**3GPP TSG-RAN WG4 Meeting # 96-e R4-2012081**

**Electronic Meeting, 17 – 28 Aug., 2020**

**Agenda item:** 7.14.1.1 & 7.14.1.2 & 7.14.1.5

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [RAN4#96e][224] NR\_CSIRS\_L3meas\_RRM\_1

**Document for:** Information

# Introduction

The documents in agenda items 7.14.1.1 & 7.14.1.2 & 7.14.1.5 contain the following 2 main topics:

* Topic #1: CSI-RS measurement configuration
* Topic #2: Synchronization assumption for CSI-RS based L3 measurement.

# Topic #1: CSI-RS measurement configuration (AI 7.14.1.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2009747 | Intel Corporation | Proposal 1: Don’t define requirement for CSI-RS configuration with {D=1 with PRBs ≥ 96} |
| R4-2009760 | Xiaomi | Proposal 1: The CSI-RS based L3 measurement requirements are not applied to {D=1 with PRBs ≥ 96} in Rel-16. |
| R4-2009839 | CATT | Proposal 1: Leave the discussion on {D=1 with PRBs ≥ 96} to Rel-17. |
| R4-2010052 | Apple | Proposal: Do not introduce additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the requirements in Rel-16. |
| R4-2010385 | Nokia, Nokia Shanghai Bell | Observation#1: The accuracy performance under {D=1 with 96 PRBs} and {D=3 with 48 PRBs} are comparable irrespective of the SCS conditions.  Proposal1: It is proposed to define additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the CSI-RS based measurement requirement. |
| R4-2010576 | NTT DOCOMO, INC. | Proposal 1: Taking the flexibility of the configuration patterns of CSI-RS resources, it is preferable to introduce multiple requirements.  Proposal 2: Specify requirements for {D=1 with PRBs ≥ 96}. |
| R4-2010760 | NEC | Proposal 1: RAN4 to introduce measurement requirements for CSI-RS configuration {D=1 with PRBs≥96} at least when CSI-RS BW is contained in active BWP.  Proposal 2: RAN4 to introduce single measurement requirement for {D=3 with PRBs≥48} and {D=1 with PRBs≥96} |
| R4-2011065 | Huawei, HiSilicon | Proposal 1: For CSI-RS based L3 measurements, it is suggest not to define CSI-RS measurement requirements for additional CSI-RS configuration with D=1 and PRBs≥96.  Proposal 2: For CSI-RS based L3 mobility, the side condition of CSI-RS measurement requirements can be defined as CSI-RS Es/Iot≥-6dB.  Proposal 3: The CSI-RS L3 measurement period requirements can be defined based on 5 available measurement samples, and the existing SSB L3 measurement period requirements can be used to derive the CSI-RS L3 measurement period requirements.  Proposal 4: For DRX cycle≤320ms, it is suggested not to introduce the sharing factor 1.5 for CSI-RS L3 measurement period requirements.  Proposal 5: It is suggested not to introduce the sharing factor Klayer1\_measurement for CSI-RS L3 measurement period requirements. |
| R4-2011314 | ZTE | Proposal 1: Define one set of requirements for both the cases of 48 PRBs with density 3 and 96 PRBs with density 1. |
| R4-2011338 | Qualcomm CDMA Technologies | Proposal1: Rel-16 doesnot introduce the CSI-RS configuration of {D=1 with PRBs ≥ 96}, or the topic can be deprioritized. |

## Open issues summary

### Sub-topic 1-1 CSI-RS measurement configuration

**Issue 1-1: Whether to define additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the CSI-RS based measurement requirement in R16?**

* Proposals
  + Option 1: No (Intel, Xiaomi, CATT, Apple, HUAWEI, Qualcomm)
  + Option 2: Yes (Nokia, Docomo, NEC, ZTE)
    - Option 2a: RAN4 to introduce measurement requirements for CSI-RS configuration {D=1 with PRBs≥96} at least when CSI-RS BW is contained in active BWP ( NEC )
    - Option 2b: RAN4 to introduce requirements for CSI-RS configuration {D=1 with PRBs≥96} for intra frequency measurement in Rel-16
* Recommended WF
  + Need more discussion.

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1: Whether to define additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the CSI-RS based measurement requirement in R16?**

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| **Company** | **Comments** |
| MTK | Support Option 1: No.  BTW, this is a low priority issue according to approved exception sheet RP-201340 in last RAN plenary meeting. RAN4 should focus on other more urgent issues. |
| ZTE | To move forward, a compromise proposal (Option 2b) is provided that requirements for {D=1, PRB=96} CSI-RS configuration are defined intra frequency measurement in Rel-16. Since the requirements for intra frequency measurement are defined without gaps, UE is capable of receiving CSI-RS resources together with serving cell data. So UE complexity is not a concern in this special case. |
| Qualcomm | Agree with Option 1.  Option2b compromises with limiting the configuration to intra-frequency. But a larger number of intra-frequency resources on a single intra-frequency layer may still be concerning for UE. Thus, we prefer to revisit this when other higher priority open issues settle. |
| Docomo | Our preference is unchanged from the last meeting, i.e. option 2 : Yes, but we can also agree with option 2a and 2b as compromising proposals.  According to the WID, one of the original motivations to specify L3 measurement with CSI-RS is to realize more flexible measurement configuration in the aspect of frequency resource usage than that with SSB. Thus, we should specify requirements for multiple configuration sets. |
| Nokia | Support Option2.  As in our simulation paper, we don’t see significant performance degradation in case of {96PRB & D=1}. To allow certain flexibility on network configuration, we support applying the requirement also to {D=1 & 96PRBs}. |
| vivo | Slightly prefer option 1. No need for D=1. To complete WI, R16 should focus on the fundamental functions |
| OPPO | Agree with MTK and QC, and support option 1. As a low priority issue, it may be further studied in future release considering this is the last meeting for this WID in Rel-16. |
| Xiaomi | Support option 1. D = 1 will increase UE complexity due to the loose resource. To complete this WI on time, we prefer to not introduce D=1 in Rel-16. |
| Huawei | We support option 1, not to define additional CSI-RS configuration {D=1 with PRBs≥96}.  As we mentioned in our paper, the CSI-RS based measurements with D=1 have performance degradation under propagation conditions with large delay spread, and the performance degradation due to sparser CSI-RS resource cannot be compensated by configuring larger bandwidth. This is the same reason why CSI-RS based RLM/BFD/CBD/L1-RSRP measurement requirements are only applied for CSI-RS configuration of D=3. |
| NEC | We are fine with option 2a/2b. We feel option 2a and option 2b as a compromise proposal addresses UE complexity.  We don’t see additional work, as same set of requirements can be specified for both D=1 and D=3. |
| CATT | We think it’s not possible to reach consensus on this configuration in Rel-16. To be realistic, we propose to leave this configuration for Rel-17. |
| Intel | Support Option 1: not to define additional CSI-RS configuration {D=1 with PRBs≥96}.  Due to low priority, we can discuss this later in Rel-17. |
| Apple | Support option 1. Do not see the benefit or system impact to introduce another CSI-RS configuration for the minimum requirements. |

### 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** |
|  | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

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

**Issue 1-1: Whether to define additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the CSI-RS based measurement requirement in R16?**

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|  | **Status summary** |
| **Issue1-1** | *Tentative agreements:* ***None***  *Candidate options:*   * Option 1: No (MTK, Qualcomm, vivo, OPPO, Xiaomi, HUAWEI, CATT, Intel, Apple) * Option 2: Yes (Nokia, Docomo, NEC, ZTE) * Option 2a: RAN4 to introduce measurement requirements for CSI-RS configuration {D=1 with PRBs≥96} at least when CSI-RS BW is contained in active BWP ( NEC, Docomo ) * Option 2b: RAN4 to introduce requirements for CSI-RS configuration {D=1 with PRBs≥96} for intra frequency measurement in Rel-16( ZTE, NEC, Docomo )   *Recommendations for 2nd round:*  *Need more discussion. Compromises from companies are expected.* |

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

**[Moderator] Since this issue has been discussed for a long time, proponents of both option 1 and option 2 please check if any compromise can be accepted.**

**Issue 1-1: Whether to define additional CSI-RS configuration {D=1 with PRBs ≥ 96} for the CSI-RS based measurement requirement in R16?**

* Option 1: No (MTK, Qualcomm, vivo, OPPO, Xiaomi, HUAWEI, CATT, Intel, Apple)
* Option 2: Yes (Nokia, Docomo, NEC, ZTE)
* Option 2a: RAN4 to introduce measurement requirements for CSI-RS configuration {D=1 with PRBs≥96} at least when CSI-RS BW is contained in active BWP ( NEC, Docomo )
* Option 2b: RAN4 to introduce requirements for CSI-RS configuration {D=1 with PRBs≥96} for intra frequency measurement in Rel-16( ZTE, NEC, Docomo )

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| --- | --- |
| **Company** | **Comments** |
| Xiaomi | Support option 1. |
| Nokia, NSB | Support Option2.  In our view, single requirement is already a compromised solution. For neighbor cell measurement, network may not configure a higher density CSI-RS resources considering SSB-based measurement is likely to happen at the same time. We propose leaving certain flexibility to network configuration.  Some companies argued this is a minimum requirement. We agree with this understanding and this exactly explains why we need additional configuration as a higher bandwidth i.e. 96PRB is required in case of density =1. As the dual configurations did not add any specification efforts, we think it is fair to enable both configurations with single requirement in Rel16. |
| MTK | Support Option 1. |
| Qualcomm | Option1 is supported.  Option2 according to Huawei may be subject to performance loss in TDL-C channel with larger delay spread, which is concerning.  And, sparser density of D=1 and larger number of RBs do have implication on UE processing as more REs are to be handled in UE accessing the memory. Smaller bandwidth UE has extra complexity to perform extra processing in order to determine the descrambling sequence within its active BWP which doesnot necessarily start from the first RE of the configured CSI-RS resource that has larger PRB size.  Further, if the interference of neighbor CSI-RS is a concern, we propose to introduce scheduling restriction in the serving cell regardless of UE types.  Due to the limited support of CSI-RS L3 in Rel-16, we hope to revisit this in Rel-17. |
| ZTE | We share Nokia view and still think Option 2 is necessary in Rel-16. |
| Huawei | We support option 1, and we have provided our reasoning in the first round comments. |
| vivo | We slightly prefer option 1.  One clarification question for option 2: Does that means new CSI-RS reference configuration need to be defined in the performance part? |
| OPPO | Prefer option 1. |
| Docomo | We still prefer potion 2, but can compromise to option 1. |

## Summary on 2nd round (if applicable)

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

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

# Topic #2: Others (AI 7.14.1.5)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2009747 | Intel Corporation | Proposal 2: For CSI-RS measurement with associated SSB, RAN4 addresses the issue of timing difference between the arrival of the CSI-RS and UE’s FFT timing in the performance part. |
| R4-2010054 | Apple | Proposal 1: The timing of CSI-RS resource should be assumed the same as the associatedSSB.  Proposal 2: No single FFT is assumed to measure CSI-RS resources from different cells.  Proposal 3: Strive to complete measurement opportunity sharing between CSI-RS and SSB based L3 measurement in R16  Proposal 4: Postpone the other open issues in table 1 to Rel-17 |
| R4-2010072 | CMCC | Proposal 1: for the CSI-RS resource with associatedSSB, basing the timing on the cell given by the cellId of the CSI-RS resource configuration is preferred. However, to move forward, compromise can be considered.  Proposal 2: the compromised solution could be the combination of introducing UE capability and specifying different requirements for different arrival timing difference. For example, normal requirements are specified for arrival timing difference no larger than CP, relaxed requirements are specified for arrival timing difference larger than CP. UE capability is introduced to differentiate different types of Ues. For the UE supporting using only single timing for CSI-RS measurement per frequency layer, if the arrival timing difference is no larger than CP, normal requirements are followed, if the arrival timing difference is larger than CP, relaxed requirements are followed. For the UE supporting using timing of associated SSB for respective CSI-RS measurement, normal requirements are always followed. |
| R4-2010315 | MediaTek Inc. | Observation 1: According to WID, UE is required to use single FFT window to measure all cells in one frequency layer.  Observation 2: The cell phase synchronization error is already larger than the CP length of SCS 30KHz, 60KHz and 120KHz, even without considering the difference due to propagation delay.  Observation 3: Inter-gNB distance and the cell phase synchronization requirement were determined in R15 and will not be further reduced due to the introduction of CSI-RS for L3 measurement.  Observation 4: The receive timing difference is only visible at UE side. Network has no knowledge about which measurement report is more reliable than the others  Observation 5: Even with the new UE capability introduced, practical UE implementation with limited number of FFT engines still need to handle the measurement on the CSI-RS signal with misaligned receive timing.  Proposal 1: RAN4 to address the issue of timing difference between the arrival of the CSI-RS and UE’s FFT timing in the performance part with different measurement accuracy requirements. |
| R4-2010334 | vivo | Proposal 1: UE should be able to obtain timing from SSBs from multiple cells without the constraint of single FFT. No need for specifying any further constraint on network synchronisation assumption beyond R15 and no need for different UE capability. The performance degradation due to interfered neighbour cell CSI-RS measurement should be further discussed in performance part.  Proposal 2: Requirement for asynchronous deployment can be delayed to R17.  Proposal 3: Requirement for FR2 is not significantly impacted by the synchronization assumption and should be specified in R16. |
| R4-2010388 | Nokia, Nokia Shanghai Bell | Observation#1: If associatedSSB is configured, tight cell synchronization is not always assumed between the cell to be measured and the serving cell.  Observation#2: There may be timing difference between the CSI-RS resources to be measured and the timing of single FFT.  Proposal#1: The impact due to the timing difference needs to be considered under the single FFT assumption when defining the requirements in Rel16.  Observation#3: The CSI-RS based measurement result makes sense only when the timing difference is within the CP length.  Proposal2: UE capability can be defined to indicate whether single FFT is applied when performing the CSI-RS based measurement on one frequency layer. |
| R4-2010577 | NTT DOCOMO, INC. | Observation 1: It is obviously described in TS38.331 that UE assumes the timing of the CSI-RS resources follows that of the cell indicated by cellId.  Observation 2: UE is assumed to acquire the timing of the target cell which is indicated by cellId with reading the associated SSB.  Proposal 1: Option 2 should be supported, i.e., the timing of the CSI-RS resources should follow that of the cell given by cellId. |
| R4-2010716 | OPPO | Proposal 1: If a new capability for UE supporting different SCS in source and target cells is defined in Rel-16 NR mobility measurement, reuse it for CSI-RS L3 measurement.  Otherwise, introduce a dedicated new capability of simultaneous reception of CSI-RS of eighbour cell and SSB of serving cell for CSI-RS L3 measurement.  Proposal 2: Do not introduce UE capability for minimum separation between two slots in Rel-16. |
| R4-2010761 | NEC | Proposal 1: RAN4 to introduce scheduling restriction such that gNB may schedule neighbour cells CSI-RS resources, whose timing is within the same Timing advance group (TAG).  Proposal 2: RAN4 to further study this problem in Rel-17 for single FFT UE implementation. |
| R4-2011173 | Huawei, HiSilicon | Observation 1: According to RAN1 specification, the timing of CSI-RS measurement with associated SSB should be based on the associated SSB.  Observation 2: If UE uses a single timing for CSI-RS measurement with associated SSB, the function of the associated SSB as timing reference for the CSI-RS measurement is completely wasted.  Observation 3: If UE uses a single timing for CSI-RS measurement with associated SSB, it will unnecessarily require network synchronization, and some use cases cannot be supported.  Observation 4: If UE uses a single timing for CSI-RS measurement with associated SSB, even in synchronous network, the accuracy performance will be degraded a lot for large SCS.  Proposal 1: When CSI-RS measurement is configured with associated SSB, UE is assumed to use the timing of the detected SSB, and the CSI-RS measurement requirements is not conditioned on network synchronization.  Proposal 2: If Proposal 1 is not acceptable, RAN4 should define a UE capability to indicate if UE supports CSI-RS measurement based on timing of each individual associated SSB or a single timing per MO. |
| R4-2011338 | Qualcomm CDMA Technologies | Proposal15: The collision between L1 measurement and CSI-RS L3 measurement shall be resolved by introducing the time-domain restrictions on the CSI-RS resources configuration.  Proposal18: RAN4 shall consider requirements only defined if the timing difference between serving and eighbour cell including cell phase synchronization is guaranteed to be less than half CP length.  Observation7: NW’s measurement configuration could be restricted to avoid different cells’ resources at the same time. The limitation is UE can ONLY follow one alternative timing other than the serving cell timing due to single FFT constraint and serving cell is subject to interruptions on CSI-RS symbols. |

## Open issues summary

### Sub-topic 2-1 Synchronization assumption for CSI-RS based measurement

**Issue 2-1: Synchronization assumption for CSI-RS based measurement**

* Proposals
  + Option 1: (Intel, MTK)
    - RAN4 to address the issue of timing difference between the arrival of the CSI-RS and UE’s FFT timing in the performance part.
  + Option 2: (Apple, CMCC, vivo, Docomo, HUAWEI, ZTE)
    - the corresponding timing of CSI-RS resources should be assume the same as the timing of the cell given by the cellId of the CSI-RS resource configuration.
  + Option 3: (CMCC, Nokia, HUAWEI)
    - introduce the UE capability to differentiate the following 2 types of Ues.
      * Type 1: UE supporting using only single timing for CSI-RS measurement per frequency layer
        + Type1.1: UE supporting using only single timing for CSI-RS measurement per frequency layer based on the serving cell timing
        + Type1.2: UE supporting using only single timing for CSI-RS measurement per frequency layer based on ONE of the associated eighbour cell SSBs
      * Type 2: UE supporting using timing of associated SSB for respective CSI-RS measurement
  + Option 4: (NEC)
    - RAN4 to introduce scheduling restriction such that gNB may schedule neighbour cells CSI-RS resources, whose timing is within the same Timing Advance Group (TAG)
    - RAN4 to further study this problem in Rel-17 for single FFT UE implementation
  + Option 5: (Qualcomm)
    - RAN4 shall consider requirements only defined if the timing difference between serving and eighbour cell including cell phase synchronization is guaranteed to be less than half CP length.
    - A baseline WID compliant UE features single FFT based on the same timing and/or same Rx beam for the serving cell. Such a baseline UE shall be assumed for defining the minimal requirements and test cases by RAN4.
* Recommended WF
  + Option 2 is recommended.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1: Synchronization assumption for CSI-RS based measurement**

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| **Company** | **Comments** |
| MTK | Support Option 1.  Regarding Option 2, we understand previous RAN1 design assumes UE to follow the timing of associated SSB, but it is later RAN Plenary’s decision to allow UE to implement single FFT. Procedure-wise, RAN Plenary should have the right to override RAN1 decision.  Regarding Option 3, we have provided our view in our paper R4-2010315. Even with the new UE capability introduced, practical UE implementation with limited number of FFT engines still has the chance to handle the measurement on the CSI-RS signal with misaligned receive timing. In this case, it is inevitable to define different accuracy requirements in performance part. So this still goes back to Option 1. |
| ZTE | Though single FFT is the assumption in the WID, it is not workable in the practical network for many cases. For example in FR1 the time difference of any two cells for a UE could be anywhere between 0 ~33 us. It is half symbols for 15kHz SCS and one symbol for 30kHz SCS. It is not possible to specify reasonable performance requirements to address such large time difference. If the time difference is small enough, e.g. within half CP, it is more like co-location deployment.  If reasonable relaxed (reduced) performance requirements cannot be specified, then some neighbor cells may never be measured as long as time difference to serving cell is too large. So the feature cannot work in a performance assured manner.  Option 2 is aligned with procedures specified by RAN1. It should be followed.  UE capability proposed by option 3 would make the feature too complicated. Two set of requirements would be specified. NW has to handle different Ues which increase NW complexity. Type 2 UE may not be useful in practical network. So it is not preferable.  Option 4 puts too much restriction at NW side. Besides the scenarios to use this feature is highly compromised. |
| Qualcomm | Our option5 can be merged with option3-type1.1.  Then both Option3-type1.1 and Option3-type1.2 are agreeable. And option1 is reasonable to discuss performance impact for these two types of Ues.  Option2 and option3 type2 are not complied with the WID assumption **potentially**. Thus, they are NOT agreeable.  Suggestion to companies and moderator,  Can we please merge option1, option3-type1.1 and option3-type1.2 and option 5? I.e.  “  *Introduce the UE capability to differentiate the following 2 types of Ues both of which are WID compliant. I.e. UE supporting using only single timing for CSI-RS measurement per frequency layer*  *Type1: UE supporting using only single timing for CSI-RS measurement per frequency layer based on the serving cell timing*  *Type2: UE supporting using only single timing for CSI-RS measurement per frequency layer based on one and only one of the associated eighbour cell SSBs*  *RAN4 to address the impact of timing difference between the arrival of the CSI-RS and UE’s FFT timing for type1 or both types of Ues in the performance part.*  ” |
| Docomo | Our preference is option 2, but we can compromise with option 1 to make a progress. However, for option 3, it is possible that NW has to control both of the Ues which follow the timing of *cellId* and them which follow the FFT timing simultaneously. In this case, we think NW scheduling will be highly complicated, thus option 3 is not preferable. |
| Nokia | Support Option 3.  According to the associatedSSB definition, Option 2 is indeed the way how the UE shall apply the timing. However, this is now conflicting with the single FFT sync assumption in WID. As this has been clearly indicated in the WID, we need stick to the single timing assumption at least in Rel16.  If the UE only supports single FFT, the UE may use the serving cell timing for intra-frequency measurement for simplicity. To solve the potential timing problem, the UE shall measure the CSI-RS resources only if the timing difference is within e.g. CP length. |
| Vivo | Our view is more like option 2.  Do not see the necessity of option 3. Option 1 and option 2 can be merged. Single FFT assumption in WI is just complicating the situation and should not be seriously considered. It can even be removed. To simplify discussion and minimize change to legacy requirements, UE CSI-RS measurement behavior that similar to SSB should be considered as the first priority in Rel. 16. |
| OPPO | Support option 2 in principle. The measurement of CSI-RS can follow the timing of associated SSB, which is aligned with the timing of corresponding serving cell. And we do not oppose option 1 that the accuracy requirements can be discussed in the performance part considering single FFT timing. |
| Xiaomi | We slight prefer option 2, and we also fine with option 1. |
| CMCC | Option 2 is our preference. Considering different UE implementation, option 3 with type 1.1 and type 2 is also OK for us to move forward. |
| Huawei | We support option 2 or option 3.  Option 2 is aligned with RAN1, and it means the CSI-RS L3 measurement can be employed by NW without any restriction, so it is our first preference.  Option 1 requires network synchronization, so L3 CSI-RS measurement cannot be supported in scenarios like async FDD network. Even in synchronous network, the accuracy performance will be degraded a lot in FR2 due to large SCS.  Option 3 is compromise solution between option 1 and option 2, where both type 1 and type 2 UEs are allowed.   1. To MTK, we are fine to define different accuracy requirements for type 1 and type 2 UEs, e.g. accuracy is relaxed for type 1 UE due to the timing error. 2. To ZTE and Docomo, the capability will enable NW to better decide whether CSI-RS L3 measurement should be used for a specific UE, e.g. type 1 UE should not be configured with CSI-RS measurement in async NW, and maybe not in FR2 due to poor accuracy. CSI-RS measurement is anyway a UE specific configuration, and it is up to NW whether or not to take into account the UE capability, so we do not think NW complexity is an issue. 3. To Qualcomm, we do not think specification should restrict UE implementation. If NW always assumes type 1 UE, the use of CI-RS measurement will be conservative even for type 2 UE.   On type 1.2 UE in option 3, we are open to accommodate it in the capability, but the UE behaviour and performance for such UE should be clarified. For example, when this UE would use serving cell timing and when it would use neighbour cell timing, and whether it will cause scheduling restriction.  On option 4 and 5, we think the assumption on NW sync should be same as in Rel-15, e.g. 3us. Also, TAG is for CA, but it does not limit the receive timing difference between cells on the same frequency layer. |
| NEC | Though we proposed option 4, our first preference is option 2. If option 2 is not agreeable, then as a compromise solution we prefer option 4.  In practical scenario, NW may not configure CSI-RS of neighbor cells having large timing difference in the same MO. Even if we opt for option 1, network may have to implement some sort of scheduling restriction so that measurement performance is not degraded. |
| CATT | Support option 2. From RAN1’s design, UE should follow the timing of associated SSB if it is configured. It is better to follow the principles defined in RAN1/RAN2.  The restriction of single FFT is too restrictive for this feature and is found not reasonable. We don’t have to stick to an unreasonable assumption. If we have agreement in RAN4, we can delete this assumption in the coming RAN plenary. |
| Intel | Support option 1. For option 2, it’s against the WID where single FFT window is assumed. For option 3, we don’t think differentiating UE capability is necessary. It’s up to UE implementation about how to apply the FFT window. It can be discussed in performance part. we can just consider the worst case with single FFT assumption. If UE is capable to apply multiple FFT windows, it can certainly satisfy the requirement based on single FFT window as well. |
| Apple | As discussed in GTW, we should confirm option 2 from CSI-RS timing perspective. Single FFT or multiple FFT can be discussed in performance part. |

### 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** |
| R4-2009763 (Xiaomi) | Nokia: This depends on whether the UE supports additional number of reporting criteria for CSI-RS based measurement, and how big the value is. Need to discuss it in RAN4. |
| Huawei: We proposed a different approach in R4-2011174. In our understanding, reporting criteria should be shared between SSB and CSI-RS measurement, considering that in typical cases they are configured in the same MO. According to RAN2, a single report configuration can be used to trigger SSB and/or CSI-RS based reporting, depending on configuration of *rsType* in *ReportConfigNR*, so we do not see the need to define additional reporting criteria due to CSI-RS measurement. |
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| R4-2010390  (Nokia) | MTK:   * This CR should be treated in [225], where the technical discussion about the requirement takes place * (9.x.1) FFT # is UE implementation issue, we can address this in the accuracy, but not in core part. * (9.x.2.1) Do not need transition requirement for CSI-RS because intra-freq measurement is always gap-less and inter-freq measurement is always gap-assisted. There is no transition between outside gap and within gap. * (9.x.2.1) "even if no explicit neighbour list with physical layer cell identities is provided" should be removed. CSI-RS measurement always needs cell ID configured by network * (9.x.2.2) the associated SSB also needs to be detectable, not just the cell |
| Nokia: Thanks MTK for the comments. This CR intends to capture the agreements from previous meetings inc. introduction, definition and applicability aspects. We understood [225] is addressing the requirements details.  About Single FFT, we understood this would impact the synchronization issues and hence the core requirements. We can wait for the discussion on 2.2.1 and adapt this part accordingly.  For other comments, we agree with your views and could update it. |
| Huawei: In addition to MTK’s comments above, the following bullet is not needed, since it has been agreed in RAN2 that ECP is not supported for CSI-RS L3 measurement.  • the CP type of CSI-RS resources on neighbour cell configured for measurement is the same as the CP type of CSI-RS resources on the serving cell indicated for measurement, which is applied for SCS = 60kHz, and |
| R4-2010392  (Nokia) | MTK: This is a performance part requirement. Suggest to postpone this to performance part. |
| Company B |
|  |
| R4-2011174 (HUAWEI) | Nokia: Agree to share the number of reporting criteria with SSB-based measurement. |
| Company B |
|  |
| R4-2011416 (Qualcomm) | MTK:   * This CR is better to be handled in [225], where the technical discussion about the requirement takes place. * There is no track change. * The technical contents are pending on the discussion in [225] * Maybe typo? “UE shall be capable of measuring without measurement gap for the intra-frequency measurements based on” * The last sentence “If the associated SSB is not configured, above restriction is not needed” is misleading. If associated SSB, UE will even not measure the CSI-RS, rather than measuring it without restriction. |
| Qualcomm: Thanks MTK for comments. Sure, let’s wait agreements in [225] and we can update accordingly. |
|  |

## 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:* |

**Issue 2-1: Synchronization assumption for CSI-RS based measurement**

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-1** | *Status:*  *The conclusion of GTW session:*  Agreement:  Rel-16 CSI-RS based measurement requirements are based on Single FFT implementation  Chair: Further discuss   * Impacts on the Core part requirements * UE time tracking assumptions for CSI-RS measurements   + Option 1: UE follows serving cell timing   + Option 2: UE follows associated neighbor cell SSBs   *Tentative agreements:*   * Introduce the UE capability to differentiate the following 2 types of UEs for intra-frequency measurement.   + Type1: UE supporting using the serving cell timing for CSI-RS based L3 measurement   + Type2: UE supporting using only one of the associated neighbour cell SSBs for CSI-RS based L3 measurement   *Recommendations for 2nd round:*   * *Capture the agreement in the WF.* * *Check the tentative agreement.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on CSI-RS configuration and synchronization assumption for CSI-RS based L3 measurement | CATT |

### 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** | **Assigned company** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |  |
| [R4-2010073](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010073.zip) | To be revised. To resolve the concerns in 1st round discussion and return to. | CMCC |
| [R4-2009844](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009844.zip) | To be revised. To resolve the concerns in 1st round discussion and return to. | CATT |
| [R4-2010335](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010335.zip) | To be revised. To resolve the concerns in 1st round discussion and return to. | vivo |
| [R4-2011116](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011116.zip) | To be revised. | Huawei, Hisilicon |
| [R4-2010715](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010715.zip) | To be revised. | OPPO |
| [R4-2010314](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009842.zip) | To be merged. | MediaTek inc. |
| [R4-2010057](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010057.zip) |  | Apple Inc. |
| [R4-2011416](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011416.zip) | To be revised. | Qualcomm |
| [R4-2009763](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009763.zip) | To be revised | Xiaomi |
| [R4-2011174](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011174.zip) | Noted  [Moderator: Merged into [R4-2009763](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009763.zip)] | Huawei, Hisilicon |
| [R4-2010390](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010390.zip) | To be revised.  To resolve the concerns in 1st round discussion.  [Moderator: Partly merged into R4-2009844] | Nokia, Nokia Shanghai Bell |
| [R4-2010391](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010391.zip) | Noted.  [Moderator: Merged into R4-2011116 and [R4-2011416](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011416.zip)] | Nokia, Nokia Shanghai Bell |
| R4-2010392 | Postponed.  [Moderator: postpone to performance part] | Nokia, Nokia Shanghai Bell |

## Discussion on 2nd round (if applicable)

**[Moderator] Companies please check the following tentative agreement.**

**Issue 2-1: Synchronization assumption for CSI-RS based measurement**

*Tentative agreements:*

* Introduce the UE capability to differentiate the following 2 types of UEs for intra-frequency measurement.
  + Type1: UE supporting using the serving cell timing for CSI-RS based L3 measurement
  + Type2: UE supporting using only one of the associated neighbour cell SSBs for CSI-RS based L3 measurement

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| --- | --- |
| **Company** | **Comments** |
| Xiaomi | According to the GTW session discussion, single FFT is assumed in this WI. If UE supports to use the serving cell timing for CSI-RS measurement on neighbour cells, there will have measurement performance degradation due to the propagation delay between serving cell and neighbour, e.g. 33us of MRTD. How to address this issue for type 1 UE is necessary before introducing different type of UE capability. One option is that Network is not allowed to configure the CSI-RS measurement on neighbour cell which the propagation delay is larger than half CP length for type 1 UE. The other option is to introduce the scheduling restriction before and after the CSI-RS measurement window for type 1 UE. And for us, we are fine with either option. |
| Nokia, NSB | We support Type1 for intra-frequency measurements.  We understood the single FFT is assumed to simplify the UE processing. As assumed for CSI-RS based L1 measurement, the UE is able to process the data and the CSI-RS based measurement simultaneously. Using the serving cell timing could at least benefit the data reception in some cases.  Type 2 may solve the timing issue with one of the neighbor cells, but the timing difference still exists for the measurements on other neighbor cells on the same band. The simultaneous data reception is also not possible in serving cell. |
| MTK | Support to the tentative agreement  We prefer Type 1 but can compromise to Type 2 if companies has concern on the measurement accuracy toward neighboring cell |
| Qualcomm | Tentative agreement is agreeable to us.  We also recommend RAN4 performance requirements and test cases are specified by focusing on type1 UEs for minimal requirements because type2 UE behavior can still be complicated depending on how UE chooses to configure the FFT timing and measure different cells. |
| LGE | We prefer Type 2 UE for intra-frequency measurement.  We think that, for Type 1 UE, CSI-RS L3 measurement is used in limited cases.  For example, when UE is not able to support mixed numerology or simultaneous reception between data and CSI-RS, the UE cannot receive the data symbol and CSI-RS symbol simultaneously. If the UE receives data symbol, the UE cannot receive CSI-RS symbol. Hence, CSI-RS L3 measurement cannot be used. If the UE receives CSI-RS symbol, the UE cannot receive data symbol from serving cell. This implies that the UE does not need to use serving cell timing.  Similarly, for FR 2, UE cannot receive the data from serving cell to measure CSI-RS for neighbor cell if UE uses different Rx beam for serving and neighbor cell. In this case, UE is better to use timing of neighbor cell since UE cannot receive data from serving cell.  In addition, even if UE is able to support mixed numerology or simultaneous reception between data and CSI-RS, there will be measurement accuracy degradation due to timing difference. |
| ZTE | We agree with almost all of LGE views. To make the feature work, requirements have to be specified by assuming Type 2 UE . |
| CMCC | In 1st round, we prefer to introduce UE capability taking the multiple FFT into consideration. However, in the GTW session, it is agreed to only consider single FFT, with this assumption, we analyze type1 UE and type 2 UE from the scheduling restriction and measurement performance point of view as following:  For type 1 UE, since serving cell timing is based, the scheduling restriction can be limited to 1 symbol and no additional symbols will be impacted. However, the measurement performance may be bad if the received timing difference is large.  For type 2 UE, the scheduling restriction may be larger than 1 symbol if the timing of the selected cell is mismatched with serving cell. The measurement performance of some cells may be also bad if the timing of those cells is mismatched with the timing of the selected cell.  Based on above consideration, we slightly prefer to only consider type 1 UE in Rel-16. |
| Huawei | We understand there is a differentiation between intra- and inter-frequency.  For intra-frequency, we support to define requirements based on Type 1, for the same reason as mentioned by Nokia above.  For inter-frequency, there is no serving cell timing, so the UE behavior has to be based on Type 2. |
| vivo | We prefer specify requirements only for Type 2 above.  If requirements is only specified for Type 2 UE, we don’t think the capability is needed.  Anyway, we are also able to compromise on this issue. |
| CATT | Support the tentative agreement. It is agreed to only consider single FFT, but it is UE implementation that which timing is used. If UE can use neighbor cell timing to achieve better performance, it should not be precluded. Then the UE capability is a better way to address UE implementation issue.  To Huawei, the UE capability is defined for intra-frequency measurement as stated in tentative agreement. |
| OPPO | Share the similar view as CMCC’s on the impact on scheduling restriction and measurement performance.  Prefer type 1 UE in Rel-16. And we can also compromise to introduce 2 types of UE. |
| Docomo | Type 2 seems fine for us.  According to the TS38.331, UE uses timing of the serving cell in the case that the associated SSB is not configured. RAN4 has already agreed all requirements are specified only for the case with the associated SSB in Rel-16. Therefore, we think Type 1 is not necessary to be considered at least for Rel-16. |

## 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”* |