**3GPP TSG-RAN WG4 Meeting #94-e R4-2002182**

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

**Agenda item: 8.11.2**

**Source: Samsung**

**Title: WF on NR eMIMO RRM requirements**

**Document for: Approval**

# **1 Background**

Rel-16 NR eMIMO WI (i.e., Enhancements on MIMO for NR) is a RAN1 leading WI with below major enhancement in RAN1 area which has potential RRM requirement impact in RAN4:

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

This WF is used to capture further agreements from RAN#94-e.

# **2 Agreement from RAN4#94-E Chairman Notes after 1st Round**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic #1: L1-SINR Measurement**  Issue 1-1-1: Applicable condition(s) for one-shot L1-SINR measurement report for CMR only scenario:  Agreement: Applicable condition(s) for one-shot L1-SINR measurement report for CMR only scenario:   * 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.   Issue 1-3-1: L1-SINR measurement side condition for Es/Iot for CMR+ZP-IMR  Agreement: Es/Iot on CMR:   * + Option 1: SSB or CSI-RS Es/Iot >= -3dB and <=25dB   CRs/TPs   |  |  | | --- | --- | | **CR/TP number** | **Decision** | | R4-2000997 | Endorsed |   **Topic #2: SCell Beam Failure Recovery**  Issue 2-1-4: RS within a deactivated SCC is implicitly configured as the BFD-RS for another activated SCell  Agreement: 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  Issue 2-1-5: RS within an activated SCC is implicitly configured as the BFD-RS for another deactivated SCell  Agreement: 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.  Issue 2-1-7: RAN1 specification and RAN4 agreement mismatch for SSB-based BFD on SCell  Agreement: RAN4 revert previous agreement by only allowing CSI-RS based BFD for SCell,to align with RAN1 specification.  **Topic #3: DL/UL beam indication with reduced latency and overhead**  Issue 3-2: RAN4 RRM requirement impact due to MAC-CE based spatial relation update for aperiodic SRS  Conclusion: The decision on whether to define MAC-CE based spatial relationship update for AP-SRS should be made in ‘NR RRM core requirement enhancement WI’ scope. Postpone discussion in the scope of NR eMIMO WI scope and wait for respective conclusions. |

# **3 Agreements for Way Forward**

3.1 L1-SINR Measurement

##### 3.1.1 Measurement period for L1-SINR measurement:

* **Restriction between measurement time restriction on IMR and CMR**
  + 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
  + *[Moderator] Ericsson is asked to check the possibility to compromise to above agreement based on majority view.*
* **Applicable condition(s) for one-shot L1-SINR measurement report for CMR+IMR scenario:**
  + 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.
  + *[Moderator] Ericsson is asked to check the possibility to compromise to above agreement based on majority view.*
* **Measurement period for SSB-based CMR+IMR scenario:**
  + 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. | |

* + - FFS the value of P.
  + *[Moderator] We combine companies’ proposed Option 1/1a/1b/1c, and left FFS for P. Ericsson and Nokia is asked to check the possibility to compromise to above agreement based on majority view, especially considering Option 2 is contradicting to approved WF [R4-1915850].*
* **Measurement period for CSI-RS-based CMR+IMR scenario:**
  + 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. | |

* + - FFS the value of P.
  + *[Moderator] Similar approach as the above SSB-based CMR+IMR scenario.*
* **Side condition for measurement accuracy:**
  + Following previous meeting’s simulation assumption, i.e., -3dB for ideal SINR
    - For NZP-IMR: Side condition (SNR) on CMR and Side condition (INR) on IMR are both 0dB
    - For ZP-IMR: Side condition (SNR) on CMR are -3dB.
  + *[Moderator] MTK and Huawei is asked to check the above side condition, which follows previous meeting’s simulation assumption.*
* **Number of Samples for L1-SINR Measurement:**
  + 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.
  + *[Moderator] The confusing wording “common accuracy requirement” is removed, and I assume the above bullet should be agreeable based on the 1st round feedback.*
* **Number of Scaling for FR2 (value of N)**
  + For the cases of CMR only, SSB+IMR, CSI-RS+ZP-IMR,
    - the variable N can be defined as same as L1-RSRP.
  + For the case of CSI-RS+NZP-IMR,
    - FFS the variable N.
  + *[Moderator] Since some companies are questioning N value for CSI-RS+NZP-IMR, Moderator suggest the above tentative agreement to FFS N value for CSI-RS+NZP-IMR scenario.*

##### 3.1.2 Measurement Restriction and Scheduling Availability

* **NZP-IMR: QCL indication**
  + 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.
  + *[Moderator] Above tentative agreement is based on majority view.*
  + *[Moderator] Pre requested, we can clarify on option 1, i.e., NZP-IMR in 1st CSI report can be configured as either CMR in 2nd CSI report or NZP-IMR in 2nd CSI report. In both situations, CMRs in 1st and 2nd CSI reports shall be QCL-ed, otherwise long measurement requirement is expect. Therefore, Option 1 contains the 1st sub-bullet in Option 2. With this clarification, MTK is asked to check the possibility to compromise the above tentative agreement based on majority view.*
* **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”:
      * The configuration of “repetition = on/off” is present only if its CSI-RS resource set is used for the other purpose than this L1-SINR measurement report;
      * RX beam for NZP-IMR for L1-SINR measurement shall always follow CMR, i.e., same RX filter shall be used.
    - Option-2: 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-3: 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.
  + *[Moderator] Consider the different views remains, we suggest to keep all suggested options open for further discussion in next meeting.*
* **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 shall only be configured with “repetition = off” in FR2.
  + *[Moderator] No big difference between Option 1 and Option 3, but depending on RAN1 and detailed RAN2 signaling design. Therefore we suggest to keep both options open for further discussion in next meeting.*
* **Measurement restriction between L1-SINR and L1-RSRP**
  + For CMR+IMR scenario, FFS when the measurement restrictions need to be applied between L1-SINR measurement and L1-RSRP measurements.
  + *[Moderator] FFS this issue.*

##### 3.1.3 Side condition and Others

* **L1-SINR measurement side condition for Es/Iot for CMR+NZP-IMR**
  + Es/Iot on CMR and NZP-IMR:
    - Option-1: Es/Iot >= -3dB and <=25dB
    - Option-2: Es/Iot >=0dB and <=25dB, and the resultant L1-SINR should also lie between -3 dB and 25 dB.
  + *[Moderator] FFS this issue by keeping both options open.*

3.2 SCell Beam failure recovery

##### 3.2.1 BFD on SCell

* **Necessity of BFD procedure on multiple serving cell on the same FR2 band**
  + No restriction introduced in RAN4. No RAN4 performance requirement will be defined for more than 1 serving cell perform BFR procedure.
  + *[Moderator] Based on the discussion for SCell BFR UE capability, seems no restriction is needed in RAN4 for multiple serving cell on the same FR2 band. On the other hand, majority companies’ view is no RAN4 performance requirement will be defined for more than 1 serving cell perform BFR procedure. In other words, if SCell BFR is configured over multiple SCells which is allowed by UE capability, the NW configuration is allowed, while no RAN4 requirement will guarantee the performance.*
* **Sharing factor for BFD Time Period for FR1 and FR2**
  + No BFD evaluation period will be specified if BFR is configured over multiple SCells:
    - Sharing factor for BFD evaluation period due to BFD over multiple Sells will not be introduced.
    - No RAN4 performance requirement will be defined for more than 1 serving cell perform BFD
  + *[Moderator] Based on previous tentative agreement, seem the above tentative agreement is reasonable.*
* **When more than 2 BFD-RSs are transmitted on a CC for current SCell and (implicitly configured for) other SCell**
  + When more than 2 BFD-RSs are transmitted on a CC for current SCell and (implicitly configured for) other SCell, 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)).
  + *[Moderator] Suggest the above tentative agreement based on majority view. Huawei is asked to check the above tentative agreement.*

##### 3.2.2 CBD on SCell

* **Sharing factor for CBD Time Period**
  + No CBD evaluation period will be specified if BFR is configured over multiple SCells:
    - Sharing factor for CBD evaluation period (due to CBD over multiple SCells) will not be introduced.
    - No RAN4 performance requirement will be defined for more than 1 serving cell perform CBD.
  + *[Moderator] Based on previous tentative agreement, seem the above tentative agreement is reasonable.*

##### 3.2.3 SCell Beam Failure Recovery ReQuest (BFRQ) Mechanism

* **RAN4 requirement defined for two step BFRQ mechanism**
  + RAN4 defines requirement for step 1 of BFR, where UE reports beam failure event through a dedicated SR like PUCCH resources:
    - No RRM core requirement is defined for UE conveying new beam information and failed CC indices via MAC-CE.
    - Applicable scenario:
      * Option-1: SCells with DL only and SCells with DL and UL
      * Option-2: SCells with DL only
  + *[Moderator] Suggest the above compromised proposed based on Option-2/2a. Companies can further check the applicable scenario in next meeting. Huawei and MTK are asked to check the above tentative agreement as compromise.*
* BFRQ requirement details
  + 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.
  + *[Moderator] Depending on previous issue,*

##### 3.2.4 UE Capability and Others

* **UE Capability of Number of SCells for BFR:**
  + 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.
  + *[Moderator] Tentative agreement based on majority view. Huawei is asked to check the above tentative agreement as compromise. Also related to 1st topic in 3.2.1 (BFD on SCell).*
* **When CBD-RS not configured, UE’s expected behavior:**
  + FFS UE is not required to perform BFD and CBD for a SCell which is not configured with CBD-RS resources.
  + FFS UE is required to perform BFD and CBD for a SCell if some RS resources are configured in SPCell but if they are implicitly configured as CBD-RS resources for SCell.
  + *[Moderator] FFS UE behavior.*

3.3 DL/UL beam indication with reduced latency and overhead

##### 3.3.1 Simultaneous TCI States Activation/Selection across Multiple CCs/BWPs

* **Simultaneous TCI States Activation/Selection across Multiple CCs/BWPs:**
  + 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.
  + *[Moderator] Tentative agreement based on majority view. Qualcomm and Nokia are asked to check the tentative agreement as compromise.*

# **4 Reference**

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| --- | --- | --- | --- |
| **T-doc Number** | Title | Source | Type |
| [**R4-2000285**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000285.zip) | On the Remaining Issues for L1-SINR Measurement Requirement | Samsung | discussion |
| [**R4-2000286**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000286.zip) | Simulation Results for L1-SINR Measurement Accuracy | Samsung | discussion |
| R4-2000287 | Simulation Results Summary for L1-SINR Measurement Accuracy | Samsung | discussion |
| [**R4-2000288**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000288.zip) | CR to TS38.133 on L1-SINR Measurement Requirement (Section 3.3 and 9) | Samsung | CR |
| [**R4-2000289**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000289.zip) | On the Remaining Issues for SCell Beam Failure Recovery RRM Requirement | Samsung | discussion |
| [**R4-2000290**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000290.zip) | CR to TS38.133 on SCell BFD and CBD (Section 8.5) | Samsung | CR |
| [**R4-2000291**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000291.zip) | CR to TS38.133 on SCell BFRQ Procedure (Section 8.5) | Samsung | CR |
| [**R4-2000292**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000292.zip) | On the Remaining Issues for Enhancement on UL/DL Transmit Beam Selection with Reduced Latency and Overhead | Samsung | discussion |
| [**R4-2000384**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000384.zip) | Discussion about L1-SINR measurement requirements | Intel Corporation | discussion |
| [**R4-2000635**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000635.zip) | Simulation results on L1-SINR | CMCC | discussion |
| [**R4-2000935**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000935.zip) | Discussion on RRM requirements for L1-SINR | MediaTek inc. | discussion |
| [**R4-2000936**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000936.zip) | Discussion on L1-SINR delay requirement | MediaTek inc. | discussion |
| [**R4-2000937**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000937.zip) | Discussion on L1-SINR accuracy requirement | MediaTek inc. | discussion |
| [**R4-2000938**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000938.zip) | Discussion on RRM requirements for BFR on Scell | MediaTek inc. | discussion |
| [**R4-2000997**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000997.zip) | CR on SS-SINR and CSI-SINR measurement report mapping (section 10.1.16.1) | OPPO | draftCR |
| [**R4-2001362**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001362.zip) | L1-SINR measurement period | Ericsson | discussion |
| [**R4-2001578**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001578.zip) | Discussion on L1-SINR measurement requirements for NR eMIMO | Huawei, HiSilicon | discussion |
| [**R4-2001579**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001579.zip) | Discussion on measurement restrictions for L1-SINR measurement | Huawei, HiSilicon | discussion |
| [**R4-2001580**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001580.zip) | discussion on SCell BFR requiremetns for NR eMIMO | Huawei, HiSilicon | discussion |
| [**R4-2002120**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002120.zip) | RRM requirements for L1-SINR estimation | Qualcomm | discussion |
| [**R4-2002121**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002121.zip) | RRM requirements for SCell BFD, CBD and BFR | Qualcomm | discussion |
| [**R4-2002122**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002122.zip) | DL/UL beam indication with reduced latency and overhead | Qualcomm | discussion |