summary.  ***FL Proposal 2.1: A UE is configured with either “Rel-15/16 BFR” BFR (i.e., 1 BFD-RS set) or “TRP-specific BFR” (i.e. 2 BFD-RS sets) on one CC. Up to 2 BFD-RS sets can be configured per CC.*** |
| Huawei, HiSilicon | Support, and suggest adding “Rel-17” before “TRP-specific BFR”. |
| Sony | Support the proposal. We would like to re-state the agreement achieved early in 106bis-e.  **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***   The highlighted yellow implies Rel.15/16 cell-specific BFRQ and the highlighted cyan implies TRP-specific BFD. And they are both carried out on a SpCell. So we think at least both cell-specific BFR and TRP-specific BFR can be configured on SpCell. |
| Xiaomi | We can support the second bullet.  As for the first bullet, since the definition of simultaneous configuration is not clear, we suggest to not use simultaneous configuration, and update it as below:   * Support configuration of both TRP-specific BFR and Rel-15/16 BFR by configuring two BFD-RS set per CC.   + With this configuration, TRP-specific BFR is triggered when beam failure is detected on any one BFD-RS set and Rel-15/16 BFR is triggered When beam failure is detected on two BFD-RS sets. |
| CMCC | Support the proposal.  We share the similar view with Sony. The agreement we achieved on the 1st GTW implied that simultaneous configuration of Rel-15/16 BFR and TRP-specific BFR can be supported, at least for SpCell. |
| NEC | Support the proposal, |
| vivo | We suggest changing “BFR” to “BFD” to avoid ambiguity. |
| Samsung | Regarding the latest FL proposal, we do not think the “Rel-15/16” BFR is tied to 1 BFD RS set in the context of MTRP. As pointed out by several companies, if two BFD RS sets fail, the “Rel-15/16” BFR is triggered. |
| Lenovo&MotM | We share similar view with Sony. According the agreement reached, it implies both cell-specific BFD and TRP-specific BFR can be configured on SpCell. |
| Convida | We’re generally fine with the latest FL proposal.  Regarding the relation with the previous agreement, it seems that any necessary parameters related to “RACH-based transmission” can be included in the configuration for “TRP-specific BFR” (only on SpCell). In other words, it doesn’t seem that “RACH-based transmission” within the TRP-specific BFR implies that Rel-15/16 needs to be configured.  Regarding “Up to 2 BFD-RS sets can be configured per CC”, we have the following agreement from RAN1#104-e:  **Agreement**  For M-TRP BFR   * Support 2 BFD-RS sets per BWP, and up to N resources per BFD-RS set * …   In our understanding, if per-TRP BFR is configured on a CC, we have 2 BFD-RS sets per BWP, either explicitly or implicitly configured. If we don’t have per-TRP BFR configured on a CC, we can configure Rel-15 BFR (SpCell) or Rel-16 BFR (SCell), with 1 BFD-RS set per BWP. Our suggestion would be:  ***Proposal: A UE is configured with either “Rel-15/16 BFR” BFR (i.e., 1 BFD-RS set per BWP) or “TRP-specific BFR” (i.e. 2 BFD-RS sets per BWP) on one CC. ~~Up to 2 BFD-RS sets can be configured per CC.~~*** |
| LGE | Support the revised proposal by Mod. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | FL proposal 2.1 is updated as follows. Hopefully this addresses companies’ concern.  ***Updated Proposal 2.1: A UE is 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 CC.*** |
| Huawei, HiSilicon | Supported updated proposal. |
| ZTE | Support |
| NTT DOCOMO | Support |
| Ericsson | As we commented in Round 1, we don’t see why only one of ‘Rel-15/16 BFD’ or ‘TRP-specific BFD’ needs to be supported in one CC.  So we do not support the latest FL proposal. We suggest the following revision:  ***Updated Proposal 2.1: A UE is configured with ~~either~~ “Rel-15/16 BFD” ~~(i.e., 1 BFD-RS set per BWP)~~ and/or “TRP-specific BFD” ~~(i.e. 2 BFD-RS sets per BWP)~~ on one CC.*** |

* 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 Introduce MAC-CE for updating explicit BFD-RS set: CATT, ZTE, Samsung, DOCOMO, vivo, Convida
* Support to associate TCI state for PDCCH with a BFD RS: OPPO, Apple, Convida
* Support to update QCL source for BFD-RS of failed TRP link to RS corresponding to reported new beam: Huawei, Hisilicon
* Support to automatically include the RS corresponding to reported new beam into BFD-RS set for the recovered TRP link: Huawei, Hisilicon

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

|  |  |
| --- | --- |
| Company | Comments |
| vivo | We support to introduce MAC-CE for updating the QCL assumption(s) of BFD-RS(s) configured explicitly. Besides, we think reusing legacy mechanisms, e.g., RRC signalling, to update explicit BFD-RS set is fine. |
| ZTE | Support explict MAC-CE update for BFD-RS, in order to guarantee the same timeline between PDCCH beam update and explicit BFD RS configuration. |
| DOCOMO | Support both RRC and MAC CE based configuration of BFD-RS resource set(s). |
| Lenovo/MotM | We support at least RRC based explicit BFD-RS set configuration, and we are open to further support MAC CE based updating of BFD-RS set. |
| Spreadtrum | For the first bullet, not support. In Rel-15/16, for the per cell BFR, RRC reconfiguraiton is used to update BFD-RS. We don’t understand why BFD-RS are needed to be updated by MAC CE for Rel-17 per TRP MFR.  For the seond bullet, the justification is not clear to us. |
| CMCC | Support the first bullet. |
| Nokia/NSB | Not support the proposals.  We are preferring this should be discussed as general beam management framework.  This proposal introduces MAC-CE update for periodic CSI-RS, which is not supported. We think this cannot be supported only for BFR.  So, we can discuss this feature in the later release e.g. the implicit configuration is specified and used when timely configuration of BFD-RS is required (updated simultaneously with active TCI state). |
| Futurewei | The justifications to support MAC-CE update of BFD-RS is not clear to us. |
| Convida | Support both directions, to reduce explicit BFD-RS update latency. |
| Huawei, HiSilicon | With explicit BFD-RS configuration, after the link to one TRP has failed and new beam has been identified/reported, the gNB would need to update the QCL source for BFD-RS or BFD-RS itself to monitor the link quality towards that TRP by RRC or MAC CE. In this case, it seems better to update the QCL source of BFD-RS to be the RS corresponding to reported new beam directly. We added this alternative to the list above. |
| Qualcomm | For MAC-CE updating BFD RS, we don’t see the need. The implicit BFD is not agreed for sDCI based mTRP. It is the best candidate to address this issue, to our understanding. No agreement for implicit BFD means no consensus on the benefit to further improve this aspect.  For associating PDCCH TCI with a BFD RS, what is the difference from implicit BFD RS?  For updating BFD RS QCL for failed TRP, we think implicit BFD is the best candidate to address this issue. No agreement for implicit BFD means no consensus on the benefit to further improve this aspect. |
| Huawei, HiSilicon | Other than updating QCL assumption of BFD-RS, we realized that it is also possible to update BFD-RS set itself. That is, after receiving beam failure recovery response, the UE automatically include the RS corresponding to reported new beam into BFD-RS set, which can help saving explicit signaling. We added this alternative to check companies’ views. |
| Samsung | We support updating BFD RS via MAC CE to keep up the same pace of TCI state update/change for PDCCH reception. |
| LGE | Not support. RRC based BFD-RS configuration is sufficient, which is same as legacy. Moreover, Nokia’s comment is valid that we are trying to MAC-CE update for periodic resource, which is not supported in legacy. |
| TCL | We support to introduce MAC-CE for updating BFD-RS set to reduce the update latency. |
| Mod | Proposal 2.2 is provided for further discussion.  @ QC, OPPO, Apple, Convida: let’s focus on the issue of updating for explicit BFD-RS set first, updating for implicit BFD-RS set can be treated as a separate issue.  @ Huawei: to our understanding, update of QCL source for BFD-RS of failed TRP according to reported new beam could be a part of the procedure after reporting of new beam, and can be discussed later.  ***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, [Lenovo/MotM], TCL, InterDigital * Not support: Spreadtrum, Nokia/NSB, Futurewei, Qualcomm, LGE, Ericsson, Intel |
| Ericsson | Not support FL Proposal 2.2.  Regarding Proposal 2.2 from FL, we don’t see the need to update explicit BFD-RS set via MAC CE. Updating via RRC reconfiguration should be sufficient for updating explicit BFD-RS sets. |
| InterDigital | Support FL’s proposal to enable MAC-CE activation of BFD-RS set. |
| Qualcomm | We prefer not to support Proposal 2.2. The best candidate for such optimization is implicit BFD, which is not agreed for sDCI mTRP. To our understanding, it implies no consensus on the value for such optimization |
| Intel | we dont support FL proposal 2.2, same argument as QC |
| Lenovo/MotM | Don’t support FL Proposal 2.2. Similar view with Ericsson. |

* + 1. **Round 2**

***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.

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support FL proposal 2.2. |
| ZTE | Opponent companies still have not reply the question of how to handle the timeline misalignment issue if only RRC explicit configuration is supported. |
| OPPO | We support the solution of configuring BFD-RS in each TCI state, which can even minimize the signaling requirement on MAC CE. |
| Convida | Support the proposal. |
| Apple | We think to configure BFD RS in TCI is a better solution given the fact that DCI based beam indication for PDCCH is supported in unified TCI framework. But we can live with it for progress.  In addition, this proposal may be incomplete. I think first we need to configure a list of candidate BFD RS resources, and the MAC CE should be used to select a sub-set from the list. |
| Huawei, HiSilicon | Not support. It is much simpler for UE to automatically replace the explicitly configured BFD-RS by the reported RS representing the identified new beam, which does not require additional MAC-CE signaling from NW. |
| Xiaomi | Since unified TCI state is updated by DCI in most cases, it seems MAC-CE still can’t handle the timeline misalignment issue.  While for configuration of BFD-RS in each TCI state, we are wondering which TCI state will be used for BFD-RS determination, if it is the TCI state for PDCCH reception, what is the difference with implicitly configuration? |
| CMCC | Support the proposal. |
| vivo | There are two update methods of explicit BFD-RS set, one is updating BFD-RS resource(s) in the explicit BFD-RS set via MAC CE, the other is updating the QCL assumption(s) of BFD-RS resource(s) in the explicit BFD-RS set. We would like to revise FL proposal 2.2 as follows:  ***FL Proposal 2.2: Support to update explicit BFD-RS set via MAC-CE.***   * **Alt-1: update BFD-RS resource(s) in the explicit BFD-RS set** * **Alt-2: update the QCL assumption(s) of BFD-RS resource(s) in the explicit BFD-RS set**   Compared with Alt-1, we prefer Alt-2. We are also fine to reuse the legacy update mechanism, e.g., RRC reconfiguration. |
| Nokia/NSB | We don’t support the proposal. |
| Samsung | Support FL proposal. Share a similar understanding to Apple that a list of candidates are needed at the first place. q\_new can be identified after beam failure, not sure how it can be used to update BFD RS if there is no beam failure detected/declared. |
| LGE | Not support. We support only RRC based BFD-RS configuration as legacy. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | As suggested by companies, the following two alternatives are listed for discussion.  ***Updated FL Proposal 2.2: Support to update explicit BFD-RS set via MAC-CE.***   * ***Alt-1: update BFD-RS resource(s) in the explicit BFD-RS set*** * ***Alt-2: update QCL assumption(s) of BFD-RS resource(s) in the explicit BFD-RS set*** |
| Huawei, HiSilicon | Not support. It is simpler for UE to automatically replace the explicitly configured BFD-RS by the reported RS representing the identified new beam, which does not require additional MAC-CE signaling from NW. |
| ZTE | Support. Automatically update by the reported RS as HW proposed can not solve the timeline misalignment issue introduced by gNB initialized beam update. |
| NTT DOCOMO | Support. And prefer Alt-1. |
| Ericsson | Not support. RRC based BFD-RS set configuration is sufficient for explicit update. No need for MAC CE based mechanism. |
| MediaTek | If RAN1 cannot reach concensus, we are okay to preclude explicit BFD-RS configuration from Rel-17 MTRP BFR.   * ***Alt3: Not support explicit BFD-RS configuration for Rel-17 MTRP BFR*** |

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

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

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We do not quite understand the first bullet. Some clarification may be needed.  For the second bullet, we support Alt1. |
| vivo | According to the discussion when the maximum number(X) of BFD RS is determined, the understanding is to at most X periodic CSI-RS resources would be configured for all the CORSETs. So it should be specified that UE does not expect larger than X periodic CSI-RS resources QCL-D’ed with configured CORESETs. |
| ZTE | Regarding first bullet, some clarification may be needed.  Regarding second bullet, we prefer to simplify the selection rule, rather than directly reusing the complicate rule for RLM-RS selection. |
| OPPO | For the 2nd bullets, we prefer Alt-1. |
| DOCOMO | For the 2nd bullets, support Alt-1. |
| Lenovo/MotM | For the first bullet, it’s not clear enough. For our understanding, the X is the number of TCI states is the number of RSs of a TCI state pool where one BFD-RS set is selected. If our understanding is correct, we support Alt-2.  For the second bullet, we support Alt-1. |
| Xiaomi | For the first bullet, it had been agreed in 106-e meeting.  **Agreement**  The maximum number of BFD-RS resources per set is a UE capability, including a possible candidate value of 1 in Rel.17.  For the second bullet, we prefer Alt-1. |
| Spreadtrum | For the second bullet, we prefer Alt-2. |
| CMCC | For the 2nd bullet, support Alt-2 |
| Nokia/NSB | For BFD-RS selection (second bullet) Alt-1 is preferred. |
| Futurewei | For the second bullet, we prefer Alt-1. |
| Convida | For the 2nd bullet, prefer to keep Rel-15/16 behavior, i.e. Alt-2. |
| Huawei, HiSilicon | Support Alt-1 for both issues. |
| Qualcomm | For 1st issue, support X depending on UE capability, which at least includes 1  For 2nd issue, support Alt-1 to align understanding at both gNB and UE |
| Samsung | We prefer Alt-1 for the second bullet. |
| LGE | We also couldn’t understand the intention of first bullet. X is determined based on the UE capability reporting regarding the number of BFD-RSs per set.  Regarding the second bullet, Alt-1 is prefered. The number of CORESETs per BWP is increased compared to Rel-15, so specific selection rule is safe for both gNB and UE. |
| TCL | For the second bullet, we prefer Alt-1. |
| Mod | According to the following agreement reached in #106e, we have similar understanding as Lenovo/MotM that X is the number of TCI states of a TCI state pool where one BFD-RS set is selected. Furthermore, the X TCI states are determined from the TCI states of CORESETs.  So, to determine the BFD-RS set implicitly, we need to determine X TCI states from a number of TCI states of CORESETs first. Based on the agreement shown below, the following two issues related to the value of X are still left open:   * Issue 1: whether the value of X is determined in spec or UE capability. According to companies’ contributions and discussion above, at least the following companies showed their preferences:   + Alt-1: Ericsson and Huawei support a fixed value of X=2   + Alt-2: CATT proposes that X is the number of TCI states of CORESETs with CORESETPoolIndex = k. it’s noted that, the second issue can be avoided with this alternative. * Issue 2: TCI selection rule when the number of CORESETs with CORESETPoolIndex = k exceeds X   **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   FL proposal 2.3 is listed below for further discussion.  ***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=2***   + ***Alt-2: X=the number of TCI states of CORESETs with CORESETPoolIndex = k*** * ***TCI state selection when the number of CORESETs with CORESETPoolIndex = k exceeds X***   + ***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***  Companies’ views on issue 2.3 are listed as follows:   * The number of TCI states (X) in implicit BFD-RS determination   + Alt-1 : Ericsson, Huawei, HiSilicon, TCL, InterDigital, Intel   + Alt-2 : CATT * BFD-RS selection when the number of CORESETs with CORESETPoolIndex = k exceeds X   + Alt-1: Qualcomm, Huawei, HiSilicon, Nokia/NSB, DCM, Ericsson, Interdigital   + Alt-2: Convida   + Alt-3: vivo |
| Ericsson | After some further offline discussion, we now prefer Alt-1 on issue 2 above. Our views are updated in the moderator summary above.  Note that we also need to resolve the last FFS: CORESETs with more than 1 activated TCI states from the above agreement. |
| InterDigital | Support FL’s proposal, and Alt-1 for both proposals. |
| Qualcomm | We suggest to reword the Proposal 2.3 as below. To our understanding, X is the total candidate TCI states, which should be further down selected if exceeding the max BFD RS # per set supported by UE, and the following agreement is applicable for both explicit and implicit BFD. With the modification below, our preference is Alt2 for 1st bullet, and Alt1 for 2nd bullet   * ***TCI state selection when ~~the number of CORESETs with CORESETPoolIndex = k exceeds X~~ X exceeds the UE capability on the maximum number of BFD-RS resources per set***   **Agreement**  The maximum number of BFD-RS resources per set is a UE capability, including a possible candidate value of 1 in Rel.17. |
| Intel | Support Alt-1, ok with QC modification |
| MediaTek | We prefer QC’s modification |
| Mod | Based on suggestion of Qualcomm, the following FL proposal is updated  ***Updated 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 ~~the number of CORESETs with CORESETPoolIndex = k exceeds X~~ 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*** |
| Lenovo/MotM | Regarding to the updated FL Proposal 2.3, we support Alt-2 for the first bullet and support Alt-1 for the second bullet. |
| Qualcomm | For the updated 2.3, our preference is Alt2 for 1st bullet, and Alt1 for 2nd bullet |

* + 1. **Round 2**

***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 : ZTE(No spec impact), Sony, HW, Xiaomi
  + Alt-2 : DCM, Convida, Lenovo/MotM, NEC, Nokia/NSB, LGE
* TCI state selection when X exceeds the UE capability on the maximum number of BFD-RS resources per set
  + Alt-1: ZTE, Sony, DCM, Apple, Lenovo/MotM, HW, Xiaomi, NEC, Nokia/NSB, LGE
  + Alt-2: Convida
  + Alt-3:

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | For 1st bullet, we support Alt-2. For 2nd bullet, we support Alt-1.  And we should add following FFS because Rel-16 rule considers CORESETs with 1 activated TCI states only.  FFS: CORESETs with 2 activated TCI states. |
| ZTE | For second proposal, we think that some clarification on the candidate of ‘similar to the RLM-RS selection rule’ is needed. In our views, if greater than 2, the BFD-RS may just based on the RS of TCI state of CORESET with lower ID. |
| OPPO | Support Alt1 for both. |
| Convida | Prefer to follow Rel-15/16 principles, i.e. Alt 2 for both. |
| Apple | For the first bullet, it seems we have agreed to introduce UE capability on maximum number of BFD RS. Is it for BFD RS per TRP or across TRPs in one CC?  For the second bullet, we support Alt-1 |
| Lenovo/MotM | For 1st bullet, we support Alt-2.  For 2nd bullet, we support Alt-1. |
| Huawei, HiSilicon | Support Alt-1 for both issues. |
| Sony | Add our preference after each preferred alternative. |
| Xiaomi | Support Alt 1 for both issues |
| NEC | Support Alt-2 for first bullet.  Support Alt-1 for second bullet.  We also support FFS added by DoCoMo. |
| Vivo | For the value of X, we think it can be configured by gNB based on the UE capability, and the value range is [1, min(the number of TCI states of CORESETs with CORESETPoolIndex = k, UE capability on the maximum number of BFD-RS resources in BFD-RS set k)]. |
| Nokia/NSB | Support Alt-2 for 1st bullet, Support Alt-1 for 2nd bullet. |
| LGE | Support Alt-2 for 1st bullet, Support Alt-1 for 2nd bullet. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | @DCM & NEC: FFS is added.  @ZTE: further clarification is added.  @Apple: as stated in the note, BFD-RS set k (k = 0, 1) is derived based on X TCI of CORESETs with CORESETPoolIndex = k. That is, X out of N TCI states activated for CORESETs with CORESETPoolIndex = k is taken, and then, according to UE capability, a number of BFD RSs in set k (k = 0, 1) is further selected from the set of X TCI states.  @vivo: Alt-B is added according to your suggestion.  ***Updated FL Proposal 2.3: For implicit configuration of BFD-RS set for M-DCI***   * ***Alt-A***   + ***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. For example, the RSs in TCI states of CORESETs with lower IDs are selected as BFD RSs.*** * ***Alt-B***   + - ***X is configured by gNB based on the UE capability, and the value range is [1, min(the number of TCI states of CORESETs with CORESETPoolIndex = k, UE capability on the maximum number of BFD-RS resources in BFD-RS set k)]***   ***FFS: CORESETs with 2 activated TCI states.***  ***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*** |
| Huawei, HiSilicon | Support Alt-2 of Alt-A. |
| ZTE | Support Alt-2 of Alt-A |
| NTT DOCOMO | Support. And prefer Alt-2 of Alt-A. |
| Lenovo/MotM | Support Alt-2 of Alt-A. |
| Erisson | Our preferences are highlighted below:  ***Updated FL Proposal 2.3: For implicit configuration of BFD-RS set for M-DCI***   * ***Alt-A***   + ***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. For example, the RSs in TCI states of CORESETs with lower IDs are selected as BFD RSs.*** * ***Alt-B***   + - ***X is configured by gNB based on the UE capability, and the value range is [1, min(the number of TCI states of CORESETs with CORESETPoolIndex = k, UE capability on the maximum number of BFD-RS resources in BFD-RS set k)]*** |

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

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

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

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support Alt1. |
| FGI/APT | We support Alt-3 with the understanding that this issue belongs to RAN2’s expertise. |
| vivo | We support Alt-1 if NBI-RS set(s) is configured. |
| ZTE | We can also live with Alt3. |
| MediaTek | Support Alt1, this can be decided in RAN1 |
| DOCOMO | Support Alt-1, and we can also accept Alt-3. |
| Lenovo/MotM | We support Alt-1. |
| NEC | We prefer Alt-1. |
| Xiaomi | We prefer to map the BFD-RS set and the NBI-RS set with the same set index. But i’m not sure it is Alt-1 or Alt-2. |
| CMCC | Support Alt-1. |
| Nokia/NSB | Prefer to leave it to RAN2 (Alt-3). |
| Futurewei | We prefer Alt-3. |
| Convida | In our understanding, the gNB can configure the NBI-RS in the NBI-RS sets freely. In other words, the gNB essentially freely swap NBI-RS set 0 and NBI-RS set 1 by configuring NBI-RSs in the right NBI-RS set. What is then the point of having a configurable association? |
| Huawei, HiSilicon | Open for both Alt-1 and Alt-2. If it is difficult reach consensus in RAN1, we suggest leaving it to RAN2. |
| Qualcomm | Support Alt-2 for flexibility, also fine for Alt3 |
| Samsung | Support Alt-1, linked with set index. |
| LGE | Either Alt-1 or Alt-3 is fine for us. |
| TCL | We prefer Alt-1. |
| Sony | Support Alt-1. |
| Mod | FL proposal 2.4 is listed below for further discussion.  ***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 2.3 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 |
| ETRI | Support Alt-3. |
| Ericsson | This can be left to RAN2 (Alt-3) |
| InterDigital | Support Alt-3. |
| Qualcomm | Support Alt3 to save time |
| Intel | Support Alt-1, RAN2 will ask RAN1 again :-) |
| Lenovo/MotM | Support Alt-1. |

* + 1. **Round 2**

***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 (15): Apple, vivo(if NBI-RS set(s) is configured), MediaTek, DOCOMO, Lenovo/MotM, NEC, CMCC, Samsung, LGE, TCL, Sony(1st), Intel, Xiaomi, Convida, FGI/APT(2nd)
* Alt-3(15): FGI/APT, ZTE, DOCOMO(2nd), Nokia/NSB, Futurewei, QC, LGE, Ericsson, ETRI, Qualcomm, OPPO, Huawei, HiSilicon, Xiaomi(2nd), Convida, Sony(2nd)

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Alt-1 is our first preference, and Alt-3 is our second preference. |
| ZTE | It may not be an essential issue, and can be left to RAN2. |
| OPPO | Ok with Alt-3. |
| Convida | Both are ok. |
| Apple | We think it is RAN1’s duty to make a decision, since RAN1 agreed to introduce 2 sets BFD/CBD RS. RAN1 should figure out the association. Since Alt1 is the majority’s view, we suggest to go with Alt1.  In addition, similar to Scell BFR, we think the CBD-RS should be mandatorily provided. This does not increase the system overhead, as gNB anyway needs to transmit some RSs for beam measurement, otherwise, we have to face the complicated “default” related issue like to use some RS in the same CC, and if there is no such RS, we use some other RS in another CC. |
| Lenovo/MotM | Support Alt-1, similar view with Apple. |
| Huawei, HiSilicon | Support Alt-3. |
| Sony | Support Alt.-1 as 1st preference and we are also okay with Alt.3 as 2nd priority. |
| Xiaomi | Our first preference is Alt 1, and we are also fine with Alt 3. |
| CMCC | Support Alt-1, |
| NEC | Prefer Alt-1. |
| Vivo | Support Alt-1 if NBI-RS set(s) is configured. @Apple, the overhead is not only in network side for RS transmission, but also lies in the fact that in Rel-16 UE capability discussion it is assumed UE always measures those NBI-RS once configured. This would create additional constraint for network scheduling since the UE capability to measure RS within a slot is bounded by reported values. For the concern that additional rules needed for the case without configuration of NBI-RS, we are fine to ruled out the possibility explicitly. |
| Nokia/NSB | Support Alt-3. No difference between the proposal because the signaling design is up to RAN2. |
| FGI/APT | Still prefer Alt-3. However, we can live with Alt-1 as well. |
| Samsung | Both Alt-1 and Alt-3 are fine for us. |
| LGE | Support the proposal. Both are OK for us. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | According the inputs from companies in the first two rounds of discussion, we have equal number of proponents for the two alternatives. However, it’s noted that Alt-1 is the 1st preference of 14 companies, while Alt-3 is the 1st preference of 12 companies. So, to make progress, I suggest to follow the first preference of majority companies.  ***FL Proposal 2.4: To associate BFD-RS set k and NBI-RS set j***   * ***Alt-1: 1-to-1, fixed in spec***   Companies’ views on issue 2.4 are listed as follows:   * Alt-1 (1st preference of 14 companies and 2nd preference of 1 company): Apple, vivo(if NBI-RS set(s) is configured), MediaTek, DOCOMO, Lenovo/MotM, NEC, CMCC, Samsung, LGE, TCL, Sony, Intel, Xiaomi, Convida, FGI/APT(2nd) * Alt-3 (1st preference of 12 companies and 2nd preference of 3 companies): FGI/APT, ZTE, DOCOMO(2nd), Nokia/NSB, Futurewei, QC, LGE, Ericsson, ETRI, Qualcomm, OPPO, Huawei, HiSilicon, Xiaomi(2nd), Convida, Sony(2nd) |
| Huawei, HiSilicon | Support the proposal. |
| ZTE | Not our preference, but we can live with the FL proposal. |
| NTT DOCOMO | Support. |
| Lenovo/MotM | Support. |
| Ericsson | Not support. Don’t think we need to spend RAN1 time on this. This can be left to RAN2. |
| MediaTek | Support FL proposal |

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

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

PUCCH-SR resource selection rule for LRR:

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | We support Alt 2.5.2A and we can also compromise to send both PUCCH-SR resources with regard to reliability. Besides, we can also accept Alt 2.5.2D. |
| FGI/APT | We support Alt 2.5.2 A and also Alt 2.5.2 D |
| ZTE | We support Alt 2.5.2 C. |
| OPPO | We do not support Alt A, B or C because they all seem to assume that one SR configuraiton is associated with two PUCCH resources in one BWP, which is not aligned with the SR configruaiton design.  Per the design specified in 38.321, each SR configuraiton can only be assciarted with up to one PUCCH resource in one BWP. If gNB uses two PUCCH resoucres for TRP BFR, that would imply that gNB would configures two SR configurations for TRP BFR. Assuming one SR configuraiton assocaited with two PUCCH resource would cause much more troubles on the specification of SR trigger procedure, which shall be avoided.  We are ok with 2.5.2.D if we can not settle down a design. |
| MediaTek | Support Alt 2.5.2 D |
| DOCOMO | We support Alt 2.5.2 C.  Based on discussion in last meeting, we think it is better to start from following proposals.   * ***Support to configure an association between a TRP (e.g., BFD-RS set) on SpCell and a PUCCH-SR resource on SpCell.*** * ***FFS configure an association between a TRP (e.g., BFD-RS set) on SCell and a PUCCH-SR resource on SpCell*** |
| Lenovo/MotM | We support Alt 2.5.2. B and Alt 2.5.2.C in general. However, the association between a PUCCH-SR resource and a BFD-RS set configured in the cell where two PUCCH-SR resources are configured is the key point. The motivation of selection between 2 configured PUCCH-SR resources is to select the PUCCH-SR resource whose link is not failed yet. While UE can know whether the link of any of the two PUCCH-SR resources in a cell where TRP-specific BFR are configured in this cell, since UE knows which link of TRP is failed by monitoring the two BFD-RS sets. Therefore, if the cell configured with two PUCCH-SR resources are configured with TRP-specfic BFR, an association between each PUCCH-SR resource of two PUCCH-SR resources in the cell and each BFD-RS set of two BFD-RS sets in the cell can be built. Then, UE can select the PUCCH-SR resource associated with the non-failed BFD-RS set if only one BFD-RS sets is failed in the cell where 2 PUCCH-SR resources are configured. If both two BFD-RS sets are not failed or TRP-specific BFR is not configured in the cell where 2 PUCCH-SR resources are configured, then it’s up to UE implementation to select any one of 2 PUCCH-SR resources. |
| NEC | We think starting from proposal listed by DoCoMo is better. |
| Xiaomi | We support either Alt 2.5.2 B or Alt 2.5.2 C to select a non-failed PUCCH-SR resource. |
| CMCC | Support Alt 2.5.2 C.  Agree with DOCOMO’s suggestion to start from the proposals from last meeting. |
| Nokia/NSB | We support either Alt 2.5.2 B or Alt 2.5.2 C. Also, we prefer the latest offline proposal in RAN1 #106e. The current proposal seems ambiguous for Alt 2.5.2 B/C.  Offline proposal (offline proposal 1 in email discussion)   * For PUCCH-SR resource selection for TRP-specific BFR,   + Support to configure an association between a TRP (e.g., BFD-RS set) on SpCell and Scell(s) (FFS) and a PUCCH-SR resource on SpCell. * Support (21): Qualcomm, DOCOMO, Lenovo/MotM, Fujitsu (at least mDCI), Sony, MTK, ZTE, InterDigital, Samsung, Huawei/HiSilicon, Xiaomi, Nokia/NSB, CMCC, vivo, TCL, CATT, Spreadtrum, ETRI * Concern (3): Apple, Convida, FGI/APT,   Also, ask proponent support Alt A/D, how the procedure is for per-TRP BFR. How gNB knows what CORESET to be used for UL grant for BFRQ without PUCCH association to TRP. |
| Futurewei | We support Alt. 2.5.2 C. We also think that it is better to start with the proposal from last meeting as DOCOMO suggested. |
| Convida | We prefer to revert the agreement (Alt 2.5.2 D). When we took the agreement in RAN1#104-e, the consequences weren’t clear, for example that it breaks the principles in the RAN2 spec (up to 1 PUCCH resource per BWP per SR configuration, but multiple logical channels can be associated with an SR configuration).  The FL assessment in the beginning of RAN1#106-e seems reasonable:   * The FL does not intend to spend online time on this, unless consensus can be reached offline. Note that if consensus is not possible, option A is the default assumption. |
| Huawei, HiSilicon | We support Alt 2.5.2 B or Alt 2.5.2 C. |
| Qualcomm | Support 2.5.2 B or 2.5.2 C |
| Samsung | We are fine to start with DOCOMO’s proposal : first agreeing on the association between PUCCH-SR for BFR and TRP. We support Alt 2.5.2 C, via PUCCH-SR resource associated with the non-failed TRP. |
| LGE | We at least support the association between PUCCH-SR resource and BFD-RS set, but Alt B and C is too restrictive. I think offline proposal in the last meeting can be a good starting point for discussion, as Nokia mentioned. |
| Sony | We support Alt 2.5.2 C.  But as Convida pointed out, if there is no offline consensus, it will lead to Alt. 2.5.2 A as a conclusion. |
| Mod | Based on discussion above, we also suggest to start from the offline proposal in the last meeting. So, the FL proposal 2.5 is listed below for further discussion.  ***FL Proposal 2.5: Support to configure an association between a TRP (e.g., BFD-RS set) on SpCell and a PUCCH-SR resource on SpCell.***  ***FFS configure an association between a TRP (e.g., BFD-RS set) on SCell and a PUCCH-SR resource on SpCell***  ***Note that if consensus is not possible, option A is the default assumption.*** |
| ETRI | Support FL Proposal 2.5. |
| Ericsson | We think the agreement on 2 PUCCH-SR resources should be reverted (Alt 2.5.2 D). Note that if the PUCCH-SR resource selection is up to the UE, the feature is anyway useless. So Alt 2.5.2D should be the default option and not Option A.  Suggest to update last bullet of FL Proposal 2.5 as follows:  ***Note that if consensus is not possible, Alt 2.5.2D is the default assumption.***  Note that this default alternative would need an agreement since we need to revert a previous agreement. |
| InterDigital | Support FL’s proposal. |
| Qualcomm | Support Proposal 2.5 |
| Intel | Support Proposal 2.5 |
| MediaTek | We are okay to Proposal 2.5. However, we share the same view with Ericsson that if no consensus, this feature will not be supported in Rel-17 thus Alt 2.5.2D would be the result. |
| Mod | Update based on Ericsson’s comment:  ***Updated FL Proposal 2.5: Support to configure an association between a TRP (e.g., BFD-RS set) on SpCell and a PUCCH-SR resource on SpCell.***  ***FFS configure an association between a TRP (e.g., BFD-RS set) on SCell and a PUCCH-SR resource on SpCell***  ***Note that if consensus is not possible, Alt 2.5.2 A or Alt 2.5.2D is the default assumption.*** |
| Lenovo/MotM | We support for the updated FL Proposal 2.5 excluding for the FFS. |

* + 1. **Round 2**

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: DCM(2nd), Huawei, HiSilicon(2nd), Xiaomi, Nokia/NSB
* Alt-2: ZTE, Sony, DCM(1st), Huawei, HiSilicon(1st), Xiaomi, CMCC, Nokia/NSB, Samsung

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Our first preference is Alt-2, and second preference is Alt-1.  But we think it may be better if we can resolve the FFS in above agreement first. Because, if the FFS is not supported, the condition ‘if all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource’ in Alt-1/2 will not happen.  Regarding the FFS, we do not support it. First, the TRP information on Scell and SpCell can be different. Second, the interference conditions and BFD results on Scell and SpCell can be also difference even if the TRP information is the same. Hence, there is no need to configure an association between a BFD-RS set on Scell and a PUCCH-SR resource.  In that case, TRP/cell-specific beam failure on Scell does not impact PUCCH-SR resource selection result, which is left to UE implementation. Only the TRP-specific beam failure on SpCell impacts PUCCH-SR resource selection result, e.g., if one TRP fails on SpCell, one PUCCH-SR associated with non-failed TRP is selected.  Such solution can also relax some companies’ concern on supporting Alt-1/2. |
| ZTE | We identify some benefits if beam and power control of PUCCH update is also supported.  In short, the mTRP-BFR will follow the rule that SR-PUCCH, and a group of PUCCH resources are both associated with TRP, and the group of PUCCH will recovered if receiving gNB response. As a result, the SR-PUCCH will be recovered automatically. Based on that, using the SR-PUCCH from non-failed TRP (with non-failed beam) will be straightforward. |
| OPPO | Since we agreed the association. Why do not just let the UE triggered the associated PUCCH-SR resource/SR configuration.  Suggest change the proposal to:   * ***The UE triggers the associated PUCCH-SR resource / SR configuration for the failed BFD-RS set.*** |
| Convida | We have some concerns.  In our understanding, the purpose of the agreement was to improve reliability of PUCCH-SR and subsequent PDCCH (for scheduling PUSCH) for the multi-TRP SpCell case. This means that the beam failure status on the SpCell should determine the PUCCH-SR resource selection.  With this understanding, the proposal might contradict the agreement. If the failed BFD-RS set on the SpCell is associated with a different PUCCH-SR resource than the failed BFD-RS set on an Scell, the proposal results in that PUCCH-SR resource selection is up to the UE implementation. However, the intention of the agreement is that the failed BFD-RS set on the SpCell should determine the selection? |
| Apple | It seems we do not need to discuss the rule, since this is up to gNB’s configuration as agreed. |
| Lenovo/MotM | We have similar view with DOCOMO. We have concerns about the selection is done if all failed BFD-RS sets cross CCs are associated with the same PUCCH-SR resource. Because the link quality of TRPs in different CCs may be different, and even the TRPs are different in different CCs. However, we only need to select a PUCCH-SR resource configured in SpCell whose link is not failed. Therefore, we only need to associate one PUCCH-SR resource with a BFD-RS set in SpCell. There is no need to build an association between a PUCCH-SR resource and a Scell.  And we propose to update the Proposal 2.5 as follows.  ***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 if at most one BFD RS set fails in SpCell ~~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 if at most one BFD RS set fails in SpCell ~~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.***   In this case, we prefer Alt 2. |
| Huawei, HiSilicon | Slightly prefer Alt-2, can accept Alt-1. |
| Sony | We support Alt-2.  When beam failure instance happened under one TRP, it would be safer for UE to transmit PUCCH-SR resource to another non-failed TRP compared with transmitting the BFRQ to the failed TRP. |
| Xiaomi | Either Alt 1 or Alt 2 is OK to us. |
| CMCC | We support Alt-2. |
| NEC | We share similar view with Lenovo, and fine with their update. Then we prefer Alt 2. |
| Vivo | We support FL Proposal 2.5. It is necessary to configure an association between a BFD-RS set on Scell and a PUCCH-SR resource / SR configuration per TRP BFR, otherwise, the condition that all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource cannot be identified. |
| Nokia/NSB | Fine with either alternatives. There is no difference in the functionality. Similar to map bit (0,1) into symbol (1,-1), (0🡪1, 1🡪-1) or (0🡪 -1, 1🡪 1) both are the same. |
| FGI/APT | We have concerns on this proposal.  Based on our understanding, one of the benefit to have PUCCH-SR resource seletion rule is that network can realize which TRP is still working (and then send UL grant accordingly). However, as we can see, both alternatives include situation that UE implementation can take over. Then, when network receives one PUCCH-SR resource, how does network understand which TRP is still workding? The seletion may not be performed by association, instead by UE implementation.  On the other hand, the wording itself may need to be revised. When some conditions are achiedved, in Alt-1, we say alt 2 is adoped; in Alt-2, we say alt 1 is adoped. |
| Samsung | We support Alt-2, which makes the most sense to us for per TRP beam failure. |
| LGE | As DOCOMO and Lenovo/MM said, first we need to resolve FFS point in the above agreement. We disagree with DOCOMO’s comment that the TRP failure states on Scell and SpCell are totally independent. SCell(s) and SpCell can be in a same band(i.g. intra-band CA), where common beam is likely to be applied across those. If the serving beam is in failure for a TRP in a CC, it is likely that the serving beam for the failed TRP in the other CC will have worse quality compared to the serving beam for the other TRP even if exact RSRP/SINR values can be different across CCs due to different interference condition. In case of inter-band CA, this argument may or may not be true depending on gNB and UE implemenatation (e.g., whether to implement multi-band antenna or separate antenna per band) and the frequency gap between the CCs. More importantly, if we introduce UE implementation based selection rule for certain case(s), it can create ambiguity to NW when two SR-PUCCH resources are configured on SpCell and TRP-specific BFD is configured for both SpCell and SCell(s). If we introduce selection rule only for SpCell, how gNB can distinguish whether the associated TRP#0 in SpCell is in BF or any TRP in SCell(s) is in BF when SR-PUCCH#0 is received by gNB, in the above case?  Thus, we prefer NOT to define any UE implementation based selection case when two PUCCH resources are configured.  ***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.~~*** |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | As suggested by some companies, let’s discuss the FFS part in agreement first.  ***FL Proposal 2.5-1: Down select one out of the following alternatives***   * ***Alt-1: Configure an association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration for per TRP BFR is supported*** * ***Alt-2: Configure an association between a BFD-RS set on SCell and a PUCCH-SR resource / SR configuration for per TRP BFR is not supported***   Regarding the comment from DCM and Lenovo/MotM, we tend to agree with LGE that the TRP failure state of Scell and SpCell are correlated at least for intra-band CA case.  @LGE: one question for clarification: based on the revision from LGE, if not all the failed BFD RS sets cross CCs are associated with the same PUCCH SR resource, what is the UE behavior?  The following FL proposal can be further discussed, if the group still think the association on SCell is needed. Otherwise, the update of proposal 2.5 from Lenovo/MotM can be considered as a starting point for further discussion.  ***FL Proposal 2.5-2: On the PUCCH-SR resource selection rule when SR is triggered and 2 PUCCH-SR resources are configured:***   * ***If all failed BFD RS sets cross CCs are associated with the same PUCCH SR resource***   + ***Alt-1: select the PUCCH SR associated to failed BFD-RS set***   + ***Alt-2: select the PUCCH SR associated to non-failed BFD-RS set*** * ***Else PUCCH-SR resource selection is up to UE implementation*** |
| Huawei, HiSilicoin | Proposal 2.5-2: Support Alt-2. |
| ZTE | Proposal 2.5-1: Support Alt-1. If not associated, whether PUCCH-SR is transmitted is up to UE implementation.  Proposal 2.5-2: Support Alt-2 at leaset for SpCell. |
| NTT DOCOMO | Proposal 2.5-1: Prefer Alt-2.  First, if beam failure happens on TRP#1 on SpCell due to large interference, it does not mean beam failure also happens on TRP#1 on SCell due to different interference on different CCs. Otherwise, we do not need per-CC BFD, if the BFD result on a TRP on SpCell is always the same as the BFD result on the same TRP on SCell.  Second, if TRP information on SCell(TRP#1, TRP#3) is different from TRP information on SpCell (TRP#1, TRP#2), in Alt-1, is association configuration also needed?  Third, if an SCell is configured with per cell BFR (one BFD-RS set), in Alt-1, is association configuration also needed? Anyway, it is not needed in Alt-2.  Proposal 2.5-2: Support Alt-2. |
| Lenovo/MotM | For FL Proposal 2.5-1, we support Alt-2. The motivation of selection between 2 PUCCH-SR resources is to increase the reliability and success of TRP-specific BFR. Considering the PUCCH-SR resource is configured in SpCell, and we only need to select a PUCCH-SR resource with good link in SpCell for TRP-specific BFR reporting. Therefore, UE only need to know the link quality of two TRPs in SpCell where 2 PUCCH-SR resources are configured. Since it’s already agreed that there is an association between a PUCCH-SR resource of two PUCCH-SR resources and a BFD-RS set in SpCell, UE can aware the link quality of each TRP and each PUCCH-SR resource by monitoring the two BFD-RS sets in SpCell. If one BFD-RS set in SpCell is failed but the other BFD-RS set is not failed, then the link of one PUCCH-SR resource is good but the link of the other PUCCH-SR resource is not good. In this case, it just need to select the PUCCH-SR with good link to report the TRP-specific BFR. While for SCells, there is no need to build an association between a PUCCH-SR resource in SpCell and a SCell since PUCCH-SR resources are only configured in SpCell.  For FL Proposal 2.5-2, don’t support since it doesn’t need the condition that all failed BFD-RS sets cross CCs must be associated with the same PUCCH-SR resource to trigger the selection scheme of Alt-1 or Alt-2. We propose to modify the proposal as follows as drafted in Rand 2.  ***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 if at most one BFD RS set fails in SpCell ~~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 if at most one BFD RS set fails in SpCell ~~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.***   In this case, we prefer Alt-2. |
| Ericsson | Proposal 2.5-2: support Alt 2. |
| MediaTek | Proposal 2.5-1: support Alt 2. |

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

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

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

* Alt-1: Only 1 (4 companies: Spreadtrum, Intel, Sony, Lenovo/MotM )
* Alt-2: up to 2; diversity (e.g. AI 8.1.2.1) when 2 spaial filters are activated (11: Xiaomi, FGI/APT, vivo, ZTE, Convida, DCM, Apple, OPPO, TCL, InterDigital, vivo)
* Alt-3: up to 2; filter selection when 2 spatial filters are activated (8: Qualcomm, LGE, Xiaomi(2nd), ETRI, CMCC, Nokia/NSB, HW, Ericsson)

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support Alt2. We failed to see the necessity for enhancement like Alt1/3. Maybe we do not need to discuss the whole issue. |
| ZTE | Support Alt2. |
| OPPO | Alt2. Why do we dicuss this here ? the SR for TRP BFR is sent in PUCCH resource but we shall not change the design of PUCCH resource. |
| DOCOMO | Support Alt2. |
| Lenovo/MotM | Support Alt 1. Multiple beams are supported for PUCCH repetition now. And it will complicate the interference in gNB side if it allows UE to select one beam from two beams. |
| Xiaomi | Our first preference is Alt-2, and we can also accept Alt-3. |
| CMCC | Support Alt2. |
| Nokia/NSB | Similar view with Apple. Alt 2 or no need for discussion |
| Convida | Similar view as Apple. In our understanding, if we don’t agree anything, a PUCCH-SR resource can have 2 spatial relations in Rel-17, just like other PUCCH resources. So we could either skip the discussion or conclude that we don’t impose any further restrictions on the configuration of a PUCCH-SR resource. |
| Huawei, HiSilicon | Support Alt-3. |
| Qualcomm | Prefer Alt3 |
| LGE | We support Alt-3 when only one PUCCH-SR configured in a cell group. |
| TCL | We prefer Alt2. PUCCH-SR resource has 2 spatial relations, which is the same as PUCCH in Rel-17. |
| Sony | We slightly prefer Alt-1. However we share the same interpretation on this issue from Convida, as RAN1 has other agenda to handle PUCCH repetition. |
| Mod | Views from companies seem to be diverged. This issue can be discussed with lower priority in this meeting. |
| Ericsson | Alt-3 seems easier from UE implementation point of view. So we can support Alt-3. |
| InterDigital | Support Alt-2. |
| Qualcomm | Support Alt3 |

* + 1. **Round 2**

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: ZTE
* Alt-3:
* Alt-4:

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support Alt-2. |
| ZTE | It seems that there is no further spec impacts, if going with Alt-2. |
| OPPO | We do not need to discuss this issue. It is part of PUCCH resource design and not part of BFR design. |
| Convida | Support Alt-2, but also agree with OPPO. |
| Apple | We failed to see the necessity for this discussion. Alt2 is by default. Alt4 is also ok. |
| Lenovo/MotM | Support Alt-1. Multiple beams can be activated for a PUCCH with repetition. And the interference in gNB’s will be more complicated if two beams are activated for a PUCCH resource with UE selection. |
| Huawei, HiSilicon | Alt-2: Suggest updating as “TDM-based diversity (i.e. AI 8.1.2.1)”.  Support Alt-3. |
| Xiaomi | Either Alt 2 or Alt 3 is OK to us. With Alt-3, it is necessary to associate the spatial filter with the BFD-RS set on SpCell for better selection. |
| CMCC | Support Alt-2. Or, Alt-2 can be used if only one PUCCH-SR resource is configured, Alt-3 can be used if two PUCCH-SR resources are configured. |
| Vivo | Support Alt-2. |
| Nokia/NSB | Prefere Alt 4 but we are fine with any alternatives other than Alt 3.  As I know, PUCCH repetition cannot be supported for SR. |
| FGI/APT | We supprot Alt-2. |
| LGE | Support Alt-3 when only a single PUCCH-SR resource is configured in a cell group. We are also open for Alt-2 since it can increase reliability of PUCCH-SR transmission. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | Views of companies on issue 2.6 are summarized as follows. From our understanding, if Acoording to views of majority, I prefer to conclude that there is no further restriction on the configuration of a PUCCH-SR resource.  ***Proposed Conclusion: There is no further restriction on the configuration of a PUCCH-SR resource.***  For reference, preference of companies are listed as follows:  Whether PUCCH-SR resource can have 1 or 2 activated spatial filters   * Alt-1: Only 1 (4 companies: Spreadtrum, Intel, Sony, Lenovo/MotM ) * Alt-2: up to 2; diversity (e.g. AI 8.1.2.1) when 2 spaial filters are activated (11: Xiaomi, FGI/APT, vivo, ZTE, Convida, DCM, Apple, OPPO, TCL, InterDigital, vivo) * Alt-3: up to 2; filter selection when 2 spatial filters are activated (8: Qualcomm, LGE, Xiaomi(2nd), ETRI, CMCC, Nokia/NSB, HW, Ericsson) |
| ZTE | Support FL proposed conclusion in principle. ‘… restriction on the TCI/spatial relation configuration …’ seems better. |
| NTT DOCOMO | Agree with ZTE’s revision. |

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

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

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

* Alt-1: 1-bit SP field (reuse Rel-16 design) (DOCOMO, CATT, NEC, Xiaomi )
* Alt-2: Two bits corresponding to two TPRs of SpCell (ZTE, CMCC)
* Alt-3: RAN2 issue (Nokia, MTK, Ericsson, Apple, OPPO, Spreadtrum, Futurewei, Convida, QC, LGE, TCL, InterDigital, Lenovo/MotM)

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support Alt3. We noticed RAN2 agreed something related to MAC CE content in last RAN2 meeting. Whether to use 1-bit or 2-bit SP field seems to be a RAN2 issue. |
| vivo | In our view, this issue only arises when RACH-based BFRQ is triggered. after discussion in the previous meetings, we think only when either of the following two conditions is met, RACH-based BFRQ will be triggered :   * Only one TRP in SpCell is declared of beam failure, but no PUCCH-SR configured and no available UL grant. * Both TRPs in SpCell are declared of beam failure within the predefined window ;   For the first case, the contents of MAC CE had been determined in the last meeting. For the second case, we think the failed CC indexes, the indications of failure event, the indications of whether new beam if found, candidate resource indices of both TRPs should be carried in MAC CE to recover both TRPs simultaneously and maintain mTRP operation as much as possible. As for the design of MAC CE, it is up to RAN2. |
| ZTE | Alt-1 may NOT work in our views. CBRA may be intialized by two types of events: #1 two TRPs in PCell both failed; #2 there is no available/configured SR. For the latter, identifying which TRP fails is necessary. |
| OPPO | We are ok to leave it to RAN2 design. |
| MediaTek | Support Alt3 |
| DOCOMO | We support Alt-1, and we can accept Alt-3. |
| Lenovo/MotM | As vivo mentioned the cases when RACH-based BFRQ will be triggered, different events should be supported. We also think the design of MAC CE should be up to RAN2. While it’s better to send a LS to RAN2 on the supported events to trigger a RACH-based BFRQ and the corresponding UE behaviours. |
| NEC | Prefer Alt 1, and maybe we can discuss this after we agree scenarios for RACH based fallback for BFR. In case of both TRPs failed, and RACH based BFR triggered, we think recovery from one TRP is enough.  And we are also fine to just leave it to RAN2. |
| Xiaomi | Prefer Alt 1, we think recovery from one TRP based on RACH procedure is acceptable. |
| Spreadtrum | Support Alt3 |
| Nokia | Support Alt3 |
| Futurewei | Support Alt-3. |
| Convida | Support Alt-3 |
| Qualcomm | Prefer Alt2 or Alt3. |
| LGE | Support Alt-3. It is more related with RAN2 work. |
| TCL | Support Alt-3 |
| Mod | Based on discussion above, from FL’s perspective, this issue can be discussed after we have decision on secnario for RACH-based fallback. |
| Ericsson | This is obviously a RAN2 issue – really surprising that RAN1 is discussing MAC CE fields. Suggest leaving this to RAN2, and no need to bring this up again in RAN1. |
| InterDigital | This should be discussed in RAN2. |
| Qualcomm | Fine to have lower priority or leave it to RAN2 |
| Lenovo/MotM | Fine to have lower priority or leave it to RAN2. |

* + 1. **Round 2**

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.

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support Alt-1. |
| ZTE | Alt-2. As we mentioned before, Alt-1 can NOT work in such case.  CBRA may be initialized by two types of events: #1 two TRPs in PCell both failed; #2 there is no available/configured SR (already supported in the spec). For the latter, identifying which TRP fails is necessary. |
| OPPO | It is about the MAC CE message design. In our view, the MAC CE designed for the per-TRP BFR shall be reused here. But it is also ok to leave it to RAN2. |
| Convida | Agree with OPPO. |
| Apple | Support Alt3 |
| Lenovo/MotM | Support Alt3. |
| CMCC | Support Alt-2. |
| Vivo | We think we only need to determine the information carried in the BFR MAC CE, such as the indication(s) of failed BFD-RS set(s) and new beam index(es), especially for the case of two TRPs in SpCell both failed, rather than the design of BFR MAC CE. The former is RAN1’s work, while the latter is up to RAN2. Therefore, we suggest adjusting the topic of the issue to the information carried in the MAC-CE related to SpCell when transmitted on msg3, msgA. |
| Nokia/NSB | Support Alt 3. MAC-CE design is upto RAN2, unless RAN1 propose new contents. |
| FGI/APT | We support Alt-3. |
| LGE | Support Alt-3. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | Given the situation in the first 2 rounds of discussion, it’s clear that majority of companies agree to leave this to RAN2. So, I prefer to conclude that the content of MAC-CE related to SpCell when transmitted on msg3, msgA is up to RAN2.  ***Proposed Conclusion: content of MAC-CE related to SpCell when transmitted on msg3, msgA is up to RAN2.***  For reference, preference of companies are listed as follows:  Content of MAC-CE related to SpCell when transmitted on msg3, msgA:   * Alt-1: 1-bit SP field (reuse Rel-16 design) (DOCOMO, CATT, NEC, Xiaomi ) * Alt-2: Two bits corresponding to two TPRs of SpCell (ZTE, CMCC) * Alt-3: RAN2 issue (Nokia, MTK, Ericsson, Apple, OPPO, Spreadtrum, Futurewei, Convida, QC, LGE, TCL, InterDigital, Lenovo/MotM) |
| ZTE | Not our preference, but we can live with the proposed conclusion for progress. |
| NTT DOCOMO | Okay. |
| Lenovo/MotM | Support FL’s conclusion. |
| Ericsson | This is obviously up to RAN2. Do not see the need to have such conclusion in RAN1 chairman’s notes. |
| MediaTek | Okay to the conclusion |

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

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

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

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support, but CORESETPoolIndex may needed to be provided in SP/P PUCCH resource. |
| FGI/APT | Support |
| vivo | Do not support beam/power update for PUCCH after receiving gNB response. The gains of such association does not justify specification effort. |
| ZTE | Support. |
| OPPO | Do not support to introduce the assocaition between TRP ID and PUCCH only for the purpose of PUCCH resource beam re-set.  This issue of association has been dicussed a lot in rel-16. It has big impact all many aspects of mTRP uplink transmisison. We cannot simply make a conclusion here by only considering this particular issue. |
| MediaTek | Not support due to spec effort and unclear gain |
| DOCOMO | Support |
| Lenovo/MotM | Support. |
| NEC | Support |
| Xiaomi | Support, since beam/power update for PUCCH after recieving gNB response is supported in Rel-15/16. |
| CMCC | Support. |
| Futurewei | Our view is that whether beam/power update for PUCCH after receiving gNB response is needed depends on whether beam correspondence between DL and UL can be assumed (e.g., whether joint DL/UL TCI state or separate DL/UL TCI state is configured as discussed in AI 8.1.1). If beam correspondence between DL and UL can be assumed (e.g., joint DL/UL TCI state is configured), the beam/power update is needed. Otherwise, it is not. |
| Convida | Similar view as OPPO. |
| Qualcomm | Support introducing the linkage. PUCCH beam resetting is also important |
| LGE | We have similar view with vivo, OPPO, MediaTek, and Convida. |
| TCL | Support beam/power update for mTRP PUCCH. |
| Sony | The PUCCH beam and UL PC parameters updated was supported in Rel.15/16 after BFR procedure. We think the same principle should also be supported in Rel.17 as a streamline design.  Next, whether/how to associate TRP and PUCCH resource can be FFS at current stage in our view. |
| Mod | As mentioned by some companies, update UL beam/power control is supported in Rel-15/16. So, it’s reasonable to extend this mechanism to multi-TRP case. To that end, the association seems necessary.  @OPPO : could you please elaborate more details regarding the impact of introducing such association on spec ?  The following FL proposal is listed for further discussion.  ***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.***   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 * Not support: vivo, OPPO, MediaTek, Convida, LGE |
| Ericsson | The formulation of Proposal 2.8 is somewhat strange. We should not introduce a linkage between a TRP and anything – since TRP is not used in the specs. If this is about resetting the PUCCH beam after BFR, a different formulation should be used instead of using ‘e.g., through BFD-RS set ID, CORSETPoolIndex, etc.’ |
| InterDigital | Support FL’s proposal. |
| Qualcomm | Support Proposal 2.8. To our understanding, TRP is for discussion purpose, and whose ID can be BFD RS set ID or CORESETPoolIndex. |
| Intel | Support in principle |
| MediaTek | We don't support the proposal |
| Mod | Based on comments above, we have the following update:  ***Updated 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]   Not support: vivo, OPPO, MediaTek, Convida, LGE |
| Lenovo/MotM | Support. |

* + 1. **Round 2**

***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, InterDigital, Qualcomm, Intel, [Ericsson], Lenovo/MotM, HW, Samsung
* Not support: vivo, OPPO, MediaTek, Convida, LGE

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support FL proposal 2.8. |
| ZTE | TRP can be replaced by ‘BFD-RS set’ as we did before. |
| OPPO | DO not support.  As we commented in previous round, this issue of association has been dicussed a lot in rel-16. It has big impact all many aspects of mTRP uplink transmisison. We cannot simply make a conclusion here by only considering this particular issue. |
| Apple | Support in principle. Regarding the association, we can start from mDCI, which is simpler. |
| Lenovo/MotM | Support it. And we have same view with ZTE that TRP can be replaced with ‘BFD-RS set’. |
| Huawei, HiSilicon | Support in principle. |
| Sony | Supportive to FL the proposal.  Recovering the PC and beam for PUCCH seems legacy behavior as Rel.16, in which the similar recovery for PUCCH can be done without BFR enhancement for mTRP. |
| Xiaomi | Support the proposal 2.8 |
| CMCC | Support |
| NEC | Support the proposal. |
| vivo | Do not support the FL proposal. |
| MediaTek | Do not support the FL proposal |
| FGI/APT | Support FL’s proposal. |
| Samsung | Suuport FL proposal in principle |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | @OPPO, vivo and MTK: regarding your concern, if my understanding is correct, the “big impact” mentioned by opponents of this proposal lies in the fact that not all the types of PUCCH can be tied with one of the CORESETPoolindexes in M-DCI case. And in maintenance stage of Rel-16, this is controversial in determining the overlapping rule of UL channels. However, in issue 2.8, we are talking about the PC and beam recovery of PUCCH, and as many companies raised, this is a legacy behavior according to current spec. Given the preference of majority of companies, we still this such proposal is needed.  ***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, InterDigital, Qualcomm, Intel, [Ericsson], Lenovo/MotM, HW, Samsung * Not support: vivo, OPPO, MediaTek, Convida, LGE |
| Huawei, HiSilicon | Support the proposal. |
| ZTE | Support the proposal. |
| NTT DOCOMO | Support |
| Lenovo/MotM | Support. |
| Ericsson | Our comment from the first round is not addressed. in the sub-bullet, what are we associating to a PUCCH? we should pick one one among BFD-RS set ID or CORESETPoolIndex to represent TRP. We cannot leave it as e.g., through BFD-RS set ID, CORESETPoolIndex, etc. |
| MediaTek | Our view is not changed from the 1st round. We don't think there is legacy behavior specifes TRP-specific operation for UL. |

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

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

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

* + Yes: Samsung, OPPO
  + No: vivo, MTK, DCM

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support. This operation is partly supported in PCell BFR. In addition, in the field, PDCCH and PDSCH always share the same beam, if PDCCH beam fails, PDSCH beam fails as well. |
| FGI/APT | Support. |
| vivo | Do not support. No need to introduce new UE behavior in Rel.17.  • For PDSCH TCI-presentinDCI = ON, UE should follow NW-provided beam, e.g. Rel.16 rule.  • For PDSCH TCI-presentinDCI = OFF, PDSCH will anyway continue to follow scheduling PDCCH or lowest CORESET (Rel.16 rule). No new UE behavior is needed. |
| ZTE | Support |
| OPPO | Support.  Ths same function is support in SCell BFR already and the reason for supporting that is because there is no CORESET-BFR in SCell BFR. The same reason is applicalble here. |
| MediaTek | Share the same view with vivo, this can be implemented by current spec w/o additonal spec support. |
| DOCOMO | Not needed. |
| Lenovo/MotM | Do not support. Same view with vivo. |
| CMCC | Not needed. |
| Nokia | Do not support. Agree with vivo |
| Futurewei | Support. |
| Convida | Same view as vivo. |
| Qualcomm | We believe resetting PDSCH beam is also beneficial, since the TCI for the new beam may not be activated yet for DCI to indicate. |
| Samsung | Support updating PDSCH beam. |
| LGE | Similar viwe with vivo. |
| TCL | Share the same view as vivo. |
| Mod | @companies not supportive to PDSCH beam updating: as shown below, based on current spec, UE follows the new beam for both PDCCH and PDSCH until the UE receives by higher layers an activation for a TCI state or any of the parameters *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList*. A question for clarification: why do people think this mechanism can’t be reused for per-TRP BFR?  The following description is extracted from clause 6 of 213:  For PDCCH monitoring in a search space set provided by *recoverySearchSpaceId* and for corresponding PDSCH reception, the UE assumes the same antenna port quasi-collocation parameters as the ones associated with index  until the UE receives by higher layers an activation for a TCI state or any of the parameters *tci-StatesPDCCH-ToAddList* and/or *tci-StatesPDCCH-ToReleaseList*. |
| Ericsson | It is unclear to us what “power update” would mean. If this is proposal 9 in [8] then it’s ok |
| InterDigital | Support updating beam for PDSCH. |
| Qualcomm | Share same view as Mod. Resetting PDSCH beam is valid, especially when the new beam is not activated yet |
| Mod | @Ericsson: it should be “beam update”, thanks for your reminder.  We have the following FL proposal for discussion.  ***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.*** |
| Qualcomm | Support 2.9 |

* + 1. **Round 2**

***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: ZTE, DCM(can live with it), OPPO, Apple, HW, Sony, Xiaomi, CMCC, NEC, MTK, FGI/APT, Samsung, QC, InterDigital
* Not support: vivo, Lenovo/MotM, LGE

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | We think it is not needed. But we can live with it. |
| ZTE | Support. |
| OPPO | Support |
| Apple | Support. This is partly supported in R15. |
| Huawei, HiSilicon | Suggest changing “failed TRP” to “failed TRP link”. |
| Sony | Support. |
| Xiaomi | Support |
| CMCC | Support |
| NEC | Support the proposal. |
| vivo | Do not support the FL proposal. |
| MediaTek | Okay |
| FGI/APT | Support |
| Samsung | Support FL proposal |
| Lenovo/MotM | Do not support the FL proposal. |
| LGE | Do not support. It is purely up to gNB configuration. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | @HW: the proposal is revised according to your suggestion.  ***Updated FL Proposal 2.9: After receiving gNB response, the UE assumes the QCL assumption of PDSCH associated with the failed TRP link to be the latest reported qnew.***  Companies’ views on issue 2.9 are listed as follows:   * Support: ZTE, DCM(can live with it), OPPO, Apple, HW, Sony, Xiaomi, CMCC, NEC, MTK, FGI/APT, Samsung, QC, InterDigital * Not support: vivo, Lenovo/MotM, LGE   @vivo, Lenovo/MotM, LGE: could you please explain why do you think such a lagecy mechanism can not be supported in Rel-17? |
| Huawei, HiSilicon | Support the proposal. |
| ZTE | Support. |
| NTT DOCOMO | Okay. |
| Lenovo/MotM | From our view, this feature is not needed since the beam of PDSCH is determined by PDCCH which is TCI filed of the scheduling PDCCH, TCI state of the scheduling PDCCH or the TCI state of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot while the beam of PDCCH can be recoverid after gNB’s confirm of TRP-specific BFR. Therefore, the PDSCH beam indication/determination can work when the beam of PDCCH is recoveried. |

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

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

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

* Alt-1: Through CORESETPool index (Nokia, CATT, Sony, TCL, ZTE(implicit), Fujitsu, MTK,, vivo, Qualcomm,OPPO, Huawei, HiSilicon, DCM (for mDCI based MTRP)), Lenovo/MoM (implicit)
* Alt-2: Either by RRC signalling or MAC CE (Lenovo/MoM(explicit), Qualcomm, ZTE(explicit))
* Alt-3: Through QCL-TypeD property of the CORESET (FutureWei)
* Alt-4 : Support association configuration between TCI state and BFD-RS set. (DCM (for sDCI based MTRP))

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support Alt-1. But it should be for mDCI mode only. |
| ZTE | For explicit configuration for BFD-RS by RRC/MAC-CE, we think that Alt-2 is needed. But for the implicit manner, Alt-1 is sufficient. |
| OPPO | Support Alt-1 |
| MediaTek | Support Alt-1 for M-DCI, which is already agreed for implicit BFD-RS configuration. |
| DOCOMO | For mDCI based MTRP, of course Alt-1 is used.  For sDCI based MTRP, support following new Alt. 4:  ***Alt-4 : Support association configuration between TCI state and BFD-RS set.***  It is because, for single-DCI based MTRP with per-TRP BFR, to update the new beam of CORESET for the failed TRP, there should be an association between CORESET and TRP (e.g., BFR-RS set). However, in case of CORESETs with 2 activated TCI states for single-DCI based MTRP for per-TRP BFR, to update the new beam(s) for the failed TRP(s), association between CORESETs and BFD-RS set is not sufficient, and there should be an association between one TCI state of the CORESET and the TRP. Hence, to support above cases for single-DCI based MTRP with per-TRP BFR, it is better to support association between TCI state and BFD-RS set. In that case, after receiving BFR response, for a CORESET with 2 activated TCI states, the TCI state(s) associated with the failed BFD-RS set(s) is updated to corresponding new beam. If per-cell BFR is configured for single-TRP operation or single-DCI based MTRP operation, the CORESETs with 2 activated TCI states can be updated to be with 1 TCI state only after receiving BFR response. And then gNB can re-configure the 2 activated TCI states for those CORESETs based on UE beam measurement/reporting. |
| Lenovo/MotM | Support Alt-2 since Alt-1 can only be applied for implicit manner. |
| NEC | Support Alt-1 for multi-DCI.  And we should also discuss the case for single-DCI, where Alt-2 is prefered. |
| Xiaomi | Prefer Alt-1 for multi-DCI and Alt 2 for single-DCI. |
| Spreadtrum | Support Alt-1 |
| CMCC | Support Alt-2. |
| Nokia/NSB | Support Alt-1 for M-DCI. For S-DCI implicit configuration, we are ok to consider DOCOMO’s proposal for further discussion. |
| Futurewei | For mDCI, support Alt-1. For sDCI, support Alt-3. We are also ok to consider DOCOMO’s proposed Alt-4 since in our opinion, Alt-4 and Alt-3 are similar in principle. |
| Huawei, HiSilicon | Support Alt-1. |
| Qualcomm | Support Alt1 for mDCI based mTRP. Support Alt2 for sDCI based mTRP. |
| Lenovo/MotM | This issue should be discussed for implicit and explicit BFD-RS set configuration separately, since only there is CORESETSETPoolIndex in implicit BFD-RS set configuration.  Therefore, for implicit BFD-RS set, we support Alt 1; for explicit BFD-RS set configuration, we support Alt 2. |
| Samsung | Support Alt-1 for mDCI. |
| LGE | Support Alt-1 for mDCI, as simple solution.  For mDCI case, isn’t it already agreed as Alt-1, as below agreement? (yellow part)  **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 |
| TCL | Support Alt-1 for multi-DCI. For single-DCI, we prefer Alt-2. |
| vivo | The functionality of the association between CORESET(s) and failed BFD-RS set is to facilitate UE to reset beam properly. As for beam reset, it should be prioritized for mDCI case, as it has higher priority and is simpler than sDCI. Therefore, we should focus on mDCI case first in the subsequent limited time.  For mDCI case, we support Alt-1 whether configured implicitly or explicitly. As mentioned by MTK and LGE, Alt-1 has been supported in implicit BFD-RS set configuration. As for explicit BFD-RS set configuration, CORESETPoolindex also can be used to associate CORESETs and BFD-RS set based on RRC signalling, e.g., introduce a new parameter as CORESETPoolindex in each BFD-RS set.  As for Alt-4, it is mainly for SFN case and should be discussed in 8.1.2.4. Therefore, we suggest removing it. |
| Mod | @LGE: from our understanding, previous agreement is about how the BFD-RS set per TRP is determined according to CORESET. It doesn’t mean that we agreed to associate CORESET and BFD-RS set. For other cases, take recovery procedure as a example, the beam of CORESET(s) corresponding to the failed TRP is also updated. For such case, we need to determine the CORESET(s) for recovery. Therefore, we need further agreement on how to associate CORESET and failed BFD-RS set.  Based on the discussion above, the FL proposal is listed below.  ***FL Proposal 2.10: To associate CORESET(s) with failed BFD-RS set***   * ***For implicit BFD-RS set configuration***   + ***Through CORESETPool index*** * ***For explicit BFD-RS configuration***   + ***Either by RRC signalling or MAC CE***   + ***Support association configuration between TCI state and BFD-RS set for S-DCI*** |
| ETRI | Support FL Proposal 2.10. |
| Ericsson | The context is somewhat unclear. However, if this is proposal 3-11 in [22], it would seem clear that alt-3 is the better choice: why would the UE stop monitoring CORESETs that are QCLd with RSs that are not in the failed BFD-RS set? Remember that it is the QCL that maps to the physical location of the TRP, not the CORESETPoolIdx. |
| InterDigital | Support FL Proposal 2.10. |
| Qualcomm | Prefer to add another alternative to Proposal 2.10. Or leave last bullet as FFS   * ***For explicit BFD-RS configuration***   + ***Either by RRC signalling or MAC CE***   + ***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*** |
| Intel | Support proposal 2.10, QC changes also ok. |
| MediaTek | For explicit BFD-RS configuration, we prefer leave the association as FFS. |
| Mod | FL proposal 2.10 is updated according to Qualcomm’s comment:  ***Updated FL Proposal 2.10: To associate CORESET(s) with failed BFD-RS set***   * ***For implicit BFD-RS set configuration***   + ***Through CORESETPool index*** * ***For explicit BFD-RS configuration***   + ***Either by RRC signalling or MAC CE***   + ***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*** |
| Lenovo/MotM | Support the updated FL Proposal 2.10. |
| Qualcomm | Support updated 2.10 |

* + 1. **Round 2**

***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: ZTE
* Not support:

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support FL proposal 2.10.  And we prefer Alt1 for S-DCI.  In case of CORESETs with 2 activated TCI states for single-DCI based MTRP for per-TRP BFR, to update the new beam(s) for the failed TRP(s), association between CORESETs and BFD-RS set is not sufficient. It is better to support association between TCI state and BFD-RS set. In that case, after receiving BFR response, for a CORESET with 2 activated TCI states, the TCI state(s) associated with the failed BFD-RS set(s) is updated to corresponding new beam. |
| ZTE | Support. For S-DCI, we can live with Alt-2. |
| OPPO | Support the first bullet.  For explicit BFD-RS configuration: we prefer to discuss it after we settle down the design of explicit BFD-RS configuration, the method of which is still FFS now. |
| Apple | Same view as OPPO |
| Mod | For implicit configuration for M-DCI, discuss over email. |
| Lenovo/MotM | For explicit BFD-RS set configuration, we think the solution should be unified for M-DCI and S-DCI. And for S-DCI and M-DCI, we support Alt 1. |
| Huawei, HiSilicon | Provided comment in email. |
| Sony | Support in principle. Provide our views in email discussion, too. |
| Xiaomi | As for the S-DCI with explicit BFD-RS configuration, what is “TCI state” in Alt 1? We prefer Alt 2. |
| CMCC | For S-DCI, we prefer to discuss it after we agreed on the BFD-RS configuration of CORESETs with more than 1 activated TCI state. |
| NEC | Support the proposal. |
| FGI/APT | Support FL’s proposal |
| LGE | Provided comment in email. |

According to commpents from companies in email discussion, the following updated proposal 2.10 seems to be acceptable to majority of companies.

**Updated FL Proposal 2.10:**

***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***
  1. Issue 2.11: SCS of the 28 symbols (discuss over email)
     1. **Round 1**

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

The SCS of the 28 symbols is:

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support Alt2, which is aligned with R16 |
| vivo | We reveise our proposal in Alt-6. |
| ZTE | First of all, we do not have a clear R16 solution due to the fact the corrresponding CR/conclusion has not been approved. Then, to be honest, we do no identify the clear difference among Alt-1, Alt-2, Alt-4 and Alt-5. Maybe, we need to clarify: the SCS of the 28 symbol is detemined per TRP or per CC. For instance, the gNB response is received in CC0, TRP1 in CC1 and CC2 fails, but TRP2 in CC3 and CC4 fails. |
| OPPO | Whatever specifed in rel16 can be re-used here. |
| MediaTek | Since gNB response for Rel-16 SCell BFR is reused for Rel-17 MTRP BFR, the SCS of the 28 symbols can be determined by el-16 mehanism as well. |
| DOCOMO | Support Alt-1. |
| Xiaomi | Support to reuse the mechanism in Rel-16, i.e., Alt-1 |
| Spreadtrum | Prefer to resue Rel-16 mechanism |
| Nokia/NSB | Alt.4. due to the similarity with R16 (alt1,alt2, alt3 seem to also cover same functionality) |
| Huawei, HiSilicon | Support Alt-1 |
| Qualcomm | Support Alt2 or Alt4, and delete Alt3, which is a typo, i.e. largest should be smallest. |
| LGE | Support Alt-1. |
| TCL | We prefer to reuse same mechanism in Rel-16. |
| Sony | Support Alt-2. |
| Mod | To our understanding, majority companies support to reuse Rel-16 mechanism as much as possible, and some of the above alternatives can be merged. A initial proposal based on Alt-4 is provided below as a starting point.  ***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.***  Also, the following description to SCS of the 28 symbols is extracted from clause 6 of 213 for your reference:  where the SCS configuration for the 28 symbols is the smallest of the SCS configurations of the active DL BWP for the PDCCH reception and of the active DL BWP(s) of the at least one SCell. |
| InterDigital | Support FL’s proposal. |
| Qualcomm | Support Proposal 2.11 |

* + 1. **Round 2**

***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.

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | Support. |
| ZTE | In our view, per-TRP may be much more straightforward and is beneficial for non-ideal backhaul scenario. So we suggest that the FL proposal is updated as follows:  ***FL Proposal 2.11: SCS of the 28 symbols is the smallest SCS of the response receiving CC and the cell(s) with the same ~~one or more~~ failed TRPs.*** |
| Apple | As we commented in the email, we think this should be “the cells with failed TRP(s) reported by BFR MAC CE” |
| Mod | Discuss over email. |
| Huawei, HiSilicon | Provided comment in email. |
| LGE | Provided comment in email. |

According to commpents from companies in email discussion, companies still have different views on whether the delay with beam update needs to be optimized or not.

**Updated FL Proposal 2.11:**   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)~~ or (s)] with the  failed TRP  link(s) reported in BFR MAC CE.

Preference for updated FL proposal 2.11:

•        ~~(s)~~ is supported: QC (1st preference), OPPO

•        (s) is supported: Huawei , HiSilicon , QC (2nd preference), ZTE, MTK

* + 1. **Round 3**

Continue the discussion on issue 2.11 over email.

* 1. Issue 2.12: RACH based transmission
     1. **Round 1**

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

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

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

|  |  |
| --- | --- |
| Company | Comments |
| Apple | Support CBRA only. The overhead for CFRA is too large. |
| FGI/APT | We share similar views with Apple. |
| vivo | We share similar views with Apple. |
| ZTE | Based on previous agreement, if a single TRP fails in SpCell, TRP-specific BFR procedure should be initialized. We fail to understand why we need to further introduce CBRA/CFRA based feed back herein. If the motivation is to clarify the UE behavior in the case that two TRPs both fail in SpCell, we think that CFRA/CBFA should be both supported. |
| MediaTek | The scenario(s) triggers the CBRA/CFRA based feedback on SpCell need to be clarified together in the proposal.  Possible scenarios captured from FL summary in the previous meeting as follows:   * Scenario 1: When beam failure is detected on all BFD-RS sets on the SpCell * 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   We support both CBRA and CFRA for Scenario 1 and Scenario 4 |
| DOCOMO | We share similar view with ZTE. What does “as a result of per-TRP beam failure” mean? If it means two TRPs fail in SpCell, we think that both CFRA and CBFA can be supported, which depends on gNB configuration. |
| Lenovo/MotM | We support both CFRA and CBRA. |
| NEC | Prefer CBRA only, and we share similar view with MediaTek that the scenarios should also be discussed. |
| Xiaomi | We share similar view with Apple. |
| CMCC | We agree with MTK to discuss the scenarios together. We support Scenario 1. |
| Nokia/NSB | This is related with issue 2.1.  We support CFRA/CBRA as a fallback operation (Scenario 1) when two BFD-RS sets are configured, and all TRPs are failed. CBRA can be performed without any restriction i.e..when SR is not configured or UL grant is not available. |
| Futurewei | We share similar view with ZTE and DOCOMO and we support both CFRA and CBRA. |
| Convida | We share the view of Apple, i.e. only CBRA fallback.  Note that CBRA is fallback also in CFRA. |
| Huawei, HiSilicon | Support at least CBRA-based fallback. |
| Qualcomm | Support CBRA. For CFRA, the relation with CBRA should be clarified, e.g. under which condition to use CFRA or CBRA. |
| Samsung | Support both CBRA and CFRA based fall back. |
| LGE | We support both CBRA and CFRA for scenario 1, as both were specified in Rel-15 BFRQ. |
| Mod | @ZTE and DCM: the intention for discussing this issue is to determine the fallback mechanism for SpCell, and the initial wording may not be suitable in the above summary. @MediaTek, CMCC and all, the following proposals are listed for further discussion.  ***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***   ***FL proposal 2.12-2: For RACH-based fallback, choose one of the following alternatives***   * ***Alt-1: Support only CBRA*** * ***Alt-2: Support only CFRA*** * ***Alt-3: support both CBRA and CFRA*** |
| ETRI | Support. We prefer to support both CBRA and CFRA based fallback (Alt-3) for Scenario 1. |
| Ericsson | Similar to Nokia, we feel that this may be related to issue 2.1 – or not, depending on how we interpret “fallback”.  Overall, we feel that these issues would be much simpler if per-TRP BFR was designed to solve the new situation where one TRP fails – there are already two solutions for the situation where all TRPs fail. |
| InterDigital | Support FL’s proposal 2.12-1 and 2.12-2. |
| Qualcomm | Support Proposal 2.12-1 and 2.12-2 as starting point  For 2.12-1, we are also fine for scenario 4  For 2.12-2, we are fine for Alt1, but can also live with Alt3, which however should clarify the interaction |
| Intel | Support Proposal 2.12-1 and 2.12-2 |
| MediaTek | Support both FL proposals |
| Lenovo/MotM | Support Proposal 2.12-1 and for Proposal 2.12-2, we support Alt-3. |

* + 1. **Round 2**

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 this proposal: OPPO, Convida, Apple, Xiaomi, CMCC, NEC, vivo, FGI/APT
* Not support this proposal
  + Support both CFRA and CBRA: DCM, ZTE, Lenovo/MotM, MTK, LGE, InterDigital

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

|  |  |
| --- | --- |
| Company | Comments |
| NTT DOCOMO | We prefer to support both CBRA and CFRA as CFRA has been supported in Rel-16 even though it may be not configured by gNB. Anyway, whether to configure CFRA for BFR can be decided by gNB.  But we can also live with CBRA only. |
| ZTE | Reserving RACH resource for CFRA is based on gNB configuration, and we do not see the reason why CFRA can NOT be configured if mTRP-BFR is enabled. It does not make sense. BTW, from spec perspective, the BFR procedure is just to initialize the RACH procedure, and how to perform RACH procedure, e.g., based on CBRA or CFRA, is individually specified.  It seems that there is some misunderstanding that CFRA is the identical to R15 BFR (it is different from issue 2.1). In fact, besides for R15 BFR, gNB still can configured CFRA for other purposes. |
| OPPO | We can live with CBRA only. Supporting both seems to be over-design. The CFRA does have large overhead. |
| Convida | We also think CBRA is sufficient.  To support CFRA, the gNB needs to configure more CFRA-BFR-related parameters, such as a candidateBeamRSList, recovery SeachSpace/CORESET, etc.. What would the relation be between the candidateBeamRS for CFRA and the per-TRP CB-RS sets? Is it worth it to use one CORESET only for the fallback?  If the CB-RS configured for CFRA are below the RSRP threshold, it seems the procedure falls back to CBRA anyway? |
| Apple | We think CBRA is enough.  We have agreed the whole TRP-specific BFR is based on SCell BFR framework, where only CBRA is supported. CFRA is with large overhead, and somehow reverts previous agreement. |
| Lenovo/MotM | We support both CBRA and CFRA. Since CFRA is configured by gNB, gNB has the flexibility whether to configure it considering the tradeoff between overhead and reliability. |
| Xiaomi | We can live with CBRA only. |
| CMCC | Fine with CBRA only |
| NEC | Support the proposal. |
| vivo | Support the possible agreement. |
| MediaTek | Still prfer both CFRA and CBRA |
| Nokia/NSB | We are fine without CFRA. We just want to have consistency with Rel-15 BFR scheme. |
| FGI/APT | Similar views as Apple. |
| Samsung | Support both CFRA and CBRA, which one to use can be configured |
| LGE | Support both CFRA and CBRA. As commented during GTW, the issue here is whether to disable one legacy feature for SpCell BFR. Based on discussions/agreements so far, TRP-specific BFR can be a super-set of single TRP failure and CC/BWP failure. For CC/BWP failure, two existing legacy options should be applicable. Which one to apply is totally up to gNB’s configuration as Rel-15.  Re Apple’s argument, we don’t think this case is for TRP-specific BFR. Rather this is for BWP/CC-specific BFR. The baseline for BWP/CC-specific BFR should be Rel-15 BFR for SpCell and Rel-16 BFR for SCell. |
| InterDigital | Don’t support the proposal.  Both CFRA and CBRA should be supported. It would be up to gNB to decide and configure. |

* + 1. **Round 3**

|  |  |
| --- | --- |
| Company | Comments |
| Mod | Regarding whether to support CBRA only or both, seems two sides are well balanced.   * Support CBRA only: OPPO, Convida, Apple, Xiaomi, CMCC, NEC, vivo, FGI/APT * Support both CFRA and CBRA: DCM, ZTE, Lenovo/MotM, MTK, LGE, InterDigital   So, can we move one litte step backward and downselect one out of the two options?  **Updated Possible Agreement**  ***For RACH-based fallback, down select one out of the two alternatives:***   * ***Alt-1:only CBRA is supported*** * ***Alt-2:support both CBRA and CFRA*** |
| Huawei, HiSilicon | Support at least CBRA. |
| ZTE | Support Alt-2. As we mentioned before, CFRA or CBRA is up to gNB configuration. BTW, CFRA herein does not refer to R15 Pcell CF-BFR. |
| NTT DOCOMO | Support Alt-2. Can live with Alt-1. |
| Lenovo/MotM | We support Alt-2, and we also accept to down select next meeting if majority supports to down select next meeting. |
| MediaTek | Okay to postpone the decision to the next meeting |

1. Other issues
   1. Issue 3.1: TRP-specific BFR for the case of CORESET with 2 TCI states

As mentioned by some companies in their contribution, HST-SFN is an important scenario for practical deployment. In addition to legacy SFN scheme based on Rel-15 transmission scheme, enhanced SFN transmission schemes for both PDCCH and PDSCH are introduced in Rel-17. Based on views of companies that are interested in the enhancement on HST-SFN, the following proposal is listed for discussion.

***FL proposal 3.1: TRP-specific BFR for the case of CORESET with 2 TCI states is supported in Rel-17.***

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.

|  |  |
| --- | --- |
| Company | Comments |
| ZTE | We are open to have some further discussion. In our initial views, this issue should be handled after sDCI-mTRP BFR is stable. |
| NTT DOCOMO | Support. |
| Lenovo/MotM | Support. |

* 1. Issue 3.2: 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.

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

|  |  |
| --- | --- |
| Company | Comments |
| ZTE | Postponed to Rel18. |
| NTT DOCOMO | Support to resolve at least partial combinations, such as PDCCH+PDCCH, PDCCH+PDSCH, etc. |
| Lenovo/MotM | Support further study on account of enhanced capability by multiple panels for supporting multiple QCL-TypeD. If time is limited for Rel.17, we prefer at least we can study the case of the same type of channels/RS with different QCL-TypeD, i.e. the first study item, on account of relative smaller standard impact from limited combination cases. |
| MediaTek | In previous meetings, we would also like to dicuss these issues. However, considering there are many unrevoled issues in this agenda, we now prefer not to spend time on them. |

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. Reference
2. [R1-2108759](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108759.zip) Enhancements on beam management for multi-TRP in Rel-17 Huawei, HiSilicon
3. [R1-2108792](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108792.zip) Beam management for simultaneous multi-TRP transmission with multi-panel reception FUTUREWEI
4. [R1-2108811](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108811.zip) On Beam Management Enhancements for Multi-TRP InterDigital, Inc.
5. [R1-2108873](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108873.zip) Enhancements on beam management for Multi-TRP ZTE
6. [R1-2108898](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108898.zip) Discussion on enhancements on beam management for multi-TRP Spreadtrum Communications
7. [R1-2108954](file:///C:\Users\suxin\AppData\Local\Docs\R1-2108954.zip) Further discussion on MTRP multibeam enhancement vivo
8. [R1-2109031](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109031.zip) Enhancements on beam management for multi-TRP Fujitsu
9. [R1-2109041](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109041.zip) Enhancements on beam management for multi-TRP OPPO
10. [R1-2109106](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109106.zip) Enhancements on beam management for multi-TRP Lenovo, Motorola Mobility
11. [R1-2109108](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109108.zip) Enhancements on beam management for multi-TRP TCL Communication Ltd.
12. [R1-2109125](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109125.zip) Discussion on beam management for multi-TRP NEC
13. [R1-2109187](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109187.zip) Beam reporting and beam failure recovery for multi-TRP CATT
14. [R1-2109273](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109273.zip) Enhancements on beam management for multi-TRP CMCC
15. [R1-2109381](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109381.zip) Enhancement on beam management for Multi-TRP Xiaomi
16. [R1-2109471](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109471.zip) Enhancements on beam management for multi-TRP Samsung
17. [R1-2109545](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109545.zip) Enhancement on beam management for multi-TRP MediaTek Inc.
18. [R1-2109594](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109594.zip) Multi-TRP enhancements for beam management Intel Corporation
19. [R1-2109661](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109661.zip) Discussion on beam management for MTRP NTT DOCOMO, INC.
20. [R1-2109774](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109774.zip) Enhancements on beam management for multi-TRP Sony
21. [R1-2109807](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109807.zip) Enhancements on beam management for multi-TRP ETRI
22. [R1-2109833](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109833.zip) Discussion of enhancements on beam management for multi-TRP FGI, Asia Pacific Telecom
23. [R1-2109873](file:///C:\Users\suxin\AppData\Local\Docs\R1-2109873.zip) Enhancements on Beam Management for Multi-TRP/Panel Transmission Nokia, Nokia Shanghai Bell
24. [R1-2110016](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110016.zip) Views on Rel-17 multi-TRP BM enhancement Apple
25. [R1-2110080](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110080.zip) Enhancements on beam management for multi-TRP LG Electronics
26. [R1-2110106](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110106.zip) On Multi-TRP BFR Convida Wireless
27. [R1-2110114](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110114.zip) Discussion on beam management for multi-TRP ASUSTEK
28. [R1-2110168](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110168.zip) Enhancements on beam management for multi-TRP Qualcomm Incorporated
29. [R1-2110241](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110241.zip) Discussion on beam management for multi-TRP ITRI
30. [R1-2110288](file:///C:\Users\suxin\AppData\Local\Docs\R1-2110288.zip) Remaining issues on beam management for multi-TRP Ericsson