**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.11.2, 8.11.2.1, 8.11.2.2, 8.11.2.3, 8.11.2.4

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for RAN4#94e\_#59\_NR\_eMIMO\_RRM

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion and provide some guidelines for email discussion if necessary.*

Rel-16 NR eMIMO WI (i.e., Enhancements on MIMO for NR) is a RAN1 leading WI with below major enhancement in RAN1 area, in which the following items are identified for having RAN4 RRM requirement impact, based on previous RAN4 discussion:

* Enhancements on multi-beam operation
  + DL/UL beam indication with reduced latency and overhead
  + Beam failure recovery for SCell
  + L1-SINR measurement

In last RAN4 meeting (RAN4#93), WF is approved as R4-1915850, in which agreement from online session is summarized and way forward is captured for above three aspects.

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

As the rapporteur for eMIMO WI, we would like to suggest the following candidate target of 1st and 2nd round email discussion:

* 1st round: Collect more views on all topics, while the following clarification achieved:
* 2nd round: Based on results from 1st round, proceed as much as possible.

# Topic #1: L1-SINR Measurement

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000285 | Samsung | Observation-1: Based on RAN1 conclusion,  - In CMR only scenario, the RRC parameters timeRestrictionForChannelMeasurements can be configured.  - In CMR+IMR scenario, timeRestrictionForChannelMeasurements and timeRestrictionForInterferenceMeasurements can be configured.  Proposal-1: In CMR only scenario, M=1(single-shot measurement)shall be applied if   * aperiodic CSI-RS resource is configured for channel measurement, or * periodic or semi-persistent CSI-RS resource is configured for channel measurement and higher layer parameter timeRestrictionForChannelMeasurements is configured.   Proposal-2: In a single CSI-reportConfig with L1-SINR CMR+IMR measurement, the same measurement time restriction should be applied for CMR and IMR, i.e., both RRC signalling IE timeRestrictionForChannelMeasurements and timeRestrictionForInterferenceMeasurements should be configured or notConifgured.  Proposal-3: In CMR+IMR scenario, M=1 (single-shot measurement) shall be applied if   * aperiodic CSI-RS resource is configured for interference measurement (for SSB-based CMR or aperiodic CSI-RS based CMR), or * periodic or semi-persistent CSI-RS resource is configured for channel and/or interference measurement and higher layer parameter timeRestrictionForChannelMeasurements or timeRestrictionForInterferenceMeasurements is configured.   + Note: by following Proposal-2, timeRestrictionForChannelMeasurements and timeRestrictionForInterferenceMeasurements shall both be configured in this case.   Proposal-4: For L1-SINR reporting with SSB based CMR and dedicated IMR configured, the measurement period requirements for FR1 and FR2 shall be defined as the below tables:  Table x: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR1   |  |  | | --- | --- | | Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TSSB) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR channel measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |   Table y: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR2   |  |  | | --- | --- | | Configuration | TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX | | Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |   Where the variable M, P, N are the same as Section 9.5.4.1 for L1-RSRP reporting.  Proposal-5: For L1-SINR reporting with CSI-RS based CMR and dedicated IMR configured, the measurement period requirements for FR1 and FR2 shall be defined as the below tables:  Table x: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR1   |  |  | | --- | --- | | Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |   Table y: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR2   |  |  | | --- | --- | | Configuration | TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) | | DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX | | Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |   Where the variable M, P, N are the same as Section 9.5.4.2 for L1-RSRP reporting.  Observation-2: Two kinds of Type-D QCL are expected for a NZP CSI-RS resource (BM purpose), in following conditions:   - NZP CSI-RS resource configured as CMR in one CSI report (either L1-RSRP or L1-SINR) and IMR in another CSI report, where two corresponding CMRs are NOT Type-D QCLed;  - NZP CSI-RS resource configured as IMR in two CSI reports, where two corresponding CMRs are NOT Type-D QCLed; In both cases, UE is not expected to conduct two measurements (for two CSI reports) on one NZP CSI-RS transmission instance.  Proposal-6: For L1-SINR reporting with CMR + NZP-IMR configured in one CSI report, L1-SINR measurement requirements apply only if the NZP-IMR is not configured in another CSI report whose CMR is not Type-D QCLed; otherwise, longer measurement requirement is expected.  Proposal-7: For L1-SINR measurement with dedicated configured NZP-IMR or ZP-IMR, there is no necessity to perform RX beam training/refinement for IMR.  Proposal-8: For L1-SINR measurement with dedicated NZP-IMR,  - “Repetition = On” may be configured if its CSI-RS resource set is used for the other BM purpose, e.g., some of CSI-RS resources within the CSI-RS resource set are used for CMR in another CSI reporting; - UE shall use NZP-IMR’s corresponding CMR’s TCI information for reception, and neglect any configuration by Repetition IE field for NZP-IMR’s CSI-RS resource set, i.e., “Repetition=On”, “Repetition=Off”, or Repetition field is not present.  Proposal-9: For L1-SINR measurement with dedicated ZP-IMR,   - “Repetition” field should not be present for ZP-IMR’s CSI-RS resource set configuration.  Proposal-10: Side condition for CMR+IMR scenario, in additional to L1-SINR lower bound (to be decided after simulation campaign), the accuracy requirement is applicable only if following conditions are satisfied:  - Es/Iot over CMR: SSB or CSI-RS Es/Iot >=3dB and <=25dB  - Es/Iot over NZP-IMR: CSI-RS Es/Iot >=3dB and <=25dB |
| R4-2000286 | Samsung | Observation 1: L1-SINR measurement in NZP-IMR scenarios (0 dB CMR/IMR side condition) is more accurate than ZP-IMR scenarios (-3 dB CMR/IMR side condition).  Proposal 1: The side conditions are confirmed to achieve the ideal SINR as -3dB for both NZP and ZP scenarios, i.e.,  - For NZP-IMR: Side condition (SNR) on CMR and IMR are both 0dB  - For ZP-IMR: Side condition (SNR) on CMR are -3dB  Proposal 2: It is proposed that the measurement period for L1-SINR as  - Single shot measurement (M=1): for single-shot scenarios (summarized in R4-2000285)  - M=3: for other scenarios. |
| R4-2000287 | Samsung | Reserved for L1-SINR measurement accuracy simulation result summary |
| R4-2000288 | Samsung | CR to TS38.133 on L1-SINR Measurement Requirement (Section 3.3 and 9) |
| R4-2000384 | Intel Corporation | Proposal 1: The measurement period for CMR only scenario can be re-used for CSI-RS based CMR+ZP-IMR scenario and CMR periodicity is used to define measurement period.  Proposal 2: Not to define requirement for L1-SINR estimation if NZP-IM is configured as” repetition=ON”.  Observation 1: there is no “repetition” configuration for ZP-IMR.  Observation 2: The L1-SINR accuracy of CSI-RS based CMR only and CMR+ZP-IMR scenarios are similar. |
| R4-2000635 | CMCC | This contribution provides simulation results on L1-SINR based on the agreed simulation assumption. |
| R4-2000935 | MediaTek inc. | Proposal 1: UE does not expect that CMR and IMR are configured with different types of resource periodicity.  Proposal 2: ZP-IMR is not required to configure as “repetition=ON” or “repetition=OFF”.  Proposal 3 : The requirement for SSB based CMR and periodic ZP-IMR can be defined.  Proposal 4: The requirement for NZP CSI-RS based CMR with “repetition = ON” and ZP-IMR can be defined, provided the QCL information of CMR is given.  Proposal 5 : The requirement for NZP CSI-RS based CMR with “repetition = OFF” and ZP-IMR can be defined, provided the QCL information of CMR is given.  Proposal 6 : SSB based CMR and NZP-IMR with “repetition = ON” is an error configuration and no requirement should be specified.  Proposal 7 : The requirement for SSB based CMR and NZP-IMR with “repetition = OFF” can be defined, provided the QCL information of NZP-IMR is given.  Proposal 8 : The requirement for NZP CSI-RS based CMR with “repetition = ON” and NZP-IMR with “repetition = ON” can be defined, provided the QCL information of CMR is given.  Proposal 9 : The requirement for NZP CSI-RS based CMR with “repetition = ON” and NZP-IMR with “repetition = OFF” can be defined, provided the QCL information of CMR is given.  Proposal 10 : NZP CSI-RS based CMR with “repetition = OFF” and NZP-IMR with “repetition = ON” is an error configuration and no requirement should be specified.  Proposal 11: The requirement for NZP CSI-RS based CMR with “repetition = OFF” and NZP-IMR with “repetition = OFF” can be defined, provided the QCL information of CMR is given. |
| R4-2000936 | MediaTek inc. | Observation 1: For CMR totally overlapped with IMR, L1-SINR delay requirement can reuse L1-RSRP requirement.  Proposal 1 : Evaluation time of L1-SINR is based on the maximum evaluation time between CMR and IMR. |
| R4-2000937 | MediaTek inc. | Proposal 1: For L1-SINR simulation assumption, the ZP-IMR should be corrected to CSI-IM.  Proposal 2: For SSB based CMR L1- SINR for reporting, the absolute measurement accuracy is +/- 3.5 dB for FR1; +/- 3.5 dB for FR2 with side condition on CMR=-3dB.  Proposal 3: For L1-SINR simulation assumption, the side condition on CMR across cases should be the same.  Proposal 4: For SSB based CMR and NZP IMR L1-SINR for reporting, the absolute measurement accuracy is +/- 3.5 dB for FR1; +/- 3.5 dB for FR2 with side condition on CMR=-3dB and IMR=-3dB.  Proposal 5: For SSB based CMR and ZP-IMR L1-SINR for reporting, the absolute measurement accuracy is +/- 3.5 dB for FR1; +/- 3.5 dB for FR2 with side condition on CMR=-3dB and IMR=-3dB.  Proposal 6: For CSI-RS based CMR and NZP IMR L1- SINR for reporting, the absolute measurement accuracy is +/- 3.5 dB for FR1; +/- 3.5 dB for FR2 with side condition on CMR=-3dB and IMR=-3dB.  Proposal 7: For CSI-RS based CMR and ZP-IMR L1- SINR for reporting, the absolute measurement accuracy is +/- 3.5 dB for FR1; +/- 3.5 dB for FR2 with side condition on CMR=-3dB and IMR=-3dB. |
| R4-2000997 | OPPO | draftCR on SS-SINR and CSI-SINR measurement report mapping (section 10.1.16.1) |
| R4-2001362 | Ericsson | Observation 1: No significant accuracy difference among different combinations of CMR and IMR.  Proposal 1: Set the common measurement accuracy requirements for the L1-SINR with CMR-only, SSB + NZP-IMR, SSB + ZP-IMR, CSI-RS + NZP-IMR and CSI-RS + ZP-IMR.  Proposal 2: Set the assumed number of samples for L1-SINR measurements to 3 if the case the measurement restriction is not configured.  Proposal 3: Set both the assumed number of CMR samples for L1-SINR measurements (MCMR) and IMR samples for L1-SINR measurements (MIMR) to 1 if the higher layer parameter *timeRestrictionForChannelMeasurement* and/or *timeRestrictionForInterferenceMeasurements* is configured.  Proposal 4: L1-SINR measurement period is set for FR1 as follows:   |  |  | | --- | --- | | Configuration | TL1-SINR\_Measurement\_Period (ms) | | Non-DRX | max(TReport, cell(M\*P)\*max(TCMR, TIMR)) | | DRX cycle <= 320 ms | max(TReport, cell(1.5\*M\*P)\*max(TDRX, TCMR, TIMR)) | | DRX cycle > 320 ms | cell(M\*P)\*TDRX | | P: Measurement gap factor.  TReport, CSI reporting period. | |   In the case of FR2, the measurement period is scaled with N as same as L1-RSRP. |
| R4-2001578 | Huawei, HiSilicon | Proposal 1: The measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_w/\_IMR for L1-SINR reporting with SSB based CMR and dedicated IMR configured could be defined as follows:  Table 1: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CMR\_w/\_IMR for FR1   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CMR\_w/\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TSSB) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured as CMR for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |   Table 2: Measurement period TL1-RSRP\_Measurement\_Period\_SSB\_CMR\_w/\_IMR for FR2   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_SSB\_CMR\_w/\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) | | DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX | | Note: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured as CMR for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting. | |   Proposal 2: The measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_w/\_IMR for L1-SINR reporting with CSI-RS based CMR and dedicated IMR configured could be defined as follows:  Table 3: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_CMR\_w/\_IMR for FR1   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_CMR\_w/\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) | | DRX cycle > 320ms | ceil(M\*P)\*TDRX | | Note 1: TCSI-RS is the periodicity of CSI-RS configured as CMR for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured as CMR for L1-SINR measurement is transmitted with Density = 3. | |   Table 4: Measurement period TL1-RSRP\_Measurement\_Period\_CSI-RS\_CMR\_w/\_IMR for FR2   |  |  | | --- | --- | | Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS\_CMR\_w/\_IMR (ms) | | non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) | | DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) | | DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX | | Note 1: TCSI-RS is the periodicity of CSI-RS configured as CMR for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured as CMR for L1-SINR measurement is transmitted with Density = 3. | |   Proposal 3: For CMR+IMR scenario, the variable M used to define L1-SINR measurement period could be defined as follows:   * M=1, if higher layer parameter timeRestrictionForChannelMeasurement or timeRestrictionForInterferenceMeasurements is configured; * M=3, otherwise.   Proposal 4: For CMR+IMR scenario, the variable P used for defining L1-SINR measurement period could be determined by the ratio of available L1-SINR measurement occasions.   * A L1-SINR measurement occasion is considered as available only when the CMR and the associated IMR are both non-overlapped with measurement gap or SMTC window.   Proposal 5: For CMR+IMR scenario, the variable N used for defining L1-SINR measurement period could be defined as 8 when SSB is configured as CMR.  Proposal 6: For CMR+IMR scenario, when CSI-RS is configured as CMR, RAN4 need to investigate how to utilize the QCL information of CMR and IMR for UE perform L1-SINR measurements. |
| R4-2001579 | Huawei, HiSilicon | Observation 1: In Rel-15, only the CSI-RS resource sets for L1-RSRP reporting can be configured with repetition.  Observation 2: There is neither repetition configuration nor QCL configuration for a ZP-CSI-RS resource.  Observation 3: When a CSI-RS resource with repetition configuration is configured as CMR or IMR for L1-SINR measurement, then the L1-SINR measurement occasions will be always overlapped with the L1-RSRP measurement occasions.  Proposal 1: For CMR+IMR scenario, RAN4 study when the measurement restrictions need to be applied between L1-SINR measurement and L1-RSRP measurements.  Proposal 2: For CMR and IMR scenario, RAN4 study the configuration restrictions between CMR and IMR. |
| R4-2002120 | Qualcomm | Observation 1: Table 1 shows the statistics of L1-SINR simulation results in different scenarios.  Table 1: Statistics of L1-SINR simulation results in different scenarios   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | SCS | # samples | Mean [dB] | | | | | CMR only | | SSB/NZP IMR | | SSB/ZP IMR | | CSI-RS/NZP IMR | | CSI-RS/ZP IMR | | | CMR only | SSB/  NZP | SSB/  ZP | CSI-RS/  NZP | CSI-RS/  ZP | 5-perc. | 95-perc. | 5-perc. | 95-perc. | 5-perc. | 95-perc. | 5-perc. | 95-perc. | 5-perc. | 95-perc. | | 15 | 1 | -1.33 | -3.3 | -3.35 | -2.9 | -3 | -2.69 | 0.12 | -4.1 | -2.6 | -4.34 | -2.45 | -3.62 | -2.19 | -3.87 | -2.17 | | 3 | -1.39 | -3.31 | -3.35 | -2.9 | -3 | -2.17 | -0.53 | -3.77 | -2.83 | -3.95 | -2.79 | -3.31 | -2.47 | -3.48 | -2.53 | | 5 | -1.4 | -3.31 | -3.36 | -2.91 | -3.01 | -1.99 | -0.74 | -3.64 | -3 | -3.79 | -2.97 | -3.24 | -2.6 | -3.37 | -2.66 | | 30 | 1 | -1.35 | -2.76 | -3.17 | -2.82 | -3.18 | -2.76 | 0.16 | -3.77 | -1.89 | -4.15 | -2.29 | -3.48 | -2.15 | -4.01 | -2.36 | | 3 | -1.41 | -2.76 | -3.18 | -2.82 | -3.18 | -2.26 | -0.55 | -3.32 | -2.26 | -3.73 | -2.58 | -3.22 | -2.43 | -3.66 | -2.71 | | 5 | -1.42 | -2.76 | -3.18 | -2.83 | -3.19 | -2.07 | -0.76 | -3.18 | -2.38 | -3.65 | -2.76 | -3.12 | -2.51 | -3.55 | -2.83 | | 120 | 1 | -1.41 | -2.89 | -3.48 | -2.55 | -3.23 | -3 | 0.15 | -3.94 | -1.91 | -5.03 | -2.16 | -3.22 | -1.84 | -4.17 | -2.41 | | 3 | -1.5 | -2.89 | -3.48 | -2.55 | -3.24 | -2.79 | -0.56 | -3.49 | -2.34 | -4.43 | -2.72 | -3.33 | -2.09 | -4.04 | -2.71 | | 5 | -1.51 | -2.9 | -3.48 | -2.55 | -3.24 | -2.51 | -0.82 | -3.37 | -2.45 | -4.15 | -2.84 | -3.08 | -2.18 | -3.79 | -2.82 |   Observation 2: If CMR is configured with “repetition = ON”, UE will have to sweep its RX beams to receive CMR. UE should use the same set of RX beams to receive NZP-IMR as well because the level of interference may vary across its different RX beams.  Observation 3: If CMR and NZP-IMR are configured with repetition pattern = “ON”, they should be located in non-overlapping symbols so that UE can change its RX beams in time domain appropriately to receive CMR and NZP-IMR signals.  Observation 4: If the L1-SINR becomes very high in CMR + NZP-IMR scenarios, UE will not be able to adapt its RX gain controller properly to receive CMR and NZP-IMR.  Proposal 1: RAN4 uses the following table to define the estimation accuracy requirements of L1-SINR.  Table: L1-SINR estimation accuracy (in dB) in different scenarios   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | SCS | # samples | CMR only | SSB/NZP IMR | SSB/ZP IMR | CSI-RS/NZP IMR | CSI-RS/ZP IMR | | 15 | 1 |  |  |  |  |  | | 3 |  |  |  |  |  | | 5 |  |  |  |  |  | | 30 | 1 |  |  |  |  |  | | 3 |  |  |  |  |  | | 5 |  |  |  |  |  | | 120 | 1 |  |  |  |  |  | | 3 |  |  |  |  |  | | 5 |  |  |  |  |  |   Proposal 2: ZP-IMR CSI-RS can be configured with “repetition = off” in FR2.  Proposal 3: NZP-IMR CSI-RS can be configured with both “repetition = off” or “repetition = on” in FR2.   * CMR and NZP-IMR should be configured with the same repetition pattern. * CMR and NZP-IMR should not overlap in time domain if they are configured with “repetition = on”.   Proposal 4: In CMR + ZP-IMR scenarios, Es/IoT of CMR should range between -3 and 25 dB.  Proposal 5: In CMR + NZP-IMR scenarios, both Es/IoT of CMR and IoT of NZP-IMR should range between 0 and 25 dB. the resultant SINR in this scenario, i.e., the ratio of CMR over NZP-IMR should also range between -3 to 25 dB. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: L1-SINR Measurement Period

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: Applicable condition(s) for one-shot L1-SINR measurement report for CMR only scenario:**

* Applicable condition(s) for CMR only scenario:
  + Option 1: M=1 shall be applied if
    - aperiodic CSI-RS resource is configured for channel measurement, or
    - periodic or semi-persistent CSI-RS resource is configured for channel measurement and higher layer parameter *timeRestrictionForChannelMeasurements* is configured.
* Recommended WF
  + Suggest RAN4 to agree on Option 1.

**Issue 1-1-2: Restriction between measurement time restriction on IMR and CMR:**

* Restriction between measurement time restriction on IMR and CMR:
  + Option 1: In a single *CSI-reportConfig* with L1-SINR CMR+IMR measurement, the same measurement time restriction should be applied for CMR and IMR, i.e., both RRC signalling IE *timeRestrictionForChannelMeasurements* and *timeRestrictionForInterferenceMeasurements* should be configured or notConfigured:
  + Option 2: No restriction applied.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-1-3: Applicable condition(s) for one-shot L1-SINR measurement report for CMR+IMR scenario:**

* Applicable condition(s) for CMR+IMR scenario:
  + Option 1: M=1 shall be applied if
    - aperiodic CSI-RS resource is configured for interference measurement (for SSB-based CMR or aperiodic CSI-RS based CMR), or
    - periodic or semi-persistent CSI-RS resource is configured for channel and/or interference measurement and higher layer parameter *timeRestrictionForChannelMeasurements* **or** *timeRestrictionForInterferenceMeasurements* is configured.
  + Option 1a: M=1 shall be applied if
    - aperiodic CSI-RS resource is configured for interference measurement (for SSB-based CMR or aperiodic CSI-RS based CMR), or
    - periodic or semi-persistent CSI-RS resource is configured for channel and/or interference measurement and higher layer parameter *timeRestrictionForChannelMeasurements* **or** *timeRestrictionForInterferenceMeasurements* is configured.
      * Note: timeRestrictionForChannelMeasurements and timeRestrictionForInterferenceMeasurements shall both be configured in this case if above Issue 1-1-2 option 1 is agreed.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-1-4: Measurement period for SSB-based CMR+IMR scenario:**

* Proposals:
  + Option 1: By following L1-RSRP measurement requirement and restricting CMR and IMR’s 1-to-1 mapping, measurement period requirements for FR1 and FR2 shall be defined as:

**Table x: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms)** |
| non-DRX | max(TReport, ceil(M\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR channel measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

**Table y: Measurement period TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TL1-SINR\_Measurement\_Period\_SSB\_CMR\_IMR (ms)** |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to SSB configured for channel measurement, with the same periodicity. | |

Where the variable M, P, N are the same as Section 9.5.4.1 for L1-RSRP reporting.

* + Option 1a: similar to above Option 1, but define P as determined by the ratio of available L1-SINR measurement occasions over all occasions.
    - A L1-SINR measurement occasion is considered as available only when the CMR and the associated IMR are non-overlapped with measurement gap or SMTC window.
  + Option 2: similar to above option 1, but replace TSSB by max(TSSB, TIMR).
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-1-5: Measurement period for CSI-RS-based CMR+IMR scenario:**

* Proposals:
  + Option 1: By following L1-RSRP measurement requirement and restricting CMR and IMR’s 1-to-1 mapping, measurement period requirements for FR1 and FR2 shall be defined as:

**Table x: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR1**

|  |  |
| --- | --- |
| **Configuration** | **TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms)** |
| non-DRX | max(TReport, ceil(M\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

**Table y: Measurement period TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR for FR2**

|  |  |
| --- | --- |
| **Configuration** | **TL1-SINR\_Measurement\_Period\_CSI-RS\_CMR\_IMR (ms)** |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil(M\*P\*N)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-SINR measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: the requirements are applicable provided that the CSI-RS resource configured for L1-SINR measurement is transmitted with Density = 3.  Note 3: The CSI-RS resource configured for interference measurement shall be 1-to-1 mapped to CSI-RS configured for channel measurement, with the same periodicity. | |

Where the variable M, P, N are the same as Section 9.5.4.2 for L1-RSRP reporting.

* + Option 1a: similar to above Option 1, but define P as determined by the ratio of available L1-SINR measurement occasions over all occasions.
    - A L1-SINR measurement occasion is considered as available only when the CMR and the associated IMR are non-overlapped with measurement gap or SMTC window.
  + Option 2: similar to above option 1, but replace TCSI-RS by max(TCSI-RS, TIMR).
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-1-6: Side condition for measurement accuracy:**

* In last meeting, the assumption for measurement accuracy evaluation is agreed.
* Proposals:
  + Option 1: -3dB for ideal SINR as -3dB
    - For NZP-IMR: Side condition (SNR) on CMR and IMR are both 0dB
    - For ZP-IMR: Side condition (SNR) on CMR are -3dB.
  + Option 2: the side condition on CMR across cases should be the same.
    - For NZP-IMR: Side condition (SNR) on CMR and IMR are both -3dB, target SINR is -4.77dB
    - For ZP-IMR: Side condition (SNR) on CMR are -3dB.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-1-7: Number of Samples for L1-SINR Measurement:**

* Based on the summary of measurement accuracy (reserved in R4-2000287), the number of samples can be decided to achieve certain measurement accuracy.
* Proposals:
  + Option 1: Common accuracy requirement M = [3] if single shot measurement is not applicable for CMR-only, SSB+NZP-IMR, SSB+ZP-IMR, CSI-RS+NZP-IMR and CSI-RS+ZP-IMR.
* Recommended WF
  + Suggest RAN4 to agree on Option 1.

**Issue 1-1-8: Number of Scaling for FR2 (value of N)**

* Proposals:
  + Option 1: the measurement period is scaled with N defined as same as L1-RSRP.
* Recommended WF
  + Suggest RAN4 to agree on Option 1.

### Sub-topic 1-2: Measurement Restriction and Scheduling Availability

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1:** **NZP-IMR: QCL indication**

* Proposals for QCL indication for NZP-IMR:
  + Option 1: For L1-SINR reporting with CMR + NZP-IMR configured in one CSI report, L1-SINR measurement requirements apply only if the NZP-IMR is not configured in another CSI report whose CMR is not Type-D QCLed; otherwise, longer measurement requirement is expected.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-2-2: NZP-IMR: “repetition = on”**

* For CSI-RS configured as NZP-IMR in FR2, whether “repetition = on” is configurable:
  + Option-1: NZP-IMR can be configured with “repetition = off” or “repetition = on”:
    - Not to define requirement for L1-SINR estimation if NZP-IM is configured as “repetition=ON”.
  + Option-2: NZP-IMR can be configured with “repetition = off” or “repetition = on” if the CSI-RS resource set is used for the other purpose than this L1-SINR measurement report:
    - RX beam for NZP-IMR shall follow CMR, i.e., same RX filter shall be used.
  + Option-3: NZP-IMR can be configured with “repetition = off” or “repetition = on”:
    - CMR and NZP-IMR should be configured with the same repetition pattern.
    - CMR and NZP-IMR should not overlap in time domain if they are configured with “repetition = on”.
  + Option-4: Depending on scenarios (i.e., configuration restriction):
    - SSB based CMR and NZP-IMR with “repetition = ON” is error configuration;
    - SSB based CMR and NZP-IMR with “repetition = OFF” is correct configuration;
    - NZP CSI-RS based CMR with “repetition = ON” and NZP-IMR with “repetition = ON” is correct configuration;
    - NZP CSI-RS based CMR with “repetition = ON” and NZP-IMR with “repetition = OFF” is correct configuration;
    - NZP CSI-RS based CMR with “repetition = OFF” and NZP-IMR with “repetition = ON” is error configuration;
    - NZP CSI-RS based CMR with “repetition = OFF” and NZP-IMR with “repetition = OFF” is correct configuration.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-2-3:** **ZP-IMR: “repetition = on”**

* For CSI-RS configured as ZP-IMR in FR2, whether “repetition = on” is configurable:
  + Option 1: “Repetition” field should not be present for ZP-IMR’s CSI-RS resource set configuration.
  + Option 2: ZP-IMR CSI-RS can be configured with “repetition = off” in FR2.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 1-2-4:** **Measurement restriction between L1-SINR and L1-RSRP**

* Proposals:
  + Option 1: For CMR+IMR scenario, RAN4 study when the measurement restrictions need to be applied between L1-SINR measurement and L1-RSRP measurements.
* Recommended WF
  + Companies’ views are collected in 1st round discussion since it is first time proposed.

### Sub-topic 1-3: Side Condition for Es/Iot

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: L1-SINR measurement side condition for Es/Iot for CMR+ZP-IMR**

* Proposals for Es/Iot on CMR:
  + Option 1: SSB or CSI-RS Es/Iot >= -3dB and <=25dB
* Recommended WF
  + Suggest RAN4 to agree on Option 1.

**Issue 1-3-2: L1-SINR measurement side condition for Es/Iot for CMR+NZP-IMR**

* Proposals for Es/Iot on CMR and NZP-IMR:
  + Option 1: Es/Iot >= -3dB and <=25dB
  + Option 2: Es/Iot >=0dB and <=25dB.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000997 | Company A |
| Company B |
|  |
| R4-2000288 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: SCell Beam Failure Recovery

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000289 | Samsung | Proposal-1: In RAN4 RRM requirement, UE is not required to perform link recovery (BFD and CBD) on a deactivated SCell.  Proposal-2: UE is not required to perform BFD and CBD on SCell within active BWP of the configured CC.  Proposal-3: For SCell BFD, only CSI-RS based BFD (periodic 1-port CSI-RS) is applicable.  Proposal-4: For SCell BFD, Rel-15 CSI-RS based BFD requirement shall be followed, and detailed requirement captured in Section 8.5.3 shall be reused for SCell BFD.  Proposal-5: For SCell CBD, Rel-15 SSB-based and CSI-RS based BFD requirement shall be followed, and detailed requirement captured in Section 8.5.5 and 8.5.6 shall be reused for SCell BFD.  Observation-1: In Rel-16 eMIMO WI, RAN1 introduced new mechanism of beam failure recovery request (BFRQ), with two steps relying on SR-like PUCCH and MAC CE on SpCell:  Step 1 is carried by a dedicatedly configured SR-like PUCCH in PCell or PSCell to inform gNB beam failure happens  Step 2 is carried by a MAC CE to report detail information, e.g. failed CC index and new beam index   * If at least one new beam is identified (L1-RSRP is higher or equal to the threshold)   + UE reports 1 new beam index and failed CC index * Else   + UE reports no new beam identified and failed CC index   Observation-2: In SCell BFRQ, the procedure of informing gNB beam failure happens and reporting detailed information (failed CC and new beam index (or no beam identified)), has no big impact on existing core requirement of BFD and CBD.  Proposal-6: For SCell BFRQ mechanism introduced in Rel-16, RAN4 still define RRM requirement by following Rel-15 specification architecture for BFD and CBD. The new procedure of informing gNB beam failure happens and reporting detailed information will not have core requirement impact on TS38.133.  Proposal-7: The maximum number of SCell for which UE performs BFR is a UE capability. |
| R4-2000290 | Samsung | CR to TS38.133 on SCell BFD and CBD (Section 8.5) |
| R4-2000291 | Samsung | CR to TS38.133 on SCell BFRQ Procedure (Section 8.5) |
| R4-2000938 | MediaTek inc. | Observation 1: It is sufficient to perform BFD procedure on one serving cell on the same FR2 band, since UE assumes the same downlink spatial domain transmission filter for the serving cells on the same FR2 band.  Proposal 1: In FR2, UE is assumed to measure BFD-RS transmitted on only one serving cell per FR2 band.  Proposal 2: For one FR2 band, only one serving cell is transmitting BFD-RS(s), which can be implicitly configured to other serving cells on the same FR2 band for BFD procedure.  Proposal 3: If SpCell is on a FR2 band, BFD-RS should be transmitted on the SpCell. For the FR2 band without SpCell, BFD-RS should be transmitted on only one of SCells in that band.  Proposal 4: For one FR2 band, the evaluation periods for SSB/CSI-RS based BFD and CBD on SCell can reuse R15 BFD and CBD requirements, provided UE is assumed to measure BFD-RS transmitted on only one serving cell per FR2 band. FFS SCell BFR for multiple FR2 bands.  Proposal 5: No core requirement impact for R16 BFRQ.  Proposal 6: UE is not required to monitor BFD-RS transmitted on a deactivated SCell, as the BFD-RS is implicitly configured for another activated cell.  Proposal 7: UE is not required to monitor BFD-RS explicitly or implicitly configured for a deactivated SCell, even though the BFD-RS is transmitted on an activated cell. |
| R4-2001580 | Huawei, HiSilicon | Proposal 1: It is suggested that UE is not required to perform BFD on RS within an activated SCC which is implicitly configured as the BFD-RS for another deactivated SCell.  Proposal 2: It is suggested that UE is not required to perform BFD on RS within a deactivated SCC which is implicitly configured as the BFD-RS for another activated SCell.  Proposal 3: When more than 2 BFD-RSs are transmitted on a CC for current serving cell and other SCell, the UE is allowed only to perform beam failure detection on the BFD-RSs for current serving cell.  Proposal 4: It is suggested not to introduce a new sharing factor for BFD and CBD evaluation period requirements.  Observation 1: There is no RRM core requirement impact by SCell BFRQ procedure.  Proposal 5: Step-1 and Step-2 of SCell BFRQ procedure which shall be defined in RAN1 specification can be verified in SCell link recovery test.  Observation 2: A SCell with CBD-RS configuration can be considered as a SCell configured for BFR.  Proposal 6: It is suggested that UE is not required to perform BFD and CBD for a SCell which is not configured with CBD-RS resources.  Proposal 7: It is left to UE implementation on how to down-select the activated SCell for BFR when the configured activated SCell for BFR exceeds the maximum number of SCell BFR by UE capability signalling. |
| R4-2002121 | Qualcomm | Observation 1: If proposal 4 gets agreed, then UE only needs to perform BFD/CBD for up to one SCell in FR2.  Proposal 1: UE is not required to perform BFD on RS within a deactivated SCC which is implicitly configured as the BFD-RS for another activated SCell  Proposal 2: UE is not required to perform BFD on RS within an activated SCC which is implicitly configured as the BFD-RS for another deactivated SCell.  Proposal 3: When more than 2 BFD-RSs are transmitted on a CC for current SCell and implicity configured for SCell, UE is required to only perform BFD on BFD-RSs for current SCell.  Proposal 4: For BFD and CBD requirements in FR2, only one serving cell is assumed to perform BFR procedure for one FR2 band  Proposal 5: RAN4 supports introducing a sharing factor in the BFD and CBD evaluation period for SCells in FR1.   * The sharing factor is proportional to the number of SCells for which UE is performing BFD/CBD. * Note: This proposal assumes that UE is performing BFR for only one serving cell in each FR2 band.   Proposal 6: RAN4 defines requirement for step 1 of BFR, where UE reports beam failure event through a dedicated SR like PUCCH resources, in SCells with DL only.   * No RRM core requirement is defined for UE conveying new beam information and failed CC indices via MAC-CE.   Proposal 7: After detecting beam failure in an Scell and determining that the L1-RSRP of one candidate beam in SCell is greater than the configured threshold, UE is required to transmit scheduling request in the PSCell within a period T   * Where T is equal to the periodicity of PUCCH that has been configured with schedulingRequestForBFR. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: BFD on SCell

**Issue 2-1-1: Necessity of BFD procedure on multiple serving cell on the same FR2 band**

* Proposals:
  + Option-1: For BFD and CBD requirements in FR2, only one serving cell is assumed to perform BFR procedure for one FR2 band.
  + Option-1a: In FR2, UE is assumed to measure BFD-RS transmitted on only one serving cell per FR2 band, which can be implicitly configured to other serving cells on the same FR2 band for BFD procedure:
    - For SpCell is on a FR2 band, BFD-RS should be transmitted on the SpCell.
    - For the FR2 band without SpCell, BFD-RS should be transmitted on only one of SCells in that band
  + Option-2: No restriction introduced in RAN4.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-1-2: Sharing factor for BFD Time Period for FR2**

* [Moderator]: In last meeting, since Rel-16 BFR could be performed over multiple SCells (based on UE capability), some company propose that it would require to investigate whether or not to introduce sharing factor when multiple SCells are configured for BFR procedure, i.e., for BFD and CBD time periods..
* Proposals:
  + Option-1: No BFD evaluation period will be specified if BFR is configured over multiple FR2 intra-band cells:
    - Sharing factor for BFD evaluation period due to BFD over multiple FR2 intra-band cells will not be introduced.
    - FFS SCell BFD for FR2 inter-band FR2 CA.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-1-3: Sharing factor for BFD Time Period for FR1**

* [Moderator]: In last meeting, since Rel-16 BFR could be performed over multiple SCells (based on UE capability), some company propose that it would require to investigate whether or not to introduce sharing factor when multiple SCells are configured for BFR procedure, i.e., for BFD and CBD time periods..
* Proposals:
  + Option-1: RAN4 supports introducing a sharing factor in the BFD and CBD evaluation period for SCells in FR1.
    - The sharing factor is proportional to the number of SCells for which UE is performing BFD/CBD.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-1-4: RS within a deactivated SCC is implicitly configured as the BFD-RS for another activated SCell**

* Proposals:
  + Option 1: UE is not required to perform BFD on RS within a deactivated SCC which is implicitly configured as the BFD-RS for another activated SCell
* Recommended WF
  + Suggest RAN4 agree on Option 1.

**Issue 2-1-5: RS within an activated SCC is implicitly configured as the BFD-RS for another deactivated SCell**

* Proposals:
  + Option 1: UE is not required to perform BFD on RS within an activated SCC which is implicitly configured as the BFD-RS for another deactivated SCell.
* Recommended WF
  + Suggest RAN4 agree on Option 1.

**Issue 2-1-6: When more than 2 BFD-RSs are transmitted on a CC for current SCell and (implicitly configured for) other SCell**

* Proposals: When more than 2 BFD-RSs are transmitted on a CC for current SCell and (implicitly configured for) other SCell
  + Option 1: UE is allowed only to perform beam failure detection on the BFD-RSs for current serving cell.
  + Option 2: it is up to UE implementation to select two BFD-RSs in active BWP in current CC to perform BFD (either for current SCell or for other Sell(s)).
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-1-7: RAN1 specification and RAN4 agreement mismatch for SSB-based BFD on SCell**

* [Moderator]: In last RAN4 meeting, it is agreed that “CSI-RS and SSB based BFD for SCell BFD can be applied”, based on the argument that SSB based BFD for PCell/PSCell is also introduced in RAN4 while not explicitly defined in RAN1 spec. However, based on the agree specification and RAN1 agreement, SSB-based BFD for SCell is explicitly not included. Based on the above RAN1 agreement and approved CR to TS38.213, it is clear RAN1 understanding that SCell BFD should only be performed based on periodic CSI-RS, for both explicit configuration (a set  of periodic CSI-RS resource configuration indexes by beamFailureDetectionResourceList) and implicit configuration (the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by TCI-State for respective CORESETs that the UE uses for monitoring PDCCH) .
* Proposals:
  + Option-1: Revert RAN4 agreement by only allowing SSB based BFD for SCell;
  + Option-2: Allowing SSB based BFD for SCell but no RAN4 requirement (core and test cases) to be defined.
  + Option-3: Define RAN4 requirements for SSB based BFD for SCell, but let RAN1 be notified about RAN4 agreement.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

### Sub-topic 2-2: CBD on SCell

**Issue 2-2-1: Sharing factor for CBD Time Period**

* Proposals:
  + Option-1: No CBD evaluation period will be specified if BFR is configured over multiple FR2 intra-band cells:
    - Sharing factor for CBD evaluation period (due to CBD over multiple FR2 intra-band cells) will not be introduced.
    - FFS SCell BFD for FR2 inter-band FR2 CA.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

### Sub-topic 2-3: Beam Failure Recovery Request (BFRQ)

**Issue 2-3-1: RAN4 requirement defined for two step BFRQ mechanism**

* Proposals:
  + Option-1: For SCells with DL only and SCells with DL and UL, RAN4 requirement is defined for two step BFRQ mechanism,
    - Step-1: UE reports beam failure event through a dedicated SR like PUCCH resource;
    - Step-2: UE conveys new beam information (if identified) and failed CC index(es) via MAC-CE.
  + Option-2: RAN4 defines requirement for step 1 of BFR, where UE reports beam failure event through a dedicated SR like PUCCH resources, in SCells with DL only.
    - No RRM core requirement is defined for UE conveying new beam information and failed CC indices via MAC-CE.
  + Option-3: No core requirement impact for Rel-16 BFRQ.
  + Option-3a: No core requirement impact for Rel-16 BFRQ, and Step-1 and Step-2 of SCell BFRQ procedure which shall be defined in RAN1 specification can be verified in SCell link recovery test.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-3-2: BFRQ requirement details (if core requirement is agreed to be introduced)**

* Proposals:
  + Option-1: After detecting beam failure in an Scell and determining that the L1-RSRP of one candidate beam in SCell is greater than the configured threshold, UE is required to transmit scheduling request in the PSCell within a period T
    - Where T is equal to the periodicity of PUCCH that has been configured with schedulingRequestForBFR.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

### Sub-topic 2-4: UE Capability and Applicability

**Issue 2-4-1: UE Capability of Number of SCells for BFR**

* Proposals:
  + Option-1: RAN4 requirement should not block the possibility of configuring BFR on multiple SCells, and no RAN4 performance requirement will be defined for more than 1 serving cell perform BFR procedure.
  + Option-2: It is left to UE implementation on how to down-select the activated SCell for BFR when the configured activated SCell for BFR exceeds the maximum number of SCell BFR by UE capability signalling.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 2-4-2: CBD-RS not configured**

* Proposals:
  + Option-1: UE is not required to perform BFD and CBD for a SCell which is not configured with CBD-RS resources.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000290 | Company A |
| Company B |
|  |
| R4-2000291 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: DL/UL beam indication with reduced latency and overhead

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000292 | Samsung | Observation-1: RAN4 has not any conclusion on testability for different UL TX spatial filters.  Proposal-1: No RAN4 RRM requirement is defined for spatial relation updates for AP-SRS via MAC-CE  Observation-2: Based on the agreed RAN1 mechanism for simultaneous TCI states activation/selection across multiple CCs/BWPs, the following scenarios are considered:  - Scenario-1: A set of TCI-state IDs for PDSCH are activated by a MAC CE for a set of CCs/BWPs;  - Scenario-2: A TCI-state ID is activated for a CORESET by a MAC CE for a set of CCs/BWPs;  - Scenario-3: Spatial Relation Info is activated for a SP/AP SRS resource by a MAC CE for a set of CCs/BWPs.  Proposal-2: For the procedure of simultaneous TCI states activation/selection across multiple CCs/BWPs in Rel-16 eMIMO work item:  - No new requirement is introduced for the simultaneous TCI states activation/selection.  - Rel-15 active TCI state switching delay requirements shall still be followed if simultaneous TCI states activation or selection across multiple CCs/BWPs is performed. |
| R4-2002122 | Qualcomm | Proposal 1: RAN4 defines requirements for activating TCI states simultaneously across multiple CCs/BWPs with a single MAC-CE command.  Proposal 2: The decision whether to define MAC-CE based spatial relationship update for AP-SRS or not should be taken in ‘RRM core requirement enhancement’ section (Agenda Item: 8.15.1).  Proposal 3: RAN4 to define requirements of MAC-CE based spatial relation update for AP-SRS.  Proposal 4: RAN4 to prioritize defining requirements for the case where the spatial relation is QCL’d to (or the QCL chain contains) SSB or CSI-RS.  Proposal 5: Re-use the known state definition for TCI state for known spatial relation. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1: Simultaneous TCI States Activation/Selection across Multiple CCs/BWPs

**Issue 3-1-1: Whether or not to introduce new Rel-16 requirement on simultaneous TCI states activation/selection across multiple CCs/BWPs**

* Proposals:
  + Option 1: RAN4 defines requirements for activating TCI states simultaneously across multiple CCs/BWPs with a single MAC-CE command
  + Option 2: No new requirement is introduced for the simultaneous TCI states activation/selection.
    - Rel-15 active TCI state switching delay requirements shall still be followed if simultaneous TCI states activation or selection across multiple CCs/BWPs is performed.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

### Sub-topic 3-2: MAC-CE based spatial relation update for aperiodic SRS

**Issue 3-2-1: RAN4 RRM requirement impact due to MAC-CE based spatial relation update for aperiodic SRS**

* Proposals:
  + Option 1: RAN4 to define requirements of MAC-CE based spatial relation update for AP-SRS.
  + Option 2: No new requirement is introduced for the simultaneous TCI states activation/selection.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 3-2-2: Prioritization for different SRS spatial relation update (if requirement is agreed to be introduced):**

* Proposals:
  + Option 1: RAN4 to prioritize defining requirements for the case where the spatial relation is QCL’d to (or the QCL chain contains) SSB or CSI-RS.
    - Note by moderator: compared with spatial relation which is QCL’d to another SRS.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

**Issue 3-2-3: Known spatial relationship, if requirement is agreed to be introduced:**

* Proposals:
  + Option 1: Re-use the known state definition for TCI state for known spatial relation.
* Recommended WF
  + Companies’ views are collected in 1st round discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |

### CRs/TPs comments collection

*[Moderator] No CRs/TPs submitted under this topic.*

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |