**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-21XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 5.7.1, 5.7.2.1, 5.7.2.2

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [98-bis-e][212] NR\_CSIRS\_L3meas\_1

**Document for:** Information

# Introduction

The documents in agenda items 5.7.1, 5.7.2.1 and 5.7.2.2 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

# Topic #1: CSI-RS RRM core requirements maintenance

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104692 | Xiaomi | **Proposal 1: 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, where the serving cell is taken as the symbol level timing reference.**  **Observation: If different CSI-RS resources in the same MO fall in different window occasions, the throughput performance degradation is expected from network point of view.**  **Proposal 2: All CSI-RS resources in the same MO are configured in the same 5ms window.** |
| R4-2104733 | CATT | **Proposal 1: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols to be measured, and on 1 OFDM symbol before and after each consecutive CSI-RS symbols to be measured.**  **Proposal 2: For the applicability of CSI-RS L3 measurement on the CSI-RS configuration, one of the following options can be accepted:**   * **Option 1: All CSI-RS resources in the same MO are configured in the same 5ms window.** * **Option 2: The CSI-RS resources can be configured as**   **where and are time offsets (in millisecond) of CSI-RS resource i and j respectively.**  **Proposal 3: There is no need to define the starting point of the 5ms time window.** |
| R4-2104734 | CATT | **Draft CR** |
| R4-2104836 | Apple | **Proposal 1a: for CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the slot boundary of the serving cell, where the corresponding slot contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.**  **Proposal 1a: for CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the boundary of slot N in the serving cell, where the following slot, i.e. slot N+1, contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.**  **Proposal 2: Single periodicity and frequency offset is defined for all CSI-RS resources in the same MO. Consequently, all CSI-RS resources in the same MO should be configured in the same 5ms window.** |
| R4-2106410 | Nokia, Nokia Shanghai Bell | **Proposal1: We propose using the same way as in SSB-based measurements to define the scheduling restriction for CSI-RS based measurement, i.e. Option 2 is preferred:**   * **When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols to be measured, and on 1 OFDM symbol before and after each consecutive CSI-RS symbols to be measured.**   **Proposal2: Different CSI-RS resources in the same MO may fall in different 5ms window.**  **Proposal3: It is unnecessary to specify the starting point as the location of the 5ms window is up to network configuration.**  **Proposal4: In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold.** |
| R4-2106459 | Intel Corporation | **Proposal 1: All CSI-RS resources in the same MO are configured in the same 5ms window.**  **Proposal 2: It’s better that NW can order these timing offset of CSI-RS resources and make sure that the first configured L3 CSI-RS resource corresponding to the smallest offset.**  **Proposal 3: For CSI-RSRP, the upper bound of timing offset for case 1 is 1CP.** |
| R4-2106525 | OPPO | **Proposal 1: Requirement are defined for the cases where all CSI-RS resources in the same MO are configured in the same 5ms window.**  **Proposal 2: Define the starting point of the 5ms window as the slot boundary of the first configured L3 CSI-RS resource is located.**  **Proposal 3: Support option 1 that 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 symbol.** |
| R4-2106614 | vivo | ***Proposal 1a: All CSI-RS resources in the same MO are configured in the same 5ms window. Or***  ***Proposal 1b: All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.***  ***Proposal 2: Define the starting point of the 5ms window as the slot boundary where the first configured L3 CSI-RS resource during one CSI-RS periodicity is located.***  ***Proposal 3: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols, and on 1 OFDM symbol after the consecutive CSI-RS symbols.*** |
| R4-2106620 | vivo | **Draft CR** |
| R4-2106926 | Huawei, HiSilicon | **Proposal 1: as there are some possible understanding of uplink scheduling restriction, there are two options of defining uplink scheduling restrictions in TDD band in FR1:**  **- Option 1: If we regard the guard period before UL symbols as the scheduling restriction, the uplink scheduling restriction is: CSI-RS resource symbols to be measured, and 1 OFDM symbol (for 15kHz/30kHz SCS) or 2 OFDM symbols (for 60kHz) before CSI-RS resource symbols to be measured,** **and 1 OFDM symbol after CSI-RS resource symbols to be measured.**  **- Option 2: without considering GP, the uplink scheduling restriction is: CSI-RS resource symbols to be measured, and 1 OFDM symbol before and after CSI-RS resource symbols to be measured.**  **Proposal 2: Support the case where different CSI-RS resources in the same MO fall in different 5ms windows.**  **Proposal 3: RAN4 to further discuss the following options for defining CSI-RS measurement window.**   * **Based on configured CSI-RS resources, which requires SFN level sync from NW** * **Based on measured CSI-RS resources, which leads to the sliding window** |
| R4-2106927 | Huawei, HiSilicon | **Draft CR** |
| R4-2106928 | Huawei, HiSilicon | **Draft CR** |
| R4-2106929 | Huawei, HiSilicon | **Draft CR** |
| R4-2107218 | Qualcomm CDMA Technologies | **Observation1: further discussions are needed for distributing CSI-RS resources into multiple windows but RAN4 has limited time remained for this work item.**  **Proposal1: RAN4 may consider option2(multiple windows per resource period) in the future release if needed.**  **Proposal2: For a CSI-RS layer, the slot boundary of the resource with the smallest (slot) offset can be treated as the starting point of the 5ms window.**  **Proposal2.1: in other words, option2 can be clarified as defining the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer.**  **Proposal3: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols to be measured, and on 1 OFDM symbol before and after each consecutive configured CSI-RS.**  **Proposal3.1: restricted CSI-RS symbols are corresponding to the CSI-RS resources configured by the network.** |
| R4-2107365 | Qualcomm CDMA Technologies | **Observation1: further discussions are needed for distributing CSI-RS resources into multiple windows but RAN4 has limited time remained for this work item.**  **Proposal1: RAN4 may consider option2(multiple windows per resource period) in the future release if needed.**  **Proposal2: For a CSI-RS layer, the slot boundary of the resource with the smallest (slot) offset can be treated as the starting point of the 5ms window.**  **Proposal2.1: in other words, option2 can be clarified as defining the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer.**  **Proposal3: When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols to be measured, and on 1 OFDM symbol before and after each consecutive configured CSI-RS.**  **Proposal3.1: restricted CSI-RS symbols are corresponding to the CSI-RS resources configured by the network.** |

## Open issues summary

### Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band

* Proposals
  + Option 1: (Xiaomi, OPPO)
    - 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, where the serving cell is taken as the symbol level timing reference
  + Option 2: (CATT, Nokia, Huawei)
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols to be measured, and on 1 OFDM symbol before and after each consecutive CSI-RS symbols to be measured.
  + Option 2a: (Qualcomm)
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols.
  + Option 3: (vivo)
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols, and on 1 OFDM symbol after the consecutive CSI-RS symbols
* Recommended WF
  + *Need more discussion*

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| Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band | |
| **Company** | **Comments** |
| Qualcomm | Option2a is supported.  Note the option aims to be precise about symbols that are configured because symbols to be measured are up for UE to determine and can be dynamic which may not be aware to the network. |
| MTK | Support Option 2a.  Option 1 is technically correct. But as other companies mentioned, the problem (also in other options) is that NW has no idea about UE’s absolute timing advance value. Therefore, we can compromise to Option 2 or 2a in which more margin is provided.  Option 2a additionally helps to resolve the issue that network does not have the knowledge about which CSI-RS UE will measure, which is determined by UE’s SSB detection results. |
| CATT | Fine with option 2 or option 2a.  For option 1, the wording ‘overlapped by CSI-RS resources’ is more likely from UE’s perspective and cannot be recognized by NW. So we suggest to follow the same wording as SSB based measurement.  For option 2, our understanding is that ‘the CSI-RS resources to be measured’ means the resources **configured to be measured** rather than the resources that exactly measured by UE after considering the SSB detection or gap configuration etc.. In this understanding, option 2 and option 2a are the same. |
| vivo | There are two aspects regarding scheduling restriction that need to be determined. One is relationship between CSI-RS resources symbols on neighbor cell and corresponding symbols on serving cell. The other aspect is whether scheduling restriction should be applied to the symbol before/after the CSI-RS symbols.  It was agreed that UE would measure CSI-RS resources with single FFT based on timing of serving cell. The important part is to clarify the timeline that UE is used to measure CSI-RS resources. It needs to be further clarified that the measurement is based on serving cell downlink timing. The uplink timeline and downlink timeline are different as depicted in Figure below.    With this clarification, there should be no ambiguous to use CSI-RS resource symbols to define scheduling restriction.  It can also be seen from the Figure that only 1 OFDM symbol after the consecutive CSI-RS symbols to be measured should not be scheduled due to timing advance. The OFDM symbol before the consecutive CSI-RS symbols to be measured can be scheduled because the UL to DL switching time has already been guaranteed by guard period before the uplink OFDM symbol.  Therefore option 3 is more reasonable to specify scheduling restriction requirements |
| OPPO | Support option 1. Regarding NW has no idea about UE’s absolute timing advance value, the wording ‘ configured CSI-RS resource symbols’ in option 2a is also fine to us. |
| Nokia | We support Option 2 and Option 2a.  As for Option 1, the condition “data OFDM symbols overlapped by CSI-RS resource symbols” is not detectable at the network side. As the network has no timing offset information, it has no means to determine if the OFDM symbol is overlapped and hence skip scheduling the UE on this symbol. Such misaligned understanding needs to be avoided. |
| Xiaomi | We are fine with either option 1 or option 2/2a. |
| apple | We prefer to option 2a considering the exact TA at UE is unknown to NW. Also, it is better to clarify only configured CSI-RS symbol should be considered. |
| Huawei | Option 2 and option 2a are aligned. Detailed analysis are provided in R4-2106926. We can support both. |
| Docomo | Support option 1. |

### Sub-topic 1-2 Time domain restriction for CSI-RS configuration

**Issue 1-2: Whether the CSI-RS resources in the same MO can be configured in the different 5ms window?**

* Proposals
  + Option 1: (Xiaomi, CATT, Apple, Intel, OPPO, vivo, Qualcomm)
    - No. All CSI-RS resources in the same MO are configured in the same 5ms window.
  + Option 2a: (Nokia, Huawei)
    - Yes. Different CSI-RS resources in the same MO may fall in different 5ms window
  + Option 3a: (CATT)
    - The CSI-RS resources can be configured as

where and are time offsets (in millisecond) of CSI-RS resource i and j respectively.

* + Option 3b: (vivo)
    - All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.
* Recommended WF
  + *Need more discussion*

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| Sub-topic 1-2 Time domain restriction for CSI-RS configuration | |
| **Company** | **Comments** |
| Qualcomm | Option1 is supported as it shouldnot result in any functional issue even without the enhancement. |
| MTK | Support Option 1.  Other options will create different gap overlapping status for CSI-RS resources in the same MO, e.g., some are overlapped by gap and some are not. We do not prefer RAN4 to open up this discussion in this very late Rel-16 stage. |
| CATT | Prefer option 1.  For option 2, in intra-frequency measurement, the requirements can keep unchanged but UE need to monitor multiple windows. In inter-frequency measurement, the requirements can also keep unchanged but UE need a smaller gap period to cover all the CSI-RS resources. Considering the minimum gap period is 20ms, we can accept option 3a as a compromise. But this actually limits the gap configuration into the minimum period. |
| vivo | The existing RRM requirements should not be changed due to any possible MO configuration for CSI-RS based measurement.  The CSI-RS resources in one CSI-RS resource periodicity should be confined within one 5ms window in general, so that UE needs to measure all CSI-RS resources within the 5ms window once during one CSI-RS resource periodicity. With more than one windows are configured, UE needs to measure all CSI-RS resources during one CSI-RS resource periodicity within two or even more window instances. This is possible for intra frequency measurement without gap under the condition existing measurement requirements apply, but extra UE complexity is required.  However, when gap is needed for inter frequency measurement, there are some issues with more than one window instances. It was agreed that CSI-RS resource periodicity for CSI-RS L3 measurement is 10ms, 20ms and 40ms. Even with 40ms CSI-RS resource periodicity, the maximum window separation can only be 20ms. It requires 20ms gap pattern to cover the two windows in one CSI-RS resource periodicity. In our understanding 20ms gap pattern is not typical configuration, especially in FR1. Even if 20ms gap pattern is configured the existing requirements need to be revised to reflect the UE behaviour that UE is required to measure CSI-RS resources in two 5ms windows during one CSI-RS resource period.  Our preference is option 1 that all CSI-RS resources in the same MO are configured in the same 5ms window as there is no clear justification that CSI-RS resources on one frequency layer cannot be configured as such. Especially for 30kHz SCS, 5ms window would be long enough to configure all the CSI-RS resources in one window.  Option 3 can be considered a compromise to address concerns from both sides. |
| Intel | Support option 1.  If all CSI-RS resource in the same MO may fall in different 5ms window, it will have impact on the measurement period requirement and CSSF. The measurement period will be more complex when there are some partially overlapping between CSI-RS MO and measurement gap. The measurement period will be different for different CSI-RS resources. Similarly, the CSSF definition is complex since some of the CSI-RS resource in the MO may overlap with measurement gap but some others may not. |
| OPPO | Support option 1. Share the similar view as QC and MTK’s. |
| Nokia | We prefer Option 2a.  As for Option1, restricting to single window would limit the flexibility of network configuration and may degrade the system performance. We understood this is just network configuration matter. Is there any hard restriction for the UE to measure multiple CSI-RS resources in different 5ms windows? |
| CMCC | Slightly prefer option 2a. We see the benefit to allow different 5ms window, and we also share the similar view that not to impact the measurement requirements at current stage. According to the comments from companies, the main concern is about the overlapping issue between gaps and CSI-RS resources, which only exist in inter-frequency measurement. But for intra-frequency measurement, since only without MG is considered for CSI-RS, we are wondering whether we can allow different 5ms window only for CSI-RS resources in the intra-frequency layer as possible way to move forward if no issues observed for intra-frequency CSI-RS measurement with different 5ms window. |
| Xiaomi | Support option 1, if different CSI-RS resources in the same MO can fall in different 5ms window, more scheduling restriction is expected. |
| apple | Support option 1 since there is no special benefit identified to leave such flexibility. |
| Huawei | As discussed during GTW, we can support 3b.  The issue with option 1 is that NW has to place all the CSI-RS for L3 measurement in a 5ms window, and it could be difficult for NW considering that in the same 5ms window NW also needs to transmit SSB, common channels and other CSI-RS resources for L1 measurement. |

### Sub-topic 1-3 Starting point of 5ms time window

* Proposals
  + Option 1: (CATT, Nokia)
    - No need to define the starting point of the 5ms time window
  + Option 2a: (Apple)
    - For CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the slot boundary of the serving cell, where the corresponding slot contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.
  + Option 2b: (Apple)
    - For CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the boundary of slot N in the serving cell, where the following slot, i.e. slot N+1, contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.
  + Option 3: (Qualcomm)
    - Define the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer
  + Option 4: (OPPO, vivo)
    - Define the starting point of the 5ms window as the slot boundary where the first configured L3 CSI-RS resource during one CSI-RS periodicity is located
  + Option 5: (Intel)
    - NW can order these timing offset of CSI-RS resources and make sure that the first configured L3 CSI-RS resource corresponding to the smallest offset.
  + Option 6: (Huawei)
    - RAN4 to further discuss the following options for defining CSI-RS measurement window.
      * Based on configured CSI-RS resources, which requires SFN level sync from NW
      * Based on measured CSI-RS resources, which leads to the sliding window
* Recommended WF
  + *Need more discussion*

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| Sub-topic 1-3 Starting point of 5ms time window | |
| **Company** | **Comments** |
| Qualcomm | Option3 is supported as it intends to base on the configured resource with the earliest offset, the slot boundary of which is regarded as the starting point. |
| MTK | Support Option 1 or Option 2a.  Slot index, boundary and SFN may not be the same between serving and neighboring cells. Therefore, Options 3, 4, 5 do not work. The second bullet of Option 6 is essentially the same as Option1 in our view. |
| CATT | Support option 1.  There is no need to define the starting point. Especially for inter-frequency measurement, since there is no configuration indication for the 5ms window and UE perform measurement within gap, the CSI-RS resources are configured within gap anyway. This starting point definition cannot bring any improvement or clarification. |
| vivo | It is important to define the starting point of the 5ms window so that UE knows which CSI-RS resources should be counted in the 5ms window. It is reasonable to definethe starting point of the 5ms window as the slot boundary that the first configured L3 CSI-RS resource is located.  Since CSI-RS based measurements are conducted based on serving cell timing with one single FFT and requirements are only applicable when timing offset between serving cell and neighbor are within CP, no issue is identified that the slot boundary is based on serving cell.  In our view option 4 and option 2a are quite the same. Both are fine for us. |
| Intel | Fine with option 3 or option 5. |
| OPPO | OK with option 4 and option 2a. The starting point is essential to be defined to ensure the same understanding of UE and network. |
| Nokia | We prefer Option 1.  Firstly we would highlight again such 5ms window is not a SMTC-like measurement window, which was concluded to be out of Rel16 scope. This 5ms window is a restriction to network configuration. The network is supposed to configure the CSI-RS resources within 5ms, which may start from the first CSI-RS resource, but nothing is required to be awared or clarified at the UE side. |
| Xiaomi | Fine with option 2a and option 4 |
| apple | Support option 2a. The issue with option 4 is UE and NW may have different understanding on the “first” arrived CSI-RS |
| Huawei | We can support option 3.  In our view it is beneficial to define the measurement window based on configured CSI-RS resources, and it should be based on the earliest resource among all cells. The first resource in the serving cell may not be the earliest resource, and if it is used to define the window start, it means some other from serving or neighbor cell with smaller offset will be always out of the window. |
| Docomo | Support option 1. |

### Sub-topic 1-4 UE behavior when the timing offset exceeds the threshold

* Proposals
  + Option 1: (Nokia)
    - In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold.
* Recommended WF
  + *Need more discussion*

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| Sub-topic 1-4 UE behavior when the timing offset exceeds the threshold | |
| **Company** | **Comments** |
| Qualcomm | We feel it is up to the UE implementation and there can be other options. For examples, UE may not report. Or, NW may not use. |
| MTK | Fine with Option 1, but this should be limited to intra-frequency case with serving cell and neighboring cell CSI-RS aligned in the same OFDM symbol. |
| CATT | We would like to understand more what difference this definition will bring on the UE or gNB behavior. |
| vivo | Though the intension is understandable, it needs further study what the best solution is. One issue of option 1 is that UE may never perform CSI-RS based measurement due to large timing offset between serving cell and neighbor cells for intra frequency measurement, especially in Heterogenous network. The reason is unknown to network if there are no reported measurement results, e.g., due to event condition is not met, or due to large timing offset. This may highly degrade UE mobility performance. |
| Intel | It may depend on the UE implementation. If single FFT is applied, it’s fine that UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold. For UE capable of multiple FFT windows, they can also measure CSI-RS. |
| OPPO | In our understanding, to be clarified, the UE is not required to meet the performance requirements of measure the CSI-RS resource if the timing difference exceeds a threshold. But whether and how UE measures and reports is up to UE implementation. |
| Nokia | We prefer Option1.  As the network is not aware of the timing difference, it is not able to identify if the received measurement report fulfills the requirements. If there is no restriction to the UE behavior, we wonder how the network can use the measurement reports and the how much the CSI-RS based measurement can practically help the network decision.  To MTK: Agree this should be appliable at least for intra-frequency case. But for inter-frequency measurements, if single FFT is still applied, is it also possible that the timing offset exceeds the threshold?  To Intel: Yes. If the UE is capable of multiple FFT windows, we understood there is no timing offset issue hence the UE can measure as normal. |
| Xiaomi | It is better to clarify that there is no RRM requirements if the timing difference is larger than the threshold, as we think whether to perform the measurement on CSI-RS resource is up to UE capability. |
| apple | Ok with the option 1. For UE who can handle CSI-RS measurements exceeding the threshold, the related performance is not specified. |
| Huawei | We have some comment as OPPO. The timing offset is already defined as the side condition of accuracy requirements, and we think it may be sufficient from spec point of view. |

### Sub-topic 1-5 Time validity of the detected associatedSSB

* Proposals
  + Option 1: (Huawei)
    - Adding the definition of detected associatedSSB in 9.10.2.5 section: The associatedSSB is detected if it has been meeting the relevant cell identification requirement during the last 5 seconds.
* Recommended WF
  + *Need more discussion*

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| Sub-topic 1-5 Time validity of the detected associatedSSB | |
| **Company** | **Comments** |
| Qualcomm | Option1 is agreeable. |
| MTK | Ok with Option 1 |
| CATT | Fine with option 1. |
| Vivo | Option 1 is fine. |
| Intel | Option 1 is OK.. |
| OPPO | Option 1 is fine. |
| Nokia | The problem is somehow understandable, but does it depend on if the UE keeps monitoring associatedSSB after it has been detected? We are expecting more clarification on the UE behavior assumption before agreeing on the proposal. |
| Xiaomi | Option 1 is fine. |
| apple | Option 1 is OK |
| Huawei | To Nokia’s question, in our understanding UE will keep monitoring associatedSSB after it has been detected. We discussed that if the associated SSB is configured but not detected by the UE, the UE is not required to monitor the corresponding CSI-RS resource.  Our CR aims to define the time validity of detected *associatedSSB*. Without the clarification, if the associatedSSB is detected a long time ago, the coarse timing information acquired by PSS/SSS detection will be invalid. Then UE needs to perform cell detection again. |

## Companies views’ collection for 1st round

### Open issues

**1.3.1.1 Media summary in 1st round**

**Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band**

***Moderator: proponents of option 2a are encouraged to provide more informations why the symbol before the consecutive CSI-RS symbols cannot be scheduled.***

* Proposals
  + Option 2a:
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols.
  + Option 3:
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols, and on 1 OFDM symbol after the consecutive CSI-RS symbols

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| **Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band** | |
| **Company** | **Comments** |
| MTK | In our understanding, the additional restricted symbol before the CSI-RS symbol is just kind of margin to accommodate the fact that network has no idea about the absolute timing difference between UE’s DL and UL symbol offset. |
| Nokia | We prefer Option 2a.  As for 1 OFDM symbol before and after the CSI-RS resource, we share MTK’s understanding. |
| Qualcomm | For option3, technically the UL symbol before the configured CSI-RS symbol doesnot need to be restricted as the UL to DL transition is assured by NTA\_OFFSET when target symbol measurement timing is the serving DL timing. But we are fine with option2a if infra vendors wish to reserve the symbol before the CSI-RS symbol for accommodating potential TA error across UEs in the UL (gNB DL). |

**Sub-topic 1-2 Time domain restriction for CSI-RS configuration**

* + Agreements in GTW:
    - On CSI-RS resources in the same MO with different offset
      * Option 1: Rel-16 L3 CSI-RS requirements are defined under assumption that all CSI-RS resources in the same MO are configured in the same 5ms window
        + Note: It is up to the network whether to configure all CSI-RS in the 5ms window and if CSI-RS resources are configured outside then UE may not measure it and the requirements do not apply.
      * Option 2: Keep the current specification unchanged
      * Option 3: All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.

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| **Sub-topic 1-2 Time domain restriction for CSI-RS configuration** | |
| **Company** | **Comments** |
| MTK | Support Option 1 or 2.  We want to highlight that in current CSSF outside gap requirement, we assume that all CSI-RS resources in the same frequency layers share the same overlapping status w.r.t. measurement gap, i.e., from “9.1.5.1 Monitoring of multiple layers outside gaps”   |  | | --- | | - CSI-RS based intra-frequency measurement in clause xxx, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap.  - CSI-RS based intra-frequency measurement in clause xxx, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap | |
| Nokia | We support Option2 but can compromise to Option 3 to move forward.  To MTK, we would assume for intra-frequency measurement, network would not configure any of the 5ms windows within gap, then the conditions above can still apply? We could focus on intra-frequency measurements and compromise to Option 3. |
| Qualcomm | Option1 can be supported. In this option, NW can split the resources in two windows, so it is possible to configure UE with resources in one window at a time. Should NW need UE to measure alternative window, a RRC reconfiguration to provide the resources for a 2nd window can be issued for UE to measure. We further suggest option1 apply to the intra-frequency resource only as that is the major concern. |

**Sub-topic 1-3 Starting point of 5ms time window**

* Proposals
  + Option 1:
    - No need to define the starting point of the 5ms time window
  + Option 2a:
    - For CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the slot boundary of the serving cell, where the corresponding slot contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.
  + Option 3:
    - Define the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer

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| **Sub-topic 1-3 Starting point of 5ms time window** | |
| **Company** | **Comments** |
| MTK | According to current spec, it is already completely up to UE implementation. In that case, Option 1 is our first preference. Option 2a is an acceptable compromise to us.  Option 3 is not feasible because the frame timing between serving and neighboring cell may not be aligned |
| Nokia | We prefer Option 1.  We would highlight again such 5ms window is not a SMTC-like measurement window, which was concluded to be out of Rel16 scope. This 5ms window is a restriction to network configuration. The network is supposed to configure the CSI-RS resources within 5ms, which may start from the first CSI-RS resource, but nothing need to be clarified at the UE side. |
| Qualcomm | We can compromise to option2a. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2104734 (CATT) | MTK: Section 9.10.2.5 was already modified by agreed CR R4-2103633. On top of 3633, we are not sure if the additional change “Note: TSSB\_time\_index\_intra is not defined for FR2 in 9.2.5.1.” is needed.  2nd comment: thanks CATT for the clarification. We understand better the issue now. Then do we also need to consider FR1 TDD? Perhaps we can revise Note: TSSB\_time\_index\_intra in 9.2.5.1 is not applicable to FR1 TDD and FR2 |
| CATT: In R4-2103633, the time for acquiring the SFN information in FR2 is still referred to TSSB\_time\_index\_intra in section 9.2.5.1 and 9.2.6.2. But actually TSSB\_time\_index\_intra for FR2is not defined in 9.2.5.1 and 9.2.6.2. Our intention is to clarify this situation. |
| vivo: Deletion in change 1 is not clear to us.  The change 2 on TDD scheduling restriction should be based on agreements in this meeting. |
| Nokia:   * Scheduling restriction depends on the conclusion of Sub-topic 1-1. * For the note, in 9.2.5.1, it says “It is assumed that deriveSSB-IndexFromCell is always enabled for FR1 TDD and FR2.”, which means TSSB\_time\_index\_intra is not applicable to FR2. Hence we would suggest following change:   Note: TSSB\_time\_index\_intra is not ~~defined~~ applicable for FR2 in 9.2.5.1. |
| R4-2106620 (vivo) | CATT：pending on the conclusion of the discussions above and the change in 9.10.2.6 is overlapped with R4-2104734 and R4-2106927 |
| Nokia: It depends on the conclusion of Sub-topic 1-1, 1-2,1-3. |
|  |
| R4-2106927 (Huawei) | CATT：pending on the conclusion of the discussion above and is overlapped with R4-2104734 |
| vivo: The change on TDD scheduling restriction should be based on agreements in this meeting. |
| Nokia: It depends on the conclusion of Sub-topic 1-1. |
| R4-2106928 (Huawei) | MTK: pending on conclusion in open issue discussion. |
| vivo: The change 1 The change 1 should be based on agreements in this meeting. |
| Nokia: It depends on the conclusion of Sub-topic 1-2 and 1-5. |
| R4-2106929 (Huawei) |  |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
| **Sub-topic 1-1** | Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band  *Tentative agreements: None*  *Candidate options:*   * Option 2a:   + When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols. * Option 3:   + When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols, and on 1 OFDM symbol after the consecutive CSI-RS symbols   *Recommendations for 2nd round: Further discuss whether option 2a can be agreeable.* |
| **Sub-topic 1-2** | Sub-topic 1-2 Time domain restriction for CSI-RS configuration  *Tentative agreements:*   * Agreements in GTW:   + On CSI-RS resources in the same MO with different offset     - Option 1: Rel-16 L3 CSI-RS requirements are defined under assumption that all CSI-RS resources in the same MO are configured in the same 5ms window       * Note: It is up to the network whether to configure all CSI-RS in the 5ms window and if CSI-RS resources are configured outside then UE may not measure it and the requirements do not apply.     - Option 2: Keep the current specification unchanged     - Option 3: All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.   *Candidate options:*   * + On CSI-RS resources in the same MO with different offset     - Option 1: Rel-16 L3 CSI-RS requirements are defined under assumption that all CSI-RS resources in the same MO are configured in the same 5ms window       * Note: It is up to the network whether to configure all CSI-RS in the 5ms window and if CSI-RS resources are configured outside then UE may not measure it and the requirements do not apply.     - Option 2: Keep the current specification unchanged     - Option 3: All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.   *Recommendations for 2nd round: Need further discussion.* |
| **Sub-topic 1-3** | Sub-topic 1-3 Starting point of 5ms time window  *Tentative agreements: None*  *Candidate options:*   * Option 1:   + No need to define the starting point of the 5ms time window * Option 2a:   + For CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the slot boundary of the serving cell, where the corresponding slot contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO. * Option 3:   + Define the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer   *Recommendations for 2nd round: Need further discussion.* |
| **Sub-topic 1-4** | Sub-topic 1-4 UE behavior when the timing offset exceeds the threshold  *Tentative agreements: None*  *Candidate options:*   * Option 1:   + In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold. * Option 2:   + No need to define this UE behaviour. It is up to UE implementation   *Recommendations for 2nd round: Need further discussion.* |
| **Sub-topic 1-5** | Sub-topic 1-5 Time validity of the detected associatedSSB  *Tentative agreements: None*  *Candidate options:*   * Option 1:   + Adding the definition of detected associatedSSB in 9.10.2.5 section: The associatedSSB is detected if it has been meeting the relevant cell identification requirement during the last 5 seconds.   *Recommendations for 2nd round: Further discuss based on the CR review.* |

### CRs/TPs

## Discussion on 2nd round (if applicable)

**Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band**

***Moderator: Proponents of option 2a are encouraged to provide more informations why the symbol before the consecutive CSI-RS symbols cannot be scheduled. Proponents of option 3 are encouraged to check whether the already provided clarification can be acceptable.***

* Proposals
  + Option 2a:
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on configured CSI-RS resource symbols, and on 1 OFDM symbol before and after each consecutively configured CSI-RS symbols.
  + Option 3:
    - When UE performs CSI-RS intra-frequency measurements in a TDD band, UE is not expected to transmit PUCCH/PUSCH/SRS on CSI-RS resource symbols, and on 1 OFDM symbol after the consecutive CSI-RS symbols

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| **Sub-topic 1-1 Scheduling restriction for intra-f CSI-RS measurement in TDD band** | |
| **Company** | **Comments** |
| MTK | In our understanding, the additional restricted symbol before the CSI-RS symbol is just kind of margin to accommodate the fact that network has no idea about the absolute timing difference between UE’s DL and UL symbol offset. |
| Nokia | We prefer Option 2a.  As for 1 OFDM symbol before and after the CSI-RS resource, we share MTK’s understanding. |
| Qualcomm | For option3, technically the UL symbol before the configured CSI-RS symbol doesnot need to be restricted as the UL to DL transition is assured by NTA\_OFFSET when target symbol measurement timing is the serving DL timing. But we are fine with option2a if infra vendors wish to reserve the symbol before the CSI-RS symbol for accommodating potential TA error across UEs in the UL (gNB DL). |
| Xiaomi | Support option 2a |
| CATT | Support option 2a. |
| vivo | Fully agree with Qualcomm. Scheduling restriction on the symbol before is not necessary considering single FFT assumption. However, we are also fine with option 2a if operators have no concern.  To MTK, as we depicted in the 1st round comment, there is no issue for UE to transmit in the symbol before no matter how much of the DL and UL timing offset. |
| Huawei | Technically the symbol before the configured to-be-measured CSI-RS is not impacted as NTA+NTA-offset is always positive. So the proposal is in theory correct.  The fact is that the similar story happens in legacy TDD band scheduling restriction requirements where both before and after symbols are avoided from network side. From Network side, it is better to use the same principle.  Therefore we prefer option 2a. |
| OPPO | Support option 2a to follow the way for legacy TDD band scheduling restriction. |

**Sub-topic 1-2 Time domain restriction for CSI-RS configuration**

* + Agreements in GTW:
    - On CSI-RS resources in the same MO with different offset
      * Option 1: Rel-16 L3 CSI-RS requirements are defined under assumption that all CSI-RS resources in the same MO are configured in the same 5ms window
        + Note: It is up to the network whether to configure all CSI-RS in the 5ms window and if CSI-RS resources are configured outside then UE may not measure it and the requirements do not apply.
      * Option 2: Keep the current specification unchanged
      * Option 3: All CSI-RS resources in the same MO are configured in the same 5ms window for inter frequency measurement, and measurement requirements should allow all CSI-RS resources in the same MO are configured in two separated 5ms windows during one CSI-RS resource period for intra frequency measurement.

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| **Sub-topic 1-2 Time domain restriction for CSI-RS configuration** | |
| **Company** | **Comments** |
| MTK | Support Option 1 or 2.  We want to highlight that in current CSSF outside gap requirement, we assume that all CSI-RS resources in the same frequency layers share the same overlapping status w.r.t. measurement gap, i.e., from “9.1.5.1 Monitoring of multiple layers outside gaps”   |  | | --- | | - CSI-RS based intra-frequency measurement in clause xxx, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the measurement gap.  - CSI-RS based intra-frequency measurement in clause xxx, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the measurement gap | |
| Nokia | We support Option2 but can compromise to Option 3 to move forward.  To MTK, we would assume for intra-frequency measurement, network would not configure any of the 5ms windows within gap, then the conditions above can still apply? We could focus on intra-frequency measurements and compromise to Option 3. |
| Qualcomm | Option1 can be supported. In this option, NW can split the resources in two windows, so it is possible to configure UE with resources in one window at a time. Should NW need UE to measure alternative window, a RRC reconfiguration to provide the resources for a 2nd window can be issued for UE to measure. We further suggest option1 apply to the intra-frequency resource only as that is the major concern. |
| Xiaomi | Support option 1. Similar view as QC, the UE measurement behavior is confused if multiple resources windows are introduced. |
| Intel | Support option 1. It’s confusing to use multiple windows for UE. On the other hand, even if no gap is configured, it’s possible that some CSI-RS in another window will collide with some other measurement, RLM, L1-RSRP. It will be more complex for scheduling restriction. |
| CATT | Fine with option 2 or option 3.  To Intel, the collision between L3 CSI-RS measurement and L1 measurement is not considered in R16. |
| vivo | Support option 2 and 1. Our understanding of option 1 is that it is almost the same as option 2 except that some clarification may be needed. |
| Huawei | We support option 3.  To address MTK’s concern, we can add another condition that the overlapping status with MG is same the two windows, so the two bullets in CSSF requirements can be met.  To QC, what you suggested is possible, but it may lead to frequent RRC reconfiguration, which is undesirable to both UE and NW considering the signaling overhead.  To Intel, not sure if we need to consider the overlapping with L1 measurement, since RAN4 has agreed to not define requirements for the case where L3 CSI-RS is colliding with SSB/CSI-RS for L1 measurement. |
| OPPO | Support option 1. We can compromise to option 2. It should apply for both intra and inter frequency measurement. |

**Sub-topic 1-3 Starting point of 5ms time window**

* Proposals
  + Option 1:
    - No need to define the starting point of the 5ms time window
  + Option 2a:
    - For CSI-RS based L3 intra-frequency measurement, the starting point of the 5ms window is the slot boundary of the serving cell, where the corresponding slot contains the first configured L3 CSI-RS resource of the serving cell in the intra-frequency MO.
  + Option 3:
    - Define the starting point of 5-ms window as the slot boundary of the resource with smallest offset for a CSI-RS frequency layer

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| **Sub-topic 1-3 Starting point of 5ms time window** | |
| **Company** | **Comments** |
| MTK | According to current spec, it is already completely up to UE implementation. In that case, Option 1 is our first preference. Option 2a is an acceptable compromise to us.  Option 3 is not feasible because the frame timing between serving and neighboring cell may not be aligned |
| Nokia | We prefer Option 1.  We would highlight again such 5ms window is not a SMTC-like measurement window, which was concluded to be out of Rel16 scope. This 5ms window is a restriction to network configuration. The network is supposed to configure the CSI-RS resources within 5ms, which may start from the first CSI-RS resource, but nothing needs to be clarified at the UE side. |
| Qualcomm | We can compromise to option2a. |
| Xiaomi | Option 2a is fine |
| Intel | Can compromise to option 2a. |
| CATT | Support option 1.  Share the same view with Nokia that this window is the network configuration restriction and there is no need to be clarified at UE side. |
| Vivo | Option 2a is fine for us. |
| Huawei | Support option 3.  Option 1 means the start of the measurement window can change dynamically, which is conflicting with the intention to introduce the condition on the 5ms window.  Option 2a can be considered, but it also relies on NW sync same as option 3. In addition, it means NW has to make sure the “first configured” resource is the same slot in all intra-frequency cells, as otherwise some resources from neighbor cell cannot be measured. Also, we would like to clarify – is the “first configured” resource the one configured “with smallest offset”? |
| OPPO | Option 2a. |

**Sub-topic 1-4 UE behavior when the timing offset exceeds the threshold**

* Option 1:
  + In Rel16, the UE is not required to measure the CSI-RS resource if the timing difference exceeds a threshold.
* Option 2:
  + No need to define this UE behaviour. It is up to UE implementation.

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| **Sub-topic 1-4 UE behavior when the timing offset exceeds the threshold** | |
| **Company** | **Comments** |
| Nokia | We would like to provide more responses to the comments in 1st round:   1. UE implementation matter. We understood measurement has never been implementation matter since UE needs to follow NW configuration. Now with the timing offset, there is risk NW may receive bad reports hence we are expecting network can always receive the qualified measurement results to avoid mis-behavior. And from UE side, why does UE still measure/report if it already knows the result is unusable? 2. Impact to UE/gNB behaviour: With this restriction, there is no impact to gNB. gNB can always trust the received measurement result. And for UE, probably the UE needs stop reporting when it detects timing offset exceeding the threshold. 3. UE capability: Probably this could be another option. But given current Rel16 timeline, is it still possible to define such capability? 4. Without the UE behaviour, the applicability condition does not take effect, as network does not know at all if the condition is fulfilled. If there is risk to receive very bad reports, network is unlikely to use it otherwise it may harm the whole system performance. |
| CATT | We understand the intention now and fine with option 1. But we are wondering even if we have this UE behavior, whether the measurement and report when timing difference exceeds the threshold is still up to UE implementation? |
| Huawei | In our understanding, the timing offset condition is similar as Es/Iot condition, and we do not have such clarification for Es/Iot. If side conditions for accuracy requirements are not met for a resource, it should be up to UE implementation whether to measure or not, so would it be sufficient to define the timing offset as the side condition of accuracy requirements? |

# Topic #2: CSI-RS RRM performance requirements

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104577 | MediaTek Inc. | **Proposal 1: Specify CSI-RSRP accuracy requirement with the absolute timing offset between UE’s FFT window and the target CSI-RS no larger than CP.** |
| R4-2104578 | MediaTek Inc. | **Proposal 1: Specify CSI-SINR accuracy requirement based on one of the following 2 options on timing offset (TΔ) and Es/Iot side condition**   * **Option 1: |TΔ |≤ CP/2 with Es/Iot ≤ 25dB** * **Option 2: |TΔ |≤ CP with Es/Iot ≤ 0 dB** |
| R4-2104735 | CATT | **Observation 1: The measurement accuracy for the timing offset CP and –CP has some small difference, but there is no significant performance gap between them.**  **Proposal 1: Specify CSI-RSRP measurement accuracy requirement when the timing offset between target CSI-RS and reference timing is smaller than or equal to CP.** |
| R4-2104736 | CATT | **Observation 1: The measurement accuracy for the timing offset CP and –CP has some small difference, but there is no significant performance gap between the results.**  **Proposal 1: Specify CSI-SINR measurement accuracy requirement when the timing offset between target CSI-RS and reference timing is smaller than or equal to CP, together with the side condition Es/Iot ≤ 15dB.** |
| R4-2104737 | CATT | **Draft CR for CSI-RSRP** |
| R4-2104738 | CATT | **Draft CR for CSI-RSRQ** |
| R4-2104739 | CATT | **Draft CR for CSI-SINR** |
| R4-2104937 | CMCC | **Simulation results for CSI-RSRP** |
| R4-2104938 | CMCC | **Simulation results for CSI-RSRQ** |
| R4-2104940 | CMCC | **Proposal 1: for CSI-RSRP, the upper bound of timing offset is proposed to be CP.** |
| R4-2104941 | CMCC | **Proposal 1: for CSI-RSRQ, the upper bound of timing offset is proposed to be CP.** |
| R4-2104942 | CMCC | **Proposal 1: for the specification of CSI-SINR measurement accuracy requirements, both Es/Iot ≤ [10] dB with timing offset within CP and Es/Iot ≤ [18] dB with timing offset within CP/2 are applied. For the test case, we can choose only one timing offset to design the test case.** |
| R4-2106411 | Nokia, Nokia Shanghai Bell | **Proposal1: The CSI-RS based measurement performance shall be defined when the timing offset is within one CP length.** |
| R4-2106412 | Nokia, Nokia Shanghai Bell | **Draft CR for CSI-RSRP** |
| R4-2106459 | Intel Corporation | **Proposal 1: All CSI-RS resources in the same MO are configured in the same 5ms window.**  **Proposal 2: It’s better that NW can order these timing offset of CSI-RS resources and make sure that the first configured L3 CSI-RS resource corresponding to the smallest offset.**  **Proposal 3: For CSI-RSRP, the upper bound of timing offset for case 1 is 1CP.** |
| R4-2106526 | OPPO | **Observation 1: The absolute measurement error of CSI-RS RSRP with negative timing offset is worse than that of CSI-RS RSRP with positive timing offset.**  **Observation 2: The absolute measurement error of CSI-RS RSRP can be within ±2.0dB for timing offset within [-0.5\*CP, +0.5\*CP], and ±3.0dB for timing offset within [-CP, +CP].**  **Observation 3: The relative measurement error of CSI-RS RSRP can be within ±1.5dB for timing offset within [-0.5\*CP, +0.5\*CP], and ±2.0dB for timing offset within [-CP, +CP].** |
| R4-2106527 | OPPO | **Observation 1: The absolute measurement error of CSI-RS RSRQ with negative timing offset is worse than that of CSI-RS RSRQ with positive timing offset.**  **Observation 2: The absolute measurement error of CSI-RS RSRQ can be within ±2.0dB for timing offset within [-0.5\*CP, +0.5\*CP], and ±3.0dB for timing offset within [-CP, +CP].**  **Observation 3: The relative measurement error of CSI-RS RSRQ can be within ±1.5dB for timing offset within [-0.5\*CP, +0.5\*CP], and ±2.0dB for timing offset within [-CP, +CP].** |
| R4-2106528 | OPPO | **Observation 1: The absolute accuracy performance of CSI-RS SINR can be found:**   * **For AWGN channel at FR1, ±4.0dB for timing offset within [-CP, +CP]** * **For TDL-A channel at FR2 ±6.0dB for timing offset within [-CP, +CP].**   **Observation 2: The relative accuracy performance of CSI-RS SINR can be found:**   * **For AWGN channel at FR1, ±2.0dB for timing offset within [-CP, +CP]** * **For TDL-A channel at FR2 ±5.50dB for timing offset within [-CP, +CP].**   **Observation 3: The absolute accuracy performance of CSI-RS SINR with negative timing offset is worse than that of CSI-RS SINR with positive timing offset.**  **Proposal 1: To ensure the absolute and relative accuracy performance of CSI-RS SINR can be reused as those of SSB’s, the upper bound of timing offset can be set within 0.9 CP.**  **Proposal 2: Option 3 as compromise for the upper limit of Es/Iot for CSI-SINR measurement with timing offset(T△):**   * **Option 3: Es/Iot ≤ [12] dB for the case that timing offset is within 0.9\*CP.** |
| R4-2106615 | vivo | **Proposal 1: The CSI-RSRP/CSI-RSRQ/CSI-SINR accuracy requirements are applicable when timing offset is within CP.** |
| R4-2106616 | vivo | *Observation 1.* If timining delay between two cells is smaller than CP, the absolute accuary of CSI-RSRP measurement with 5 samples is within ±2 dB in both FR1 and FR2.  *Observation 2.* The CSI-RSRP accuracy is comparable between timing offset of CP and 0.9CP.  *Observation 3.* The CSI-RSRP accuracy is comparable between corresponding positive timing offset and negative timing offset. |
| R4-2106617 | vivo | *Observation 1.* If timining delay between two cells is smaller than CP, the absolute accuary of CSI-RSRQ measurement with 5 samples is within ±2 dB in both FR1 and FR2.  *Observation 2.* The CSI-RSRQ accuracy is comparable between timing offset of CP and 0.9CP.  *Observation 3.* The CSI-RSRQ accuracy is comparable between corresponding positive timing offset and negative timing offset. |
| R4-2106618 | vivo | *Observation 1.* If timining delay between two cells is smaller than CP, the absolute accuary of CSI-SINR measurement with 5 samples is within ±2 dB in both FR1 and FR2.  *Observation 2.* The CSI-SINR accuracy is comparable between timing offset of CP and 0.9CP.  *Observation 3.* The CSI-SINR accuracy is comparable between corresponding positive timing offset and negative timing offset. |
| R4-2106619 | vivo | **Proposal 1a: The upper limit of Ês/Iot for CSI-SINR accuracy can be set as 15dB under the condition of timing offset is within CP/2.**  **Proposal 1b: The upper limit of Ês/Iot for CSI-SINR accuracy can be set as 25dB under the condition of timing offset is within CP/2 and for AWGN channel only.** |
| R4-2107023 | Huawei, HiSilicon | **Proposal: For CSI-RSRP and CSI-RSRQ the upper bound of timing offset for case 1 is 1\*CP.** |
| R4-2107024 | Huawei, HiSilicon | **Proposal: Define the CSI-SINR accuracy based on timing offset condition 0.9\*CP and the upper bound Es/Iot 6dB.** |
| R4-2107025 | Huawei, HiSilicon | **Draft CR for CSI-SINR** |
| R4-2107214 | Qualcomm CDMA Technologies | **Observation1: trivial degradation of the measurement error for 1CP relative to 0.9CP.**  **Observation2: simulated accuracy is the baseband accuracy only.**  **Proposal1: Same accuracy requirements as SSB based measurements can be resused for CSI-RSRP.**  **Proposal1.1: Cell timing offset of 1CP or 0.9 CP can be supported as the side condition.** |
| R4-2107215 | Qualcomm CDMA Technologies | **Es/Iot≤20dB with certain margin.**  **Proposal1: Support to reuse the accuracy requirements of SS-SINR measurement with the side condition of Es/Iot ≤ [18] dB for the case that timing offset is within CP/2** |

## Open issues summary

### Sub-topic 2-1 CSI-RSRP measurement accuracy requirements

**Issue 2-1: Timing offset for specifying CSI-RSRP measurement accuracy requirements**

* Proposals
  + Option 1: (MTK, CATT, CMCC, Nokia, Intel, vivo, Huawei, Qualcomm)
    - Specify CSI-RSRP accuracy requirement with the absolute timing offset between the reference measurement timing and the target CSI-RS in one layer no larger than CP
* Recommended WF
  + *Agree on option 1.*

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| Sub-topic 2-1 Timing offset for specifying CSI-RSRP measurement accuracy requirements | |
| **Company** | **Comments** |
| Qualcomm | Option1 is supported |
| MTK | Support Option 1 |
| CATT | Support the recommended WF. |
| Intel | Agree with recommended WF. |
| OPPO | Option 1 is fine. |
| Nokia | We support the recommended WF. |
| CMCC | Support the recommended WF. |
| Xiaomi | Support the recommended WF. |
| apple | With single FFT assumption, I think we should assume all CSI-RS arrives within a window with length of CP. If so, option 1 is not accurate enough. |
| Huawei | Support the recommended WF. |
| Docomo | Support the recommended WF. |

### Sub-topic 2-2 CSI-RSRQ measurement accuracy requirements

**Issue 2-2: Timing offset for specifying CSI-RSRQ measurement accuracy requirements**

* Proposals
  + Option 1: (CMCC, vivo, Huawei)
    - Specify CSI-RSRQ accuracy requirement with the absolute timing offset between the reference measurement timing and the target CSI-RS in one layer no larger than CP
* Recommended WF
  + *Agree on option 1.*

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| Sub-topic 2-2 CSI-RSRQ measurement accuracy requirements | |
| **Company** | **Comments** |
| Qualcomm | Option1 is supported |
| MTK | Support Option 1 |
| CATT | Support the recommended WF. |
| OPPO | Option 1 is fine. |
| Nokia | We support the recommended WF. |
| CMCC | Support the recommended WF. |
| Xiaomi | Support the recommended WF. |
| apple | Same comments as issue 2-1 |
| Huawei | Support the recommended WF. |

### Sub-topic 2-3 CSI-SINR measurement accuracy requirements

**Issue 2-3: Timing offset and upper limit of side condition for specifying CSI-SINR measurement accuracy requirements**

* Proposals
  + Specify CSI-SINR accuracy requirement based on one of the following options on timing offset between the reference measurement timing and the target CSI-RS (TΔ) and Es/Iot side condition
    - When |TΔ |≤ CP/2
      * Option 1: (MTK, vivo)
        + Es/Iot ≤ 25 dB for AWGN only
      * Option 2: (Qualcomm)
        + Es/Iot ≤ [18]dB
    - When |TΔ |≤ CP
      * Option 3: (MTK)
        + Es/Iot ≤ 0 dB
      * Option 4: (CATT)
        + Es/Iot ≤ 15 dB
    - When |TΔ |≤ 0.9\*CP
      * Option 5: (OPPO)
        + Es/Iot ≤ [12] dB
      * Option 6: (Huawei)
        + Es/Iot ≤ 6dB
    - Option 7: (CMCC)
      * Both |TΔ |≤ CP with Es/Iot ≤ [10] dB and |TΔ |≤ CP/2 with Es/Iot ≤ [18] dB are applied. But choose one to design the test cases.
* Recommended WF
  + *Need more discussion.*

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| Sub-topic 2-3 CSI-SINR measurement accuracy requirements | |
| **Company** | **Comments** |
| Qualcomm | Option2 is supported.  Option1 is also agreeable to us for AWGN only.  We also notice some options were not in line with the recommended WF.. for example, we are open to discuss option6 if companies are open for including 0.9CP. |
| MTK | Support Option 1 and Option 2.  To us, it is fine to slightly limit the timing offset in order to achieve good measurement accuracy in higher Es/Iot region. |
| CATT | Fine with option 2 or option 7. It is not preferred to open more discussion on the value of timing offset based on the conclusion in last meeting. |
| Vivo | We also have another proposal in our paper that |TΔ |≤ CP/2 , the upper bound can be Es/Iot ≤ [15] for all propagation channels.  If timing offset |TΔ |≤ CP is used, then Es/Iot ≤ 12dB. |
| OPPO | Option 2 and 5 are fine to us. We can also compromise to Es/Iot ≤ [12] dB when |TΔ |≤ CP. |
| CMCC | We suggest that the CSI-SINR accuracy requirements are applied to both CP and CP/2, and only choose one to design the test case. The reason is that if only CP is adopted, the applied side condition is very low, which may not satisfy the demand in real network; if only CP/2 is adopted, although the applied side condition is higher, but the timing offset is CP/2, which may limit the applied scenario. Taking above consideration into account, it is proposed that both side conditions are adopted for the CSI-SINR measurement accuracy. But for the test case design, in order to reduce the number of test cases, we can choose only one timing offset. |
| apple | Option 2 is OK. It is suggested to only define a single requirement. |
| Huawei | Based on the GTW discussion, we can support to define two sets of side conditions (CP/2 and CP).  For CP/2, we suggest to define the upper limit as 15dB and applicable for all channels.  For CP, we suggest to further study the upper limit because 10dB as proposed in option 7 is not achievable based on our simulation. |

## Companies views’ collection for 1st round

### Open issues

**2.3.1.1 Media summary in 1st round**

**Sub-topic 2-3 CSI-SINR measurement accuracy requirements**

* + Agreements in GTW:
    - Specify CSI-SINR accuracy requirement based on one of the following options on timing offset between the reference measurement timing and the target CSI-RS (TΔ) and Es/Iot side condition(s)
      * Side condition #1:
        + |TΔ|≤ CP/2
        + Es/IoT

Option A: Es/Iot ≤ 18 dB

Option C: Es/Iot ≤ 15 dB

* + - * FFS: Side condition #2
        + |TΔ|≤ CP
        + No dedicated test cases will be introduced for Side condition #2 if introduced
        + Side condition #2 is subject to decision in RAN4 #98-bis-e

*Moderator: Based on the agreement in GTW, companies are encouraged to provide views on the value of Es/Iot. It is noted that multiple side conditions are also existed in other RRM requirement.*

* Proposals
  + Side condition #1:
    - |TΔ|≤ CP/2
    - Es/IoT
      * Option A: Es/Iot ≤ 18 dB
      * Option C: Es/Iot ≤ 15 dB
  + FFS: Side condition #2
    - |TΔ|≤ CP
      * Option 2A: Es/Iot ≤ 10 dB
      * Option 2B: Es/Iot ≤ 6 dB
      * Option 2C: Es/Iot ≤ 0 dB

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| **Sub-topic 2-3 CSI-SINR measurement accuracy requirements** | |
| **Company** | **Comments** |
| MTK | On side condition #1, either one is fine to us.  On side condition #2, our first preference is not to define this separate side condition for timing offset. If there is a group consensus to introduce the 2nd side condition, our preference is Es/Iot ≤ 0dB. |
| Qualcomm | Option C for side condition #1;  Option 2B for side condition #2 **only under the AWGN channel.** |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
| R4-2104737 (CATT) | Nokia: We don’t think current 48PRB is wrong. This defines the condition where the accuracy is derived. We have same statement for CSI-RS based L1-RSRP measurement performance.  - The bandwidth of CSI-RS is 48 PRBs and the density is 3. |
| Company B |
|  |
| R4-2104738 (CATT) | Nokia: We have applied separate sub-chapter for CSI-RS based measurements. We think nothing is wrong in current version? |
| Company B |
|  |
| R4-2104739 (CATT) |  |
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| R4-2106412 (Nokia) | CATT：the clause number has been updated in the endorsed big CR R4-2101291. The draft CR should be based on the endorsed big CR according to the guideline. |
| Nokia: Thanks CATT for the comments. Will revise it in updated version. |
|  |
| R4-2107025 (Huawei) | MTK: pending on the conclusion in open issue. |
| vivo: the change is to be aligned with agreements in this meeting. |
| Nokia: Current way forward is CP instead of 0.9CP. |

## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
| **Sub-topic 2-1** | **Issue 2-1: Timing offset for specifying CSI-RSRP measurement accuracy requirements**  *Tentative agreements:*  Specify CSI-RSRP accuracy requirement with the absolute timing offset between the reference measurement timing and the target CSI-RS in one layer no larger than CP  *Candidate options: None*  *Recommendations for 2nd round: No more discussion.* |
| **Sub-topic 2-2** | **Issue 2-2: Timing offset for specifying CSI-RSRQ measurement accuracy requirements**  *Tentative agreements:*  Specify CSI-RSRQ accuracy requirement with the absolute timing offset between the reference measurement timing and the target CSI-RS in one layer no larger than CP.  *Candidate options: None*  *Recommendations for 2nd round: No more discussion.* |
| **Sub-topic 2-3** | **Issue 2-3: Timing offset and upper limit of side condition for specifying CSI-SINR measurement accuracy requirements**  *Tentative agreements:*   * Agreements in GTW:   + Specify CSI-SINR accuracy requirement based on one of the following options on timing offset between the reference measurement timing and the target CSI-RS (TΔ) and Es/Iot side condition(s)     - Side condition #1:       * |TΔ|≤ CP/2       * Es/IoT         + Option A: Es/Iot ≤ 18 dB         + Option C: Es/Iot ≤ 15 dB     - FFS: Side condition #2       * |TΔ|≤ CP       * No dedicated test cases will be introduced for Side condition #2 if introduced       * Side condition #2 is subject to decision in RAN4 #98-bis-e   *Candidate options:*   * Side condition #1:   + |TΔ|≤ CP/2   + Es/IoT     - Option A: Es/Iot ≤ 18 dB     - Option C: Es/Iot ≤ 15 dB * FFS: Side condition #2   + |TΔ|≤ CP     - Option 2A: Es/Iot ≤ 10 dB     - Option 2B: Es/Iot ≤ 6 dB     - Option 2C: Es/Iot ≤ 0 dB   *Recommendations for 2nd round: Further discuss and decide the value of Es/Iot.* |

### CRs/TPs

## Discussion on 2nd round (if applicable)

**Sub-topic 2-3 CSI-SINR measurement accuracy requirements**

* + Agreements in GTW:
    - Specify CSI-SINR accuracy requirement based on one of the following options on timing offset between the reference measurement timing and the target CSI-RS (TΔ) and Es/Iot side condition(s)
      * Side condition #1:
        + |TΔ|≤ CP/2
        + Es/IoT

Option A: Es/Iot ≤ 18 dB

Option C: Es/Iot ≤ 15 dB

* + - * FFS: Side condition #2
        + |TΔ|≤ CP
        + No dedicated test cases will be introduced for Side condition #2 if introduced
        + Side condition #2 is subject to decision in RAN4 #98-bis-e

*Moderator: Based on the agreement in GTW, companies are encouraged to provide views on the value of Es/Iot.*

* Proposals
  + Side condition #1:
    - |TΔ|≤ CP/2
    - Es/IoT
      * Option A: Es/Iot ≤ 18 dB
      * Option C: Es/Iot ≤ 15 dB
  + FFS: Side condition #2
    - |TΔ|≤ CP
      * Option 2A: Es/Iot ≤ 10 dB
      * Option 2B: Es/Iot ≤ 6 dB
      * Option 2C: Es/Iot ≤ 0 dB

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| --- | --- |
| **Sub-topic 2-3 CSI-SINR measurement accuracy requirements** | |
| **Company** | **Comments** |
| MTK | On side condition #1, either one is fine to us.  On side condition #2, our first preference is not to define this separate side condition for timing offset. If there is a group consensus to introduce the 2nd side condition, our preference is Es/Iot ≤ 0dB. |
| Qualcomm | Option C for side condition #1;  Option 2B for side condition #2 **only under the AWGN channel.** |
| CMCC | For side condition #1, our preference is option A. but since the accuracy is not applied to a specific propagation condition, and some companies’ simulation results show that the SS-SINR accuracy requirements cannot be met for CSI-SINR for the higher side condition, we can compromise to option C to move forward.  For side condition #2, we still think it is necessary to support it. We do not see the difficulty to support side condition #2, since we already agreed that SS-SINR accuracy requirements will be reused, which means that there is only one set of accuracy requirements, and both the two side conditions can be applied for the assumption of single FFT. As for the detail value of Es/Iot, our preference is option 2A, but we are open to have further discussion. |
| CATT | We are fine to define side condition 2. It is noted that multiple side conditions are also existed in other RRM requirements. It should be also applicable for CSI-RS measurement.  For side condition 1, we are fine with either option.  For side condition 2, we prefer option 2A, but considering the difference between the simulation results from companies, we can compromise to option 2B to move forward. |
| vivo | For side condition 1, support option C based on simulation results.  For side condition 2, we would like to propose it is applicable to lower bound Es/Iot (-6dB). Based on evaluations from companies there is no issue to specify SINR accuracy requirements under -6dB Es/Iot with timing offset < CP. Meanwhile the CSI-RSRP/CSI-RSRQ/CSI-SINR accuracy requirements are all specified for -6dB Es/Iot with timing offset < CP. |
| Huawei | For side condition #1, support option C.  We support to define requirements for side condition #2, but the upper bound needs to be further studied, or we can go with option 2C if we need to decide in this meeting. |
| OPPO | For side condition #1, support option C. |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on performance requirements of CSI-RS based L3 measurement | CATT,OPPO |  |
| WF on core part maintenance of CSI-RS based L3 measurement requirements | Apple |  |
| Draft Big CR: Introduction of Rel-16 CSI-RS based L3 measurement RRM performance requirements | CATT |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2104734 | draft CR on CSI-RS based L3 measurement | CATT | Revised |  |
| R4-2106620 | Draft CR to 38.133 Correction on core requirements for CSI-RS based measurement | vivo | Revised |  |
| R4-2106927 | CR on CSI-RS based intra-frequency scheduling restriction | Huawei | Merged |  |
| R4-2106928 | CR on CSI-RS measurement window and intra-frequency measurements | Huawei | Revised |  |
| R4-2106929 | Adding intra-frequency CSI-RS measurement in CSSF | Huawei | Agreeable |  |
| R4-2104737 | draft CR on performance requirement for CSI-RSRP | CATT | Revised |  |
| R4-2104738 | draft CR on performance requirement for CSI-RSRQ | CATT | Revised |  |
| R4-2104739 | draft CR on performance requirement for CSI-SINR | CATT | Agreeable |  |
| R4-2106412 | 38.133 draftCR on the CSI-RSRP accuracy requirements | Nokia | Revised |  |
| R4-2107025 | draftCR on CSI-SINR accuracy requirements | Huawei | Revised |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents