**3GPP TSG-RAN WG4 Meeting # 97-e R4-2017020**

**Electronic Meeting, 2 – 13 Nov., 2020**

**Agenda item:** 7.14.1, 7.14.2.1

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [97e][221]NR\_CSIRS\_L3meas\_RRM\_1

**Document for:** Information

# Introduction

The documents in agenda items 7.14.1 & 7.14.2.1 contain the following 2 main topics:

* Topic #1: CSI-RS RRM core requirements maintenance
* Topic #2: CSI-RS RRM performance requirements.
  + Topic #2.1 CSI-RSRP requirements
  + Topic #2.2 CSI-RSRQ requirements
  + Topic #2.3 CSI-SINR requirements

*Note:* *The following contributions on CSI-RS configuration for mobility are moved to [97e][222]NR\_CSIRS\_L3meas\_RRM\_2 since they are more related to test cases.*

* *R4-2014288 (Qualcomm)*
* *R4-2014433 (CATT)*
* *R4-2014666(Xiaomi)*

# Topic #1: CSI-RS RRM core requirements maintenance(AI 7.14.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014236 | Apple | **Proposal 1: Specify requirements for both scenario 1 and 2.**  **Proposal 2: CSSF frame work can generally apply to both scenarios**  **Proposal 3: CSI-RS and SSB for L3 measurement, including gap based and non-gap based, equally share the measurement opportunities for both scenarios.**  **Proposal 4: Scaling factor of 8 for Rx beam sweeping in FR2 bands**  **Proposal 5: When UE performs CSI-RS intra-frequency measurements in a TDD band**   * **UE is not expected to transmit on data OFDM symbols overlapped by CSI-RS resource symbols to be measured, and 1 OFDM symbols before and after each consecutive CSI-RS symbols** |
| R4-2014314 | Qualcomm CDMA Technologies | **Proposal1: Issues 5.1(CMTC), 5.2(synchronization) and 5.4(dedicated CSI-RS engine) ought not be discussed as the maintenance topics in the Rel-16 context.**  **Proposal2: Unless RAN1/2 rejects the LS out[4] from RAN4, issue5.3(multiple MOs per layer) ought not to be discussed for Rel-16.**  **Proposal3: No requirements are to be defined if longer measurement delay is caused by the conflict of CSI-RS based L3 measurement with SSB or CSI-RS based L1 measurement under certain conditions.**  **Proposal3.1: Specifically. following conditions can cause longer measurement delay when CSI-RS L3 measurement can not be processed simultaneously with L1 measurement.**   1. **UE doesnot support simultaneousRxDataSSB-DiffNumerology and cannot process CSI-RS L3 based intra-frequency measurement and SSB based measurement simultaneously due to mixed SCS.** 2. **UE has to employ an measurement GAP to measure the CSI-RS L3 inter-frequency measurement and cannot measure CSI-RS for RLM, BFD, CBD or L1-RSRP measurement simultaneously.** 3. **FR2 UE has to measure CSI-RS L3 and SSB or CSI-RS for RLM, BFD, CBD or L1-RSRP measurement with different Rx beams.**   Observation1: Most remaining issues in the exception sheet [5] have become either out of scope or closed after RAN4 96-e and RP 89-e meeting.  **Propose4: When the UE performs intra-frequency CSI-RS L3 measurements in a TDD band, the following restrictions apply**  **- The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive CSI-RS symbols to be measured and 1 data symbol after each consecutive CSI-RS symbols to be measured within the CSI-RS measurement window duration.** |
| R4-2014530 | vivo | **Proposal 1 Do not introduce scheduling restriction for TDD band in R16 CSI-RS based L3 measurement requirements.**  **Proposal 2 Capture last meeting agreements on the number of layers in TS 38.133.**  **Proposal 3 Remove the side condition for SSB measurement in clause 9.10.2.2 of TS 38.133**  **Proposal 4 Remove the exact number of cells to be monitored in TS 38.133.**  **Proposal 5 The description on relation between CSI-RS for RRM and CSI-RS for RLM is removed.** |
| R4-2014622 | MediaTek Inc. | **Observation 1: In TS38.331, CP type of CSI-RS for mobility is not indicated in the measurement object.**  **Proposal 1: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit on data OFDM symbols fully or partially overlapped by CSI-RS resource symbols** to be measured.  **Proposal 2: RAN4 to agree on the Text proposal 1 in this paper.**  **Proposal 3: RAN4 to agree on the Text proposal 2 in this paper.**  **Proposal 4: RAN4 to agree on the Text proposal 3 in this paper.** |
| R4-2014824 | NTT DOCOMO, INC. | **Observation 1: Regarding the scaling factor for the RX beam sweeping in FR2, fixed value seems better than variable value considering complexity of NW scheduling.**  **Observation 2: From the aspect of UE mobility, shorter measurement delay is desirable.**  **Proposal 1: The scaling factor for the RX beam sweeping in FR2 should be min of (the number of different associated SSB, 8) for realizing both of smoother UE mobility and reduction of NW scheduling complexity.**  **Proposal 2: There is no need to consider any restricted OFDM symbol before and after CSI-RS symbols to be measured in a TDD band.** |
| R4-2015489 | Huawei, HiSilicon | **Proposal 1: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to tranmsit uplink signals on configured CSI-RS symbol and on 1 OFDM symbol before and after each configured CSI-RS symbol to be measured within the configured slot as indicated in *slotConfig.***  **Proposal 2: The scheduling restriction of mixed numerology between data and CSI-RS L3 mobility is slot level.**  **Proposal 3: The CSI-RS measurement requirements apply provided that any two CSI-RS resource i and resource j of a frequency layer satisfy**    **where and are time offsets (in millisecond) of CSI-RS resource i and j respectively with respect to the serving cell timing.** |
| R4-2016043 | Nokia, Nokia Shanghai Bell | **Proposal1: When UE performs CSI-RS intra-frequency measurements in a TDD band, scheduling restriction is applied to the CSI-RS symbols to be measured only.**  **Proposal2: Scheduling restriction shall apply to FR1 FDD that the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on CSI-RS symbols to be measured.**  **Proposal3: It is proposed to adopt the 38.133 CR on scheduling restrictions in [3].**  **Proposal4: When CSI-RS based mobility is configured, the CSSF shall only be extended if CSI-RS resources are configured within SMTC. The CSSF remains unchanged if CSI-RS resources are configured outside SMTC.** |

## Open issues summary

### Sub-topic 1-1 Measurement restriction

The following scenarios are raised in R4-2014236:

* Scenario 1: CSI-RS resources and SSB are fully or partially overlapped in time domain
* Scenario 2: CSI-RS resources and SSB are non-overlapped in time domain

**Issue 1-1-1: Whether to define requirements for scenario 1 and scenario 2 in R16?**

* Proposals
  + Option 1: Specify requirements for both scenario 1 and 2. (Apple)
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-1-1: Whether to define requirements for scenario 1 and scenario 2 in R16?** | |
| **Company** | **Comments** |
| MTK | Support option 1, but same requirement for both scenarios.  Current spec already treats CSI-RS as a separate frequency layer to SSB. Therefore, whether CSI-RS resources and SSB are fully-overlapped, partially-overlapped or non-overlapped in time does not make difference. |
| Huawei, Hisilicon | Support option1. The current specification has already cover both cases. |
| Xiaomi | Support option 1, since the measurement for CSI-RS and SSB is considered as separate MO, thus the measurement requirement applies to all the scenarios. |
| CATT | Support option 1. |
| Qualcomm | For scenario1, our understanding is per previous meeting’s chairman note, the worst case is assumed meaning CSI-RSL3 and SSB cannot be measured simultaneously if they are overlapped or partially overlapped. So measurements are assumed to be handled sequentially and longer measurement delay is expected according to the previously proposed CSSF framework which shall be generic to cover the scenario2 as well. So option1 is supported. |
| OPPO | Support option 1. |
| Intel | support option 1. |
| LGE | Support option 1. |
| vivo | Support option 1. |

**Issue 1-1-2: How to define requirements for scenario 1 and scenario 2?**

* Proposals
  + Option 1: CSSF frame work can generally apply to both scenarios. (Apple)
  + Option 2: CSI-RS and SSB for L3 measurement, including gap based and non-gap based, equally share the measurement opportunities for both scenarios. (Apple)
  + Option 3: When CSI-RS based mobility is configured, the CSSF shall only be extended if CSI-RS resources are configured within SMTC (Scenario 1). The CSSF remains unchanged if CSI-RS resources are configured outside SMTC (Scenario 2). (Nokia)
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-1-2: How to define requirements for scenario 1 and scenario 2?** | |
| **Company** | **Comments** |
| MTK | Support Option 1 and 2 for simple specification.  Option 3 would complicated the requirements a lot if there are multiple SSB layers and multiple CSI-RS layers configured to the same UE. |
| Huawei | Support option 1 and option2.  We understand the motivation of option 3, however the requirements based on option are not easy to be defined. As we ever discussed in R15 CSSFoutsidegap, how to define the overlapping of carriers was discussed for a long time, and finally we used the worst case for simplicity. Similar, CSSF calculation is suggested not to consider if SSB and CSI-RS are being measured at the same time or not. |
| Xiaomi | Support option 1 and option 2 |
| CATT | Support option 1 and option 2. Since the CSSF is defined based on the number of layers and the SSB and CSI-RS are thought as 2 layers, the CSSF should be applicable no matter whether SSB and CSI-RS are overlapped. |
| Qualcomm | We are ok to define the spec assuming the worst case which is scenario 1 and UE has to measure SSB and CSI-RSL3 by time sharing.  For scenario2, the CSSF framework outside the gap shall cover this.  So we support options 1 and 2. |
| OPPO | Support option 1&2. Agree not to consider if SSB and CSI-RS are being measured at the same time or not for CSSF calculation. |
| Intel | support option 1 and 2. For the worst overlapping case, timing sharing will applied for CSI-RS and SSB measurement. |
| vivo | Option 1 and option 2. The time is not enough in R16 to revisit these requirements. We are fine with the principle of agreed CR in last meeting. |

### Sub-topic 1-2 Scaling factor for RX beam sweeping in FR2 band

**Issue 1-2-1: Scaling factor for RX beam sweeping in FR2 band**

* Proposals
  + Option 1: N=8 (Apple)
  + Option 2: N=min(the number of different associated SSB, 8) (NTT DOCOMO)
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-2-1: Scaling factor for RX beam sweeping in FR2 band** | |
| **Company** | **Comments** |
| MTK | Support Option 1.  It is also OK for us to directly re-use the values for SSB (PC-specific). |
| Huawei, HiSilicon | Support option 1. With option 1 UE fix one Rx beam direction for one CSI-RS window and changes to another RX beam direction for the next CSI-RS window. During CSI-RS window duration, UE measures the CSI-RS resources whose *assciatedSSB* are detectable. In essence this procedure is beam sweeping. Thus the scaling factor, i.e., Rx beam number (8), shall be scaled.  Option 2 depends on the configured associated SSBs. From UE implementation point of view, the scheme will impact the UE RX sweeping scheduling and make implementation complex. |
| Xiaomi | Support option 1, prefer to use the same value defined for SSB. |
| CATT | Support option 1. |
| Qualcomm | Option1 is supported.  Further improvements may be considered for future release. |
| OPPO | Support option 1. |
| Intel | support option 1. |
| LGE | Support option 1. |
| vivo | Option 1 is preferred.  For option 2, if inter-frequency measurement is considered, different number of associated SSB can be configured on different layers, and in this case if option2 is adopted then it would means requirements would be different for different layers. We agree with Huawei that this would lead to additional UE complexity. |

### Sub-topic 1-3 Scheduling restriction

**Issue 1-3-1: Whether/How to define scheduling restriction when UE performs CSI-RS intra-frequency measurements in a TDD band?**

* Proposals
  + Option 1: Introduce scheduling restriction for TDD band.
    - Option 1a: When UE performs CSI-RS intra-frequency measurements in a TDD band
      * UE is not expected to transmit on data OFDM symbols overlapped by CSI-RS resource symbols to be measured, and 1 OFDM symbols before and after each consecutive CSI-RS symbols. (Apple, Qualcomm, Huawei)
    - Option 1b: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit on data OFDM symbols fully or partially overlapped by CSI-RS resource symbols to be measured. (MTK)
    - Option 1c: When UE performs CSI-RS intra-frequency measurements in a TDD band, scheduling restriction is applied to the CSI-RS symbols to be measured only. (Nokia)
  + Option 2: Do not introduce scheduling restriction for TDD band. (vivo, NTT DOCOMO)
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-3-1: Whether/How to define scheduling restriction when UE performs CSI-RS intra-frequency measurements in a TDD band?** | |
| **Company** | **Comments** |
| MTK | Support Option 2  Regarding Option 1, given single FFT assumption and UL tx timing is always advanced, we do not understand why we need one OFDM symbol margin **after** CSI-RS symbol.  Regarding Option 1c, it does not work because UL transmission is always timing advanced. The UL symbol boundary never aligns with DL symbol boundary. |
| Huawei | Support option 1a and option 1b. Option1a has the assumption that the TA is not extremely large. Option 1b’s description is also fine to us.  Regarding option 2, if there is no scheduling restriction for TDD band, then the DL measurement interference will be large resulting from uplink transmission from other UEs. |
| Xiaomi | Support option 1a. The same UE measurement behavior shall be defined for a TDD band, UE shall prioritize to CSI-RS measurement other than UL transmission. |
| CATT | Support option 1a and 1b. In TDD band, the CSI-RS from neighbor cell can be overlapped with UL symbols of serving cell. In this case, the scheduling restriction should be defined i.e. UE is not expected to transmit on data OFDM symbols fully or partially overlapped by CSI-RS resource symbols to be measured. |
| Qualcomm | Option1a was proposed by leveraging the same article as the scheduling restriction for SSB based measurement in TDD band.  We also understand option1b is compliant with the single FFT assumption since UE is not expected to measure the neighbor cells that are lagging the serving cell. So we will support option1b. |
| OPPO | Support option 1a. |
| Intel | support option 1a and 1b which are similar. CSI-RS symbol from other cell may overlapped with UL symbols of serving cell due to timing offset in TDD band. Scheduling restriction for TDD band is necessary. |
| LGE | Support option 1a |
| vivo | Option 2.  According to clause 11.1.1 of TS 38.213,  “*For unpaired spectrum operation for a UE on a cell in a frequency band of FR1, and when the scheduling restrictions due to RRM measurements [10, TS 38.133] are not applicable, if the UE detects a DCI format indicating to the UE to transmit in a set of symbols, the UE is not required to perform RRM measurements [10, TS 38.133] based on a SS/PBCH block or CSI-RS reception on a different cell in the frequency band if the SS/PBCH block or CSI-RS reception includes at least one symbol from the set of symbols.*”  it is already stated as “no requirement” if DCI indicates the slot format as uplink transmission. Note that such DCI can be group common DCI and it would apply to a group of UEs. Therefore, if network schedules any uplink for some UEs in the slot, then by DCI signalling network is also able to indicate all other UEs that are potentially influenced, in which case CSI-RS based L3 RRM measurement can be cancelled and there is no requirement for this case.  Regarding comments from Huawei, we share the same understanding that the uplink interference will impact RRM measurements. However since in 38.213 it is already stated no requirements for this case, we do not think defining scheduling restriction in TS 38.133 is needed.  Regarding comments from Xiaomi, CATT and Intel, we do not think CSI-RS measurement would be prioritized in this case. The CSI-RS would be configured outside SMTC, and if scheduling restriction is defined for CSI-RS, it would be difficult for network to find any slot for flexible TDD transmission. This would probable make flexible TDD feature useless. Moreover, it is not clear from TS 38.133 that for some cases where no requirements can be applied, e.g. CSI-RS is not confined in 5ms window, whether scheduling restriction is still applicable. Based on current description it seems scheduling restriction can be applied even for the no requirement cases. |

**Issue 1-3-2: Whether/How to define scheduling restriction under the case of mixed numerology?**

* Proposals
  + Option 1: The scheduling restriction of mixed numerology between data and CSI-RS L3 mobility is slot level. (Huawei)
  + Option 2 (existing requirement): No scheduling restriction under the case of mixed numerology.
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-3-2: Whether/How to define scheduling restriction under the case of mixed numerology?** | |
| **Company** | **Comments** |
| MTK | Support Option 2  In last meeting, there is already a note in main session note when discussing UE feature list.   |  | | --- | | Chair: for FG “Simultaneous reception of intra-frequency CSI-RS and data of serving cell with mixed numerologies in FR1”, RAN4 agrees to restrict the use case to the **same numerology for intra-frequency CSI-RS and data of serving cell**. As a result, this FG is no longer needed |   Therefore, we think we do not need add scheduling restriction for mix-numerology for intra-frequency CIS-RS measurement. To make the spec clear, we can add the above chairman’s note somewhere in the sepc. |
| Huawei, HiSilicon | Option 2 with adding a note which pointed out same numerology for intra-frequency CSI-RS and data of serving cell is also agreeable to us. |
| Xiaomi | Support option 2. |
| CATT | Support Option 2. The numerology of CSI-RS of neighbor cell is the same as that of serving cell according to the definition of intra-frequency measurement. And it is corner case that the CSI-RS resources and data of serving cell have different numerology. So there is no need to consider mixed numerology for intra-frequency CSI-RS based measurement. |
| Qualcomm | Option2 is supported and we agree with MTK it is necessary to add a note for reflecting the chairman’s note. |
| OPPO | Agree with CATT and support option 2. |
| Intel | support option 2. |
| LGE | Support option 2 |
| vivo | We are fine with option 2 and adding the note proposed by Huawei. |

**Issue 1-3-3: Whether/How to define scheduling restriction for FR1 FDD?**

* Proposals
  + Option 1: Scheduling restriction shall apply to FR1 FDD that the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on CSI-RS symbols to be measured. (Nokia)
  + Option 2 (existing requirement): No scheduling restriction for FR1 FDD.
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-3-3: Whether/How to define scheduling restriction for FR1 FDD?** | |
| **Company** | **Comments** |
| MTK | Support Option 2.  We do not understand the intention of Option 1 in which neither mix-numerology nor TDD is mentioned. |
| Huawei | which scenario for issue 1-3-3? |
| Xiaomi | Support option2 |
| CATT | Support option 2. |
| Qualcomm | Option2 is supported. |
| OPPO | Support option 2. |
| vivo | Option 2. For FDD case, full duplex would be considered and there is no need to restrict uplink. For downlink it is not necessary to restrict scheduling if numerology is the same. |

### Sub-topic 1-4 Time domain restriction

Background:

In RAN4#96-e, it is agreed [WF R4-2012178] that

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| * Introduce the same time domain restriction for intra-frequency measurement and inter-frequency measurement in Rel-16.   + Do not associate CSI-RS location with SMTC   + CSI-RS resources per frequency layers are configured within 5 ms window at any location   + CSI-RS periodicities for L3 measurement: 10, 20, 40 ms   + Up to 1 CSI-RS periodicity can be configured per CSI-RS intra-frequency layer   + Up to 1 CSI-RS periodicity can be configured per CSI-RS inter-frequency layer   + The exact relative location between CSI-RS and SMTC can be decided by NW to make sure a single MG pattern can cover both CSI-RS and SMTC for inter-frequency layer.   + Note: the restrictions above are the conditions to apply the requirements for both Core and Performance part |

**Issue 1-4-1: How to define the time domain restriction for CSI-RS resource configuration?**

* Proposals
  + Option 1: (Huawei)
    - The CSI-RS measurement requirements apply provided that any two CSI-RS resource i and resource j of a frequency layer satisfy



where Offi and Offj are time offsets (in millisecond) of CSI-RS resource i and j respectively with respect to the serving cell timing.)

* + Option 2: (existing requirement)
    - The CSI-RS measurement requirements apply provided that CSI-RS resources per frequency layers are configured within 5 ms window at any location
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-4-1: How to define the time domain restriction for CSI-RS resource configuration?** | |
| **Company** | **Comments** |
| MTK | Support Option 2.  In SSB-based measurement, UE can assume the SSB from all cell in the same frequency layer are transmitted in one SMTC occasion. This hugely simplifies UE implementation complexity. I.e., one single SMTC is sufficient for UE to identify all cells and perform measurement. If we follow Option 1, UE will need multiple occasions to ensure all cells in the same frequency layers are measured. |
| Huawei | In our understanding, with the wording of the existing requirements it is unclear if both Case 1 and Case 2 in the figure below are supported.  - Case 1: all CSI-RS resources are confined in the same window duration  - Case 2: different resources fall in different windows    Our preference is to support both cases as it allows more flexibility in NW configuration, and there is no particular challenge from UE perspective. The intention of option 1 is to clarify that both options are supported, but we are open to discuss the wording.  To MTK: as CSI-RS measurement is anyway on per resource basis, we understand that it may not make much difference whether all CSI-RS resource of a frequency layer is measured with 1, 2 or 4 windows. One additional effort for UE to support Case 2 is to determine the CSI-RS resources to be measured for each window instance based on the configured time offset, but this not be a big issue as UE already needs to do something similar today, e.g. based on the change of status of the associated SSB. |
| Xiaomi | We think either option 1 or option 2 is fine. 5ms window means that the time offset of CSI-RS resources are confined in 5ms window. We are fine to have further clarification. |
| CATT | Slightly prefer option 2. The CSI-RS resources of all cells in the same frequency layer should be configured in the same 5ms window. |
| Qualcomm | For option1, we are open to hear views from infra vendors about the benefits. However, it may complicate the CSSF further because effective longer period is possible depending on how many windows are needed for distributing the CSI-RS L3 resources which could’ve been confined within one window. |
| OPPO | We agree that UE assume all CSI-RS resources are confined in the same one window duration. Some further clarification is needed. |
| vivo | We see the same issue as Huawei and we think at least clarification is needed. We prefer option 1 in its current form compared to option 2 and would also open to hear about other solutions. |

### Sub-topic 1-5 Definition of CSSF

*Moderator: There are three papers giving the definition of CSSFoutside\_gap with different approaches, companies please directly provide your comments on CR R4-2014235, R4-2014623 and R4-2015491 in section 1.3.2.*

### Sub-topic 1-6 Collision case between CSI-RS L3 and L1measurement

Background:

In RAN4#96-e, it is agreed [WF R4-2012178] that

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| * Do not define CSI-RS measurement requirements in Rel-16 for the collision case:   + Collision between CSI-RS L3 measurement of neighbor cell and serving cell measurement for RLM/BFD or other CSI-RS L1 measurements |

**Issue 1-6-1: Whether the agreement is applicable to SSB based L1 measurement?**

* Proposals
  + Option 1: Yes.
    - Do not define CSI-RS measurement requirements in Rel-16 for the collision case:
      * Collision between CSI-RS L3 measurement of neighbor cell and SSB/CSI-RS based L1 measurement.
  + Option 2: No (existing requirement)
    - Do not define CSI-RS measurement requirements in Rel-16 for the collision case:
      * Collision between CSI-RS L3 measurement of neighbor cell and serving cell measurement for RLM/BFD or other CSI-RS L1 measurements.
* Recommended WF
  + *Need more discussion.*

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| **Issue 1-6-1: Whether the agreement is applicable to SSB based L1 measurement?** | |
| **Company** | **Comments** |
| MTK | Support Option 2 to simplify the spec. |
| Huawei | Actually option1 and option 2 are not clear to us.  In our understanding, the agreement in last meeting is applicable to SSB based L1 measurement. |
| Xiaomi | Support option 2. As agreed in previous meeting, no requirement is applied when CSI-RS resource of serving cell is not available. Thus, we prefer not to consider the collision case between CSI-RS L3 measurement of neighbor cell and SSB based L1 measurement. |
| CATT | Support option 1.  It seems there is ambiguity on the agreement in last meeting. In my understanding, the agreement in last meeting just excluded the collision case between CSI-RS based L3 measurement and CSI-RS based L1 measurement. So this issue is to clarify whether the collision case between CSI-RS based L3 measurement and SSB based L1 measurement should also be excluded (option 1 is yes and option 2 is no).  So our suggestion is to modify the agreement as below to make it clear:   * Do not define CSI-RS measurement requirements in Rel-16 for the collision case:   + Collision between CSI-RS based L3 measurement and SSB/CSI-RS based L1 measurement.including RLM/BFD/CBD/L1-RSRP/L1-SINR measurement. |
| Qualcomm | Agree with CATT that option1 is supported.  SSB based L3 measurements and CSI-RS L3 measurements are to be addressed via CSSF. |
| OPPO | Support option 1. The agreement in last meeting is also applicable to SSB based L1 measurement. |
| Intel | Support option 1. Collision between CSI-RS based L3 measurement and SSB based L1 measurement should be considered and no requirement is defined as well. |
| LGE | Support option 1. No requirement for collision between CIS-RS L3 and SSB is defined for simplification. |
| vivo | If the intention of option 1 is to include the case of collision with SSB-based L1-RSRP/L1-SINR measurements in the cases of no requirements, then we are also fine to option 1. |

### Sub-topic 1-7 Spec correction

*Moderator: Regarding to the other spec correction issues, companies please directly provide your comments on the CRs in section 1.3.2.*

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2014188 (Qualcomm) | MTK:  • CR version wrong  • Change on change  • pending on the conclusion of **Issue 1-3-1** |
| Huawei: depends on the outcome of sub-topic 1-1. We suggest to use one CR to capture all scheduling restriction requirements including FR2, TDD band and mix numerology (may be a note). |
| CATT:   * The clause number should be 9.10.2.6. * The applicability of intra-band and inter-band CA case was missing. |
| Qualcomm:  To MTK, The CR is revised from R4-2012174 which was already approved in RAN4 96-e but not implemented, and rev is automatically provided by the 3GPP portal. And the only additional change was to add the top level clause section name and number as advised by Steven.  To Huawei, we suggest this CR be approved as it was already approved but wasnot implemented. For the other scheduling restrictions (TDD and/or mixed numerology), we could prepare another draft CR in the second week for approval.  To CATT: we are not sure if CA case has been discussed. |
| vivo:  We are not sure how to deal with this overlapped change with CATT’s CR 4432. |
| R4-2014432 (CATT) | MTK: CR number is missing |
| Qualcomm: Can moderator company please decide which CR to approve between this and above R4-2014188. Seems redundant. |
| vivo:  In general we are fine with the contents on FR2 CA in this CR. However we are not sure how to deal with this overlapped change with Qualcomm’s CR 4188. |
| R4-2016045 (Nokia) | MTK:   * 9.10.2.5.3.2 does not have any condition * Do we still need before-and-after 1 symbol margin scheduling restriction for FR2 beam issue? |
| Huawei: depends on the conclusion of sub-topic 1-1. |
| CATT:   * WI code is incorrect * The scheduling restriction in TDD band pends on the conclusion of issue 1-3-1. |
| Qualcomm: Suggest we approve R4-2014188 for FR2 scheduling restriction and endorse this CR based on the updated agreements of sub-topic 1-1 for TDD and/or mixed numerology. |
| vivo:  If RAN4 agrees not to introduce scheduling restriction in issue 1-3-1, the corresponding revision can be removed. Then in our understanding this CR should be merged with Qualcomm’s CR 4188 and CATT’s CR 4432 |
| R4-2014235 (Apple) | MTK:   * Seems the editorial issues remains. The font size is not consistent in the CR * There is an ambiguity in Minter,i,j on how many layers are counted for a MO has both SSB and CSI-RS, a MO has only SSB and a MO has only CSI-RS. |
| Huawei: we correct one area in CSSFoutsidegap (or is changed to plus)  If SCell#1 is configured with both ssb-ConfigMobility and csi-rs-ResourceConfigMobility, SCell#2 is configured with csi-rs-ResourceConfigMobility only, The CSSF for each candidate shall be [2(for SCell#1) +2(for SCell#2) +1 (for inter-frequency layer w/o gap)]. |
| CATT:   * WI code is incorrect |
| Qualcomm: We need to firstly agree whether to review this CR versus R4-2014623 for this meeting. Can moderator please confirm? |
| vivo:  Compared to MTK’s CR 4623, the wording in this CR is slightly more difficult to understand.  We slightly prefer to further discuss based on 4623 and this CR can be not pursued. |
| R4-2014623 (MTK,CATT) |  |
|  |
| R4-2015491 (Huawei) | CATT:   * Why the frequency layer configured only CSI-RS need to be counted 2 times? * Suggest a more simple way like R4-2014623 to show the table if possible. |
| Vivo:  We slightly prefer wording in MTK’s CR 4623. If we follow 4623, this CR can be not pursued. |
| R4-2014413 (CATT) | MTK:   * Regarding "The UE shall be capable of monitoring a total of at least **7** effective NR carrier frequency layers excluding NR serving carrier(s), comprising of any above defined combination of NR inter-RAT carriers excluding NR serving carrier(s) configured by PCell and NR inter-frequency carriers configured by NR PSCell.", The **7** needs to be updated similarly as what we did in TS38.133. * Gap sharing should only applicable to inter-freq CSI-RS measurement. RAN4 agreed to not to specify requirement for Intra-frequency with gap. |
| Huawei:   1. “window configured for CSI-RS based L3 measurement” is not correct since the CSI-RS L3 measurement window is not configured by network. 2. Changes in 7.32.2.6.1 and 7.36.2.5.1 need to be further discussed, as we understand RAN4 has not discussed CSI-RS measurement requirements for deactivated SCell.   3. Changes in 8.1.2.1.1b.1 and 8.1.2.1.1c.1 need to be aligned with the wording in 38.133:  - Depending on UE capability, 7 NR SSB inter-frequency carriers configured by PSCell, and  - Depending on UE capability, 8 NR inter-frequency carriers including SSB and CSI-RS in total configured by PSCell, and  4. Current wording in the CR may cause confusion e.g. that UE is required to support 8 NR SSB inter-frequency carriers configured by NR PSCell. |
| Qualcomm: change “8.1.2.1.1b Monitoring of multiple layers using gaps (E-UTRA-NR dual connectivity)” to “8.1.2.1.1b Monitoring of multiple layers using gaps (EN-DC)”  Change “or window configured for CSI-RS based L3 measurement for NR intra-frequency measurement are fully overlapping with per-UE measurement gaps” to “or window configured for CSI-RS based L3 measurement for NR inter-frequency measurement are fully overlapping with per-UE measurement gaps” |
| R4-2014429 (CATT) | MTK: CR number is missing |
| Qualcomm: draft CR can be endorsed. |
| vivo: If this CR is endorsed, wording in 4531 needs to be aligned to this CR. Suggest to make conclusion in the first round. |
| R4-2014430 (CATT) | MTK: CR number is missing |
| Huawei: Changes to 9.10.1 on the measurement window depends on outcome of sub-topic 1-4. |
| Qualcomm: “The CSI-RS for measurement is QCL-ed to the associated SSB for FR2.” Should be “The CSI-RS for measurement is QCL-ed to the associated SSB ~~for FR2~~.” And similar change is needed in “9.10.2.2 Requirements applicability” |
| Vivo:  1. Do not see the need of duplicated description in 9.10.1 and 9.10.2.2.  2. It is suggested to clarify “*the cells monitored based on the layer of associated SSB*”. |
| R4-2014431 (CATT) | MTK: CR number is missing |
| Qualcomm: it is not clear to us why “The associated SSB of the cell being identified or measured is detectable.” is removed. The agreements are focus on associated SSB shall be detected per our understanding. |
| Vivo:  1. As discussed in our paper 2014530, SS-RSRP, SS-RSRQ and SS-SINR related side condition are not needed.  2. It is suggested to clarify “*the cells monitored based on the layer of associated SSB*”. |
| R4-2014531 (vivo) | Huawei:  For Change 1, we have similar view that the definition of SSB and CSI-RS layer needs to be clarified. We have provided our text proposal in our CR R4-2015782, and we are open to further discuss on the wording. The statement “It is counted as one CSI-RS layer if a frequency layer is the centre frequency of all CSI-RS resources in any CSI-RS-ResourceConfigMobility” is a bit misleading, as it means CSI-RS resources from multiple MOs are counted as one layer.  For Change 4, we understand the last paragraph should not be added, as UE needs to measure neighbour cell on all inter-frequency layers.  [vivo]  For the first comment, we have one clarification added in our CR in clause 9.10.1, as “Only one MO is configured on the CSI-RS layer” which captures previous agreements in R4-2012290. However, we are not sure whether we should move all contents in 9.10.1 to clause 9.1.1, i.e. the introduction part for both SSB and CSI-RS, since some important requirements are captured in 9.1.X, such as CSSF. Maybe moderator/rapporteur/chairman suggestion is needed on this issue.  For the second comments, it is true that Huawei’s original proposal might be for the intra-frequency layer only, according to R4-2012225 in last meeting. However, it was not clear from the issue description and also the related WF in R4-2012290. Based on the wording in agreed WF R4-2012290 it would applied to both intra-frequency and inter-frequency layer. Anyway if clarification can be agreed in this meeting we are also fine to revise the corresponding CR. We suggest to have some further discussion on this issue. |
| CATT:   * ‘Associated SSB is configured and detectable in 9.10.1’ should not be deleted. * ‘The associated SSB layer of the CSI-RS follows the same requirements as SSB based measurements defined in 9.2’ is indicated in intra-frequency measurement requirement in 9.10.2.5 and no need to duplicate here. * The condition that SSB can be detectable should not be deleted.   [vivo]  For the first comment, it is not deleted but moved to 9.10.2.2 and 9.10.3.2. In our view it is not clear in 9.10.1 about what is the definition of detectable and 9.10.2.2 and 9.10.3.2 can provide precise information on this.  For the second comment, it is also fine for us to move this sentence to 9.10.2.3 and 9.10.3.3, since the number of cells to be monitored would have dependence on the SSB layer.  For the third comment, as discussed in our discussion paper, since SS-RSRP, SS-RSRQ, SS-SINR are not derived in CSI-RS measurements, they should not be added. On the other hand, the condition on whether SSB is detectable is not removed but moved together with the wording “Associated SSB is configured and detectable”. |
| R4-2014660 (Xiaomi) | MTK:  • Extended CP cannot even be configured.  [Xiaomi]: To align with RAN2 spec TS38.300. in TS38.300, a note is added to clarify this issue. If we remove this condition in the definition, we need to send LS to RAN2 for the update. Either way is fine for us.  •Why to delete "The CSI-RS for measurement is QCL-ed to the associated SSB for FR2." ? •  [Xiaomi]: Since this condition was stated in clause 9.10.1, general introduction for CSI-RS based L3 measurements. So we suggest to remove it in 9.10.3 to reduce the redundant.  • On # of cells: we think previous version is better. UE is not able to measure CSI-RS from a cell of which the SSB is not detetcable.  [Xiaomi]: If we follow previous version, how UE applies this requirement? The same number or the subset? |
| Huawei: 1.the intra-frequency measurement requirements for CSI-RS was implemented mixed with positioning in clause 9.9.2.4 and 9.9.2.6. so section 9.9.2.4 and 9.9.2.6 shall be removed as well. Please see the changes in our CR [R4-2015490].  [Xiaomi]: this change can be captured in maintenance CR for Positioning WI.  2. we understand the sentence “The cells to be monitored based on CSI-RS can be the same set or a subset of the cells monitored based on SSB” is more accurate, so it should not be removed.  [Xiaomi]: If we follow previous version, how UE applies this requirement? The same number or the subset? |
| Qualcomm: “**The cells to be monitored based on CSI-RS can be the same set or a subset of the cells monitored based on SSB**”, could change to “The cells to be monitored based on CSI-RS can be the same set or a subset of the identified cells monitored based on SSBs that have been detected” if it is more clear. |
| Vivo:  1. Agree with MediaTek and Huawei that the previous version would be better. “The cells to be monitored based on CSI-RS can be the same set or a subset of the cells monitored based on SSB”. Moreover, It is suggested to clarify “*the cells monitored based on the layer of associated SSB*”.  2. Not sure RAN4 have achieved any agreements on which clause will be used for CSI-RSRP, CSI-RSRQ and CSI-SINR accuracy requirements. Anyway if agreements can be achieved in this meeting we are also fine to revise the CR. |
| R4-2015490 (Huawei) | MTK: There is no eCP configuration, not just the requirement. |
| Huawei: @MTK: you are right, based on RAN1’s discussion history, extended CP for CSI-RS based mobility measurement is not supported in Rel-16, so it implies the second condition of CP type comparison for intra-frequency measurement is always satisified in this release. In RAN2 the CR [R2-2007002] to clarify this was already agreed. Our CR is alligned with RAN2’s CR. |
| CATT:   * Meeting date is wrong |
| Qualcomm: the CR is agreeable. |
| R4-2015782 (Huawei) | MTK: Regarding “"If ssbfrequency, smtc1, smtc2 and ssbSubcarrierSpacing are same in multiple MOs, the multiple MOs are counted as one SSB frequency layer.", RAN4 already has some chapter about MO merging. Prefer to put all MO merge issues in the same section” |
| Huawei: @ MTK, it is indeed desirable if we can put all MO merging related requirements in one place. However, the existing sections in 38.133 for MO merging are particularly for EN-DC and NE-DC, and they are about the merging of MOs configured by MN and SN separately. We understand here the scenario is a bit different, and that’s why we put separate requirements as in the CR, but we are open to hear further comments from MTK and other companies. |
| CATT:   * The font of CR number is not consistent * The change about time window pends on the conclusion of issue 1-4-1 |
| Qualcomm: new extension in “any two CSI-RS resource i and resource j of a frequency layer satisfy…” is subject to the agreements in issue1-4-1 |
| Vivo:  1. Suggest to put detectable condition in 9.10.2.2 and 9.10.3.2.  2. Regarding the text proposal to clarify the definition of SSB and CSI-RS layer,  a. For SSB frequency layer, both vivo’s CR 4531 and Huawei’s CR 5782 can provide accurate information and we are fine with either one. For MTK’s comments, we share the same view as Huawei that this should be different issue and it is better clarified somewhere different.  b. For CSI-RS frequency layer, the note to state that “Multiple MO configuration is not precluded” is not considered in R16 requirements definition. In our understanding RAN4 do not need to consider this case. As for intra-frequency layer, it is not clear for us how many intra-frequency layer UE need to monitor if this CR is adopted. Clearly this would allow more than 1 intra-frequency layer, which is not aligned with previous RAN4 agreements. Therefore we suggest to use the wording in vivo’s CR 4531. However we are open to discuss on this issue.  c. It is suggested to also clarify that “If both *ssb-ConfigMobility* and *csi-rs-ResourceConfigMobility* are configured in the same *MeasObjectNR*, they are counted as 1 SSB layer and 1 CSI-RS layer.” This is the wording in the agreed WF R4-2012290. |
| R4-2016044 (Nokia) | MTK: The sentence "Intra-frequency CSI-RS resources are completely contained within the active BWP bandwidth" should not be deleted. |
| Huawei: colliding with multiple CRs. |
| CATT:   * CR number is missing * WI code is incorrect * For the number of cells, the exact cell number should be deleted |
| Qualcomm: Similar view as Huawei. Suggest one company to merge multiple CRs for endorsement. |
| Vivo:  1. Suggest to put detectable condition in 9.10.2.2 and 9.10.3.2. The description in 9.10.1 can be removed to avoid duplication.  2. SS-RSRP, SS-RSRQ and SS-SINR related side condition are not needed.  3. It is suggested to clarify “*the cells monitored based on the layer of associated SSB*”. |

## 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: CSI-RS RRM performance requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014354 | Qualcomm CDMA Technologies | Observation1: existing RAN4 intra-frequency measurement accuracy tests for TDD mode assume 3us between serving cell and neighbor cell.  Observation2: the degradation in the measurement accuracy at 3us timing offset is not obvious for FR1 and ~3.0dB for FR2 in AWGN channel.  **Proposal1: without cell timing errors, same performance requirements for CSI-RS based L1-RSRP can be reused for CSI-RS based L3 measurements.**  **Proposal2: It is recommended to further relax the requirement on intra-frequency CSI-RS L3 measurement accuracy by ~1.0dB for FR1 and ~3.0dB for FR2 when specifying the RAN4 performance test requirements for CSI-RSRP.**  **Proposal2.1: RAN4 test configurations shall exclude FDD duplex mode due to large cell timing offset between serving and target cells at least for intra-frequency measurement test cases.** |
| R4-2014435 | CATT | **Proposal 1: Approve the proposed work plan for performance part of CSI-RS based L3 measurement and test case list to complete performance requirements in Rel-16 timeline (March 2021).** |
| R4-2014436 | CATT |  |
| R4-2014437 | CATT | **Observation 1: For the case SINR=-5.97dB, when the sample number is larger than 5, for most of cases, the measurement error which is indicated by delta RSRP can be in .**  **Observation 2: For the case SINR=-3.97dB, when the sample number is larger than 3, for most of cases, the measurement error which is indicated by delta RSRP can be in .** |
| R4-2014438 | CATT | **Observation 1: For the case SINR=-5.97dB, when the sample number is larger than 5, for most of cases, the measurement error which is indicated by delta RSRQ can be in .**  **Observation 2: For the case SINR=-3.97dB, when the sample number is larger than 3, for most of cases, the measurement error which is indicated by delta RSRQ can be in .** |
| R4-2014439 | CATT | **Proposal 1: Side conditions for CSI-RSRP measurement are defined -6dB for intra-frequency measurement in FR1 and FR2.**  **Proposal 2: CSI-RSRP measurement requirements are defined based on 5 samples for intra-frequency measurement.**  **Proposal 3: The conditions of SSB based measurement can be reused for CSI-RS based L3 measurement.**  **Proposal 4: The reporting range and resolution of SS-RSRP measurement can be reused for CSI-RSRP measurement for L3 reporting.** |
| R4-2014440 | CATT | **Proposal 1: The side condition for CSI-RSRQ measurement are defined as -6dB.**  **Proposal 2: CSI-RSRQ measurement requirements are defined based on 5 samples for intra-frequency measurement.**  **Proposal 3: The conditions of SSB based measurement can be reused for CSI-RS based measurement.**  **Proposal 4: The reporting range and resolution of SS-RSRQ measurement can be reused for CSI-RSRQ.** |
| R4-2014624 | MediaTek Inc. | **Proposal 1: To maintain comparable measurement accuracy to SS-RSRP, it is suggested to specify CSI-RSRP accuracy requirement with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP. FFS whether and how to specify requirements with timing offset larger than CP.**  Proposal 2: The absolute CSI-RSRP accuracy requirements with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP are the same as SSB, i.e.,   * FR1 intra-frequency: ±4.5dB @ Es/Iot≥-6dB * FR2 intra-frequency: ±6dB @ Es/Iot≥-6dB * FR1 inter-frequency: ±4.5dB @ Es/Iot≥-6dB * FR2 inter-frequency: ±6dB @ Es/Iot≥-4dB   Proposal 3: The relative CSI-RSRP accuracy requirements with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP are the same as SSB, i.e.,   * FR1 intra-frequency: ±3dB @ Es/Iot≥-6dB * FR2 intra-frequency: ±6dB @ Es/Iot≥-6dB * FR1 inter-frequency: ±4.5dB @ Es/Iot≥-6dB * FR2 inter-frequency: ±6dB @ Es/Iot≥-4dB |
| R4-2014625 | MediaTek Inc. | **Observation 1: The timing offset between UE’s FFT window and the CSI-RS will bring non-trivial degradation at high Ês/Iot.**  **Proposal 1: To maintain comparable measurement accuracy to SS-SINR, it is suggested to specify CSI-SINR accuracy requirement with the timing offset between UE’s FFT window and the target CSI-RS shorter than [CP]. FFS whether and how to specify requirements with timing offset larger than** [CP].  Proposal 2: The absolute CSI-SINR accuracy requirements with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP are the same as SSB, i.e.,   * FR1 intra-frequency: ±3.5dB @ Es/Iot≥-6dB * FR2 intra-frequency: ±3.5dB @ Es/Iot≥-6dB * FR1 inter-frequency: ±3.5dB @ Es/Iot≥-6dB * FR2 inter-frequency: ±3.5dB @ Es/Iot≥-4dB   Proposal 3: The relative CSI-SINR accuracy requirements with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP are the same as SSB, i.e.,   * FR1 inter-frequency: ±4dB @ Es/Iot≥-6dB * FR2 inter-frequency: ±4dB @ Es/Iot≥-6dB   **Observation 1: The timing offset between UE’s FFT window and the CSI-RS will bring non-trivial degradation at high Ês/Iot.**  **Proposal 4: RAN4 to discuss how to handle the upper limit of Ês/Iot in the CSI-SINR accuracy requirement together with the timing offset.** |
| R4-2014659 | Xiaomi | **Proposal 1: The accuracy requirement of CSI-RS L3 measurement can be defined as adding 1dB margin on the basis of SSB based accuracy requirement.**  **Proposal 2: The reporting rang of CSI-RSRP, CSI-RSRQ and CSI-SINR shall be defined according to the agreement in [7].**  **Proposal 3: The side condition of CSI-RSRP/CSI-RSRQ/CSI-SINR for intra-frequency measurement and inter-frequency measurement in both FR1 and FR2 can be defined as -6dB and -4dB, respectively.** |
| R4-2014703 | CMCC | **Simulation results** |
| R4-2014790 | OPPO | **Proposal 1: Reuse the accuracy requirements RSRP, RSRQ and SINR of SSB as baseline for CSI-RS L3 measurement.**  **Proposal 2: Some margin of accuracy requirements for CSI-RSRP, CSI-RSRQ and CSI-RS SINR can be considered on the top of those for SSB.**  **Proposal 3: RAN4 specify the CSI-RSRP, CSI-RSRQ and CSI-SINR report mapping that**   * **reporting range of CSI RSRP can be represented with up to 128 reported values (7 bits) and the granularity shall be 1dB.** * **reporting range of CSI-RSRQ and CSI-SINR can be represented with up to 128 reported values (7 bits) and the granularity shall be 0.5dB.** |
| R4-2015783 | Huawei, HiSilicon | **Proposal 1: The side condition of CSI-RSRP measurement accuracy is defined as**   * **Es/Iot condition same as SS-RSRP L3 measurement** * **BW of 48-RB and Density of D=3** * **5 measurement samples (it is captured as core requirements, and is used to derive the accuracy)** * **3us timing error (other values can be discussed for FDD)**   **Proposal 2: RAN4 to collect simulation results with timing error from interested companies.**  **Proposal 3: CSI-RSRP accuracy requirements are defined to be SCS specific.**  **Proposal 4: Reuse the RF margin in SSB accuracy requirements for CSI-RSRP accuracy.**  **Proposal 5: Reuse the report mapping of SS-RSRP for CSI-RSRP, i.e. the range of CSI-RSRP report is from -156 dBm to -31 dBm with 1 dB resolution.** |
| R4-2015785 | Huawei, HiSilicon | **Proposal 1: The side condition of CSI-RSRQ measurement accuracy is defined as**   * **Es/Iot condition same as SSB L3 measurement** * **BW of 48-RB and Density of D=3** * **5 measurement samples (it is captured as core requirements, and is used to derive the accuracy)** * **3us timing error (other values can be discussed for FDD)**   **Proposal 2: RAN4 to collect simulation results with timing error from interested companies.**  **Proposal 3: CSI-RSRQ accuracy requirements are defined to be SCS specific.**  **Proposal 4: The range of CSI-RSRQ report is from -43 dB to 0 dB with 0.5 dB resolution.** |
| R4-2015787 | Huawei, HiSilicon | **Proposal 1: The side condition of CSI-SINR measurement accuracy is defined as**   * **Es/Iot condition same as SSB L3 measurement** * **BW of 48-RB and Density of D=3** * **5 measurement samples (it is captured as core requirements, and is used to derive the accuracy)** * **3us timing error (other values can be discussed for FDD)**   **Proposal 2: RAN4 to collect simulation results with timing error from interested companies.**  **Proposal 3: CSI-SINR accuracy requirements are defined to be SCS specific.**  **Proposal 4: The range of CSI-SINR report is from -23 dB to 40 dB with 0.5 dB resolution.** |
| R4-2016046 | Nokia, Nokia Shanghai Bell | **Observation#1: If *associatedSSB* is configured, the CSI-RS resources are measured with a time difference from its real timing i.e. the timing of the *associatedSSB*.**  **Observation#2: The CSI-RS based measurement with big timing difference does not provide decent measurement results and may mislead the network decision.**  **Proposal1: In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold. Typically, the threshold could be set to one or twice of the CP lengths.**  **Proposal2: The CSI-RS based measurement delay requirements are defined based on 3 samples for {D=3 & 48PRB} given SNR = -6dB.** |
| R4-2016049 | Nokia, Nokia Shanghai Bell | **Simulation results** |
| R4-2014441 | CATT | **CR** |
| R4-2014442 | CATT | **CR** |
| R4-2014443 | CATT | **CR** |
| R4-2014661 | Xiaomi | **CR** |
| R4-2014662 | Xiaomi | **CR** |
| R4-2014663 | Xiaomi | **CR** |
| R4-2014791 | OPPO | **CR** |
| R4-2014792 | OPPO | **CR** |
| R4-2015784 | Huawei, HiSilicon | **CR** |
| R4-2015786 | Huawei, HiSilicon | **CR** |
| R4-2015788 | Huawei, HiSilicon | **CR** |
| R4-2016047 | Nokia, Nokia Shanghai Bell | **CR** |

## Open issues summary

### Sub-topic 2-1 General (Work Plan, simulation assumption, conditions)

***Moderator: Companies please directly provide your comments on the papers below in section 2.3.2***

Work plan for performance part of CSI-RS based L3 measurement was provided in ***R4-2014435***

Updated simulation assumption for CSI-RS based L3 measurement was provided in ***R4-2014436***

*The conditions for CSI-RS based L3 measurement were provided in three contributions (CR* ***R4-2014434, R4-2014664 and R4-2016048****).*

### Sub-topic 2-2 CSI-RSRP requirements

Background:

In RAN4#96-e, it is agreed [WF R4-2012168] that

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| --- |
| * Rel-16 CSI-RS based measurement requirements are based on Single FFT implementation * UE supports using the serving cell timing for CSI-RS based L3 measurement for intra-frequency measurements in Rel-16   + Note: the measurement degradation can be expected for the case when timing difference is larger than CP and it can be discussed in the performance part |

**Issue 2-2-1: How to handle the potential performance degradation of CSI-RSRP measurement due to single FFT?**

* Proposals
  + Option 1: Possibly specify 2 sets of requirements. (MTK, CATT)
    - Specify CSI-RSRP accuracy requirement with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP. FFS whether and how to specify requirements with timing offset larger than CP.
    - Reuse the accuracy requirements of SS-RSRP for CSI-RS based L3 measurement with the timing offset between UE’s FFT window and the target CSI-RS shorter than CP.
  + Option 2: 1 set of requirements with a margin on existing requirements
    - Option 2a: (Xiaomi)
      * The accuracy requirement of CSI-RS L3 measurement can be defined as adding 1dB margin on the basis of SSB based accuracy requirement.
    - Option 2b: (Qualcomm)
      * Reuse the requirements for CSI-RS based L1-RSRP when without cell timing errors.
      * Further relax the requirement on intra-frequency CSI-RS L3 measurement accuracy by ~1.0dB for FR1 and ~3.0dB for FR2.
  + Option 3: 1 set of requirements to be SCS specific (Huawei)
    - CSI-RSRP accuracy requirements are defined to be SCS specific.
    - CSI-RSRP accuracy requirements are derived from the simulation results.
  + Option 4: 1 set of requirements with applicability (Nokia)
    - In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold. Typically, the threshold could be set to one or twice of the CP lengths.
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-2-1: How to handle the potential performance degradation of CSI-RSRP measurement due to single FFT?** | |
| **Company** | **Comments** |
| MTK | Support Option 1 to at least secure some scenarios without performance degradation.  Regarding degraded performance, we can further down select between Option 2 and 3. |
| Huawei | Support option 3. To be more specific, we suggest to define one set of accuracy requirements based on [3]us timing error.  From network perspective, it is unlikely that the synchronization is enhanced just for CSI-RS measurement, so the assumption should be based on existing synchronization assumptions. It is noted that the smaller timing error is used, the more restriction is imposed on network synchronization.  For a fixed timing error of 3us, the accuracy degradation would depend on SCS, so we suggest to define the accuracy requirements to be SCS specific. |
| Xiaomi | Support option 2. We prefer to have 1 set of requirements with a relaxed requirement other than having multiple set of requirement to follow. |
| CATT | Support option 1. Suggest to specify the normal accuracy requirement when the timing offset shorter than CP first. Then further solutions can be discussed for degraded performance, for example, add a margin or degrade as SCS specific. |
| Qualcomm | We are open to consider the baseline based on SSB or via simulations. But we need to clarify whether timing offset is assumed to be 3us or CP. |
| OPPO | Support option 2. The value(s) of margin with 1~3dB is fine to us. |
| Intel | Support option 1. it’s fine to define accuracy requirement based on different timing offset. Whether the timing offset is based on 3us or CP needs further discussion. We slight prefer 3us since it may be challenge for network side to further reduce the timing offset. In this case, the performance degradation impact on different SCS level may needs to be considered respectively. |
| vivo | We share similar view with Qualcomm. In our understanding even multiple options are listed, common understanding is that CSI-RS measurement accuracy can only be ensured if limited timing difference is considered. The only difference is how much timing offset is set for defining requirements. |

**Issue 2-2-2: Side condition for CSI-RSRP measurement?**

* Proposals
  + Option 1: Reuse the side condition of SS-RSRP (MTK, Xiaomi, CATT, Huawei)
    - FR1 intra-frequency: Es/Iot≥-6dB
    - FR2 intra-frequency: Es/Iot≥-6dB
    - FR1 inter-frequency: Es/Iot≥-6dB
    - FR2 inter-frequency: Es/Iot≥-4dB
* Recommended WF
  + *Option 1 is recommended.*

|  |  |
| --- | --- |
| **Issue 2-2-2: Side condition for CSI-RSRP measurement?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | Support the recommended WF |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Intel | Support the recommended WF |
| vivo | Support the Recommended WF. |

**Issue 2-2-3: Report mapping for CSI-RSRP measurement?**

* Proposals
  + Option 1: Reuse the report mapping of SS-RSRP (i.e from -156 dBm to -31 dBm with 1 dB resolution). (Xiaomi, OPPO, CATT, Huawei)
* Recommended WF
  + *Option 1 is recommended.*

|  |  |
| --- | --- |
| **Issue 2-2-3: Report mapping for CSI-RSRP measurement?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | Support the recommended WF |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Intel | Support the recommended WF. |
| vivo | Support the recommended WF. |

**Issue 2-2-4: Number of samples to be used for defining CSI-RSRP measurement accuracy requirements?**

* Proposals
  + Option 1: 5 samples (Huawei, CATT)
  + Option 2: 3 samples (Nokia)
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-2-4: Number of samples to be used for defining CSI-RSRP measurement accuracy requirements?** | |
| **Company** | **Comments** |
| MTK | Support Option 1.  Note that margin for RF calibration error needs to be additionally considered. |
| Huawei | Support option 1, which is consistent with core requirements. |
| Xiaomi | Support option 1 |
| CATT | Support option 1. |
| Qualcomm | Option1 is supported. |
| OPPO | Support option 1. |
| Intel | Support option 1. |
| vivo | Support option 1. |

**Issue 2-2-5: Whether to introduce test case for FDD duplex mode?**

* Proposals
  + Option 1: No (Qualcomm)
  + Option 2: Yes
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-2-5: Whether to define test case for FDD duplex mode?** | |
| **Company** | **Comments** |
| MTK | Ok with Option 1 to reduce the test case number. |
| Huawei | We do not have strong view but slightly prefer option 2.  The existing RRM test cases are defined in such a way that both FDD and TDD can be tested with a single test case (this is reflected in the supported test configurations), and we could follow the same approach. On the other hand, the synchronization in the test case should be aligned with the side condition for the accuracy requirements. |
| Xiaomi | OK with option 1 |
| CATT | We are fine with option 1. |
| Qualcomm | Option1 is supported due to the constraints of Rel-16. Introducing test cases for FDD with side condition, say 3us, is not realistic but also adds unnecessary number of test cases. |
| OPPO | Fine with option 1. |
| vivo | Agree with option 1. |

### Sub-topic 2-3 CSI-RSRQ requirements

**Issue 2-3-1: How to define accuracy requirements for CSI-RSRQ measurement?**

* Proposals
  + Option 1: Reuse the requirements for L3 SS-RSRQ. (CATT)
  + Option 2: Derived from the simulation results. (Huawei)
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-3-1: How to define accuracy requirements for CSI-RSRQ measurement?** | |
| **Company** | **Comments** |
| MTK | Suggest on hold this issue after RAN4 collects more results from companies. |
| Huawei | This depends on Issue 2-2-1. If RAN4 agrees to define the accuracy based on timing error larger than CP, it may be possible to reuse the SS-RSRQ accuracy which is defined without timing error. |
| Xiaomi | The degradation due to time difference should be considered when defining the accuracy requirements for CSI-RSRQ. |
| CATT | Can follow the principle of issue 2-2-1. For normal requirements i.e. when the timing difference shorter than CP, support option 1 according to our simulation results. But we are fine to collect more results. |
| Qualcomm | Pending on conclusions on how to deal with CSI-RSRP |
| OPPO | Also agree to discuss it together with issue 2-2-1. The similar method should be adopted. |
| Intel | timing error impact needs to be considered. |
| vivo | Agree to discuss this after we have conclusion in 2-2-1. |

**Issue 2-3-2: Report mapping for CSI-RSRQ measurement?**

* Proposals
  + Option 1: Reuse the report mapping for L3 SS-RSRQ (i.e. from -43 dB to +20 dB with 0.5 dB resolution). (CATT, Xiaomi, OPPO)
  + Option 2: The range of CSI-RSRQ report is from -43 dB to 0 dB with 0.5 dB resolution. (Huawei)
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-3-2: Report mapping for CSI-RSRQ measurement?** | |
| **Company** | **Comments** |
| Huawei | CSI-RSRQ cannot be larger than 0dB because RSSI is measured on OFDM symbols with CSI-RS, so our first preference is option 2. On the other hand, to move forward we can also compromise to option 1 as the SS-RSRQ range is larger than CSI-RRSQ range. |
| Xiaomi | Support option 1 |
| CATT | Support option 1. |
| Qualcomm | Option1 is supported. |
| OPPO | Fine with option 1. But we also confuse about why RSRQ can be larger than 0dB. Some clarification may be needed before we decide to reuse the report mapping of L3 SS-RSRQ. |
| vivo | We can accept option 2. At least this may need further discussion after we have conclusion on previous issue. |

**Issue 2-3-3: Side condition for CSI-RSRQ measurement requirements?**

* Proposals
  + Option 1: Reuse the side condition for L3 SS-RSRQ. (CATT, Xiaomi, OPPO, Huawei)
* Recommended WF
  + *Option 1 is recommended.*

|  |  |
| --- | --- |
| **Issue 2-3-3: Side condition for CSI-RSRQ measurement requirements?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | Support the recommended WF |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Intel | Support the recommended WF |
| vivo | Support the recommended WF |

**Issue 2-3-4: Number of samples to be used for defining CSI-RSRQ measurement accuracy requirements?**

* Proposals
  + Option 1(moderator): Follow the conclusion of CSI-RSRP measurement in issues 2-2-4.
* Recommended WF
  + *Agree on option 1.*

|  |  |
| --- | --- |
| **Issue 2-3-4: Number of samples to be used for defining CSI-RSRQ measurement accuracy requirements?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | It should be the same number used for defining CSI-RSRQ measurement accuracy requirements |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Intel | Support the Recommended WF. |
| vivo | Support the Recommended WF. |

### Sub-topic 2-4 CSI-SINR requirements

**Issue 2-4-1: Accuracy requirements for CSI-SINR measurement?**

* Proposals
  + Option 1: Reuse the requirements of SS-SINR. (MTK, CATT)
  + Option 2: Derived from the simulation results. (Huawei)
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-4-1: Accuracy requirements for CSI-SINR measurement?** | |
| **Company** | **Comments** |
| MTK | Support Option 1 for small timing offset and low SINR side condition.  With larger timing offset and higher SINR side condition, there will be additional degradation due to ISI. RAN4 may need more time to discuss. |
| Huawei | This depends on Issue 2-2-1. If RAN4 agrees to define the accuracy based on timing error larger than CP, it may be possible to reuse the SS-SINR accuracy which is defined without timing error. |
| Xiaomi | The degradation due to time difference should be considered when defining the accuracy requirements for CSI-SINR. |
| CATT | Can follow the principle of issue 2-2-1. For normal requirements i.e. when the timing difference shorter than CP, support option 1. But we are fine to collect more results. |
| Qualcomm | We will further check the impact of timing offset on CSI-SINR in the following meetings. |
| OPPO | Also agree to discuss it together with issue 2-2-1. The similar method should be adopted. |
| Intel | similar with CSI-RSRP. Timing error impact needs to be considered. |
| vivo | Same as issue 2-3-1. |

**Issue 2-4-2: Side condition of CSI-SINR measurement?**

* Proposals
  + Option 1: RAN4 to discuss how to handle the upper limit of Ês/Iot in the CSI-SINR accuracy requirement together with the timing offset. (MTK)
  + Option 2: Same as L3 SS-SINR measurement. (Huawei, CATT)
* Recommended WF
  + *Need more discussion.*

|  |  |
| --- | --- |
| **Issue 2-4-2: Side condition of CSI-SINR measurement?** | |
| **Company** | **Comments** |
| MTK | Support Option 1.  We encourage companies to check the issues of degradation with large timing offset and high SINR side condition. |
| Huawei | We think the issue behind option 1 is valid, and we are open to discuss more details once the assumption of timing error for accuracy is decided. |
| Xiaomi | Support option 1 |
| CATT | Fine with option 1. |
| OPPO | Fine with option 1. |
| Intel | Support Option 1. |
| vivo | Support Option 1. |

**Issue 2-4-3: Report mapping of CSI-SINR measurement?**

* Proposals
  + Option 1: Reuse the report mapping of SSB based L3 measurement (i.e. from -23 dB to 40 dB with 0.5 dB resolution). (Huawei, CATT, Xiaomi)
* Recommended WF
  + *Option 1 is recommended.*

|  |  |
| --- | --- |
| **Issue 2-4-3: Report mapping of CSI-SINR measurement?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | Support the recommended WF |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Intel | Support the Recommended WF. |
| vivo | Support the Recommended WF. |

**Issue 2-4-4: Number of samples to be used for defining CSI-SINR measurement accuracy requirements?**

* Proposals
  + Option 1(moderator): Follow the conclusion of CSI-RSRP measurement in issues 2-2-4.
* Recommended WF
  + *Agree on option 1.*

|  |  |
| --- | --- |
| **Issue 2-4-4: Number of samples to be used for defining CSI-SINR measurement accuracy requirements?** | |
| **Company** | **Comments** |
| MTK | Support the recommended WF |
| Huawei | Support the Recommended WF. |
| Xiaomi | It should be the same number used for defining CSI-RSRQ measurement accuracy requirements |
| CATT | Support the recommended WF. |
| Qualcomm | Recommended WF is agreeable. |
| OPPO | Support the recommended WF. |
| Vivo | Support the recommended WF. |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2014435 (CATT)  Work plan | MTK: 2 meetings may not be sufficient to conclude everything. Perhaps we can still approve the WP as it is and reschedule the WID in next RP meeting |
| Qualcomm: Agree with MTK. |
|  |
| R4-2014436 (CATT) | MTK: Regarding the bandwidth, we only need to keep 48 PRBs. Suggest to remove 96 and 264 |
| Huawei: In general we support to update the simulation assumption based on the outcome of the core part discussions, to facilitate the derivation of accuracy requirements.  Technically, the Relative Delay of 1st Path needs to be further discussed. For FR2 with 120k SCS, the largest value of 1.5\*CP is 0.88us, which is quite tight considering the cell phase error is 3us |
| Qualcomm: support that requirements specification shall stick to 48PRBs. |
| R4-2014434 (CATT) | MTK:   * SCSSSB should be changed to SCSCSI-RS. * The SCS for CSI-RS in FR2 should be 60KHz and 120KHz |
| Huawei: There are many “SCSSSB” in the new tables. 60k SCS should be added for FR1. There is no 240k SCS for CSI-RS in FR2. |
| R4-2014664 (Xiaomi) | MTK: How is the minimum CSI\_RS RP calculated for FR2 60KHz SCS? |
| Huawei: For FR2 tables, could it be clarified why the min RP defined for SSB of 120k SCS is reused for CSI-RS of 60k SCS?  [Xiaomi]: Refer the same value defined for CSI-RS based L1-RSRP in FR2. |
| R4-2016048 (Nokia) | Huawei: There is no 240k SCS for CSI-RS in FR2. The applicable SCS for FR2 should be 60k and 120k in our understanding. |
|  |
| R4-2015213 (Xiaomi) |  |
|  |

## 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*

|  |  |  |
| --- | --- | --- |
|  | **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*

|  |  |
| --- | --- |
| **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”* |