**3GPP TSG-RAN WG4 Meeting # 104-e R4-22XXXXX**

**Electronic Meeting, 15– 26 August 2022**

**Agenda item:** 11.16

**Source:** Moderator (MediaTek Inc.)

**Title:** Email discussion summary for [104-e][237] NR\_Mob\_enh2

**Document for:** Information

# Introduction

This document is the email discussion summary for [104-e][237] NR\_Mob\_enh2 with the following topics covered

* Topic 1: General and work plan
* Topic 2: Study of improvement on FR2 SCell/SCG setup/resume
* Topic 3: L1/L2 based inter-cell mobility
* Topic 4: CHO/CPAC Enhancement

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

* 1st round: Invite companies to comment in each sub-topic.
* 2nd round: TBA.

It is appreciated that the delegates for this topic put their contact information in the table below.

Contact information

|  |  |  |
| --- | --- | --- |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

# Topic #1: General and work plan

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211550 | MediaTek Inc., Apple | **Proposal 1:** RAN4 to endorse the RRM work plan for Further NR Mobility Enhancements as presented in this contribution. |

## Open issues summary

### Sub-topic 1-1: Work plan

**Issue 1-1: Work plan proposals**

* Proposals
	+ Option 1: work plan in R4-2211550
* Recommended WF
	+ Companies are encouraged to comment on the work plan in R4-2211550 in the 1st round.

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| **Company** | **Comments** |
| Apple | Support the work plan. |
| Qualcomm | For those items below, we’re a bit skeptical about the effectiveness of starting the discussion even before RAN2 design hasn’t been matured.* L1/L2-based inter-cell mobility
* Enhanced CHO
 |
| Ericsson | We share similar view with QualcommEnhanced CHO |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing Wis, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | 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:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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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)

# Topic #2: Study of improvement on FR2 Scell/SCG setup/resume

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211685 | CATT | **Proposal 1:** It is suggested to reduce RX beam sweeping scaling factor to shorten the measurement delay. |
| R4-2211910 | Apple | **Observation 1**: RRC connection setup latency is much shorter than cell identification/measurement period in FR2.**Observation 2**: using fewer measurement samples can reduce measurement latency. However, measurement accuracy cannot be guaranteed. Therefore, network may not be able to rely on measurement result to configure CA/DC.**Proposal 1**: further study is needed before RAN4 confirms the feasibility of early measurement during connection setup. |
| R4-2211938 | CMCC | **Observation 1**: the existing CA/DC measurement delay requirements are so long that it is not suitable for the measurement performed during RRC connection setup/resume**Proposal 1**: it is proposed to firstly determine with which case to perform study on Rel-18 FR2 Scell/SCG setup/resume:* Case 1: UE perform CA/DC measurement closely before RRC connection setup/resume
* Case 2: UE perform CA/DC measurement during RRC connection setup/resume

**Proposal 2**: if case 2 (UE perform CA/DC measurement during RRC connection setup/resume) is considered, it is proposed to discuss the possible UE architecture to perform both CA/DC measurement and RRC connection setup/resume:* Only one RF chain is used to perform both CA/DC measurement and RRC connection setup/resume. In this way, it is inevitable that performing measurement will have impact on RRC connection setup/resume procedure.
* Two RF chains are used, one RF chain is used for SCG/Scell setup/resume, while the other RF chain is used for CA/DC measurement. In this way, CA/DC measurement and RRC connection setup/resume are performed independently, performing measurement will not have impact on RRC connection setup/resume procedure.

**Proposal 3**: if UE perform CA/DC measurement during RRC connection setup/resume, following impacts on RRM requirements are identified:* the number of samples and/or the scaling factor (N1) need to be reduced
* the requierments can not be specified based on DRX, SMTC need to be considered (DRX is not in use during RRC connection setup/resume procedure)
 |
| R4-2211966 | Xiaomi | **Observation 1**: If the EMR measurement results are not available or invalid, the UE initiates the improved measurement when UE requests RRC connection setup/resume.**Observation 2**: RAN4 to study the solution to reduce the improved measurement delay.**Observation 3**: RAN4 to consider the following alternatives to reduce the improved measurement delay:* Alt.1: Reduce the scaling factor of Rx beam sweeping
* Alt.2: Reduce the number of EMR carriers to be measured for improved measurement
* Alt.3: The improved measurement is based on L1-RSRP measurement
 |
| R4-2212408 | MediaTek Inc. | **Observation 1:** RRC connection setup/resume delay is too short to define any requirements for measurement during RRC connection setup/resume.**Proposal 1:** Suggest the proponents of Objective 7 to propose feasible schemes. Otherwise, objective7 should be removed from the WID. |
| R4-2212869 | Nokia, Nokia Shanghai Bell | **Observation 1:** Fast DC/CA resume/setup enables data DC/CA usage with lower latency that improves user throughput.**Observation 2:** Reduced DC/CA setup latency enhances load balancing between different cells/carrier frequencies and avoids congestion.**Observation 3:** Reduced DC/CA setup delay contributes to lower user energy consumption by reducing the data transmission time and enabling faster release of the user to idle/inactive mode. **Observation 4:** Based on RAN4 UE RRM requirement for FR2 operation assumptions, the user has one Rx panel active at a time. Additionally, the UE is allowed to sweep its receive panels/beams when performing measurements. This imposes an additional delay in FR2 compared to FR1 operation. **Observation 5:** Idle-mode FR2 inter-frequency carrier measurement requirements may take more than 2.5 minutes (which is 8 times more than that of required for FR1). **Observation 6:** Considering that the cell sizes are relatively small in FR2, 2.5 minutes measurement delay may contribute to sub-optimal DC/CA setup decision especially for mobile Ues.**Observation 7:** EMR requirements apply only when timer T331 is running. When T331 expires, it is up to the UE implementation whether to perform idle-mode DC/CA measurement, and this is only possible if the measurement configuration is provided in SIB.**Observation 8:** Inter-frequency DC/CA idle-mode measurement is supported for the users with capability of *idleInactiveNR-MeasReport-r16* when serving gNB also supports idle mode CA/DC measurement reporting and it is the validity area.**Observation 9:** Connected mode FR2 inter-carrier frequency measurement (even for one carrier frequency) may take up to **4160 msec.** **Observation 10:** Making network aware of an available FR2 cell in connected mode may take up to five times longer delay than what is required for FR1 which significantly delays FR2 DC/CA setup.**Observation 11:** Additional measurement enhancements are needed to reduce secondary link (Pscell/Scell) establishment and enhance the user experience while accounting user constraints. **Observation 12:** Most of the offered load is transmitted from the Pcell when Scell setup delays is long.**Observation 13:** Reduction of the CA/DC setup delay helps in providing additional resources to the Ues faster when UE is entering connected mode.**Observation 14:** With shorter setup delay we observe a reduction in UE energy consumption due to faster offload.**Observation 15:** RAN2 has defined UE actions when receiving paging for MT-originating calls or triggering RRC connection establishment/resume for MO-originating calls.**Proposal 1:** RAN4 to clarify that the “when UE has initiated access” is the point in time when RRC procedures in clauses 5.3.2.3, 5.3.3.2 or 5.3.13.2 are initiated.**Proposal 2:** Enable simultaneous use of EMR and Search threshold, i.e. UE can be requested to perform EMR even with the search thresholds.**Proposal 3:** UE can be configured to perform FR2 cell measurements during connection setup (i.e. paging, RRC connection establishment, RRC connection resume).**Proposal 4:** UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes. |
| R4-2213013 | Huawei, HiSilicon | **Observation1**: It seems hard for UE to execute a complete L3 FR2 measurement during RRC connection setup/resume procedure. **Observation 2**: Due to RX beam sweeping for FR2 measurement, there is a risk that MSG2/MSG4 during RACH procedure are lost.**Proposal 1**: Suggest to further discuss the feasibility of improvement in FR2 Scell/SCG setup delay. |
| R4-2213018 | vivo | **Observation 1:** RRC connection setup delay is very short for improved measurements on FR2 Scell/SCG setup.**Proposal 1:** Further extension of the assumption on the sequence of events in FR2 Scell/SCG setup can be considered, e.g., UE initiates and performs improved measurements a bit earlier. **Proposal 2:** Further study the feasibility on only performing a quick improved measurement on the cells that have been detected/measured in early measurement. |
| R4-2213903 | Ericsson | **Proposal 1:** RAN4 shall study the potential FR2 measurement requirements enhancement based on current Early Measurement Procedure defined in Rel-16.**Proposal 2:**  RAN4 shall study the potential UE measurement enhancement that whether certain additional information or procedure can help UE to measure in a more effective way.**Proposal 3:** RAN4 shall also study what potential network/UE procedure can clarify the UE behavior with respect to the T331 timer setup with the support potential from other RAN group eg RAN2 |

## Open issues summary

### Sub-topic 2-1: Clarification and potienial direction

#### Issue 2-1-1: Clarification on time point of “when UE has initiated access”

* Proposals
	+ Option 1(Nokia): RAN4 to clarify that the “when UE has initiated access” is the point in time when RRC procedures in clauses 5.3.2.3, 5.3.3.2 or 5.3.13.2 (38.331) are initiated.
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | In our understanding, the intention to clarify the starting point of “when UE has initiated access” is to discuss the starting point of enhanced measurement if feasible.In our view, we can discuss issue 2-1-2 directly instead of discussing this issue. |
| CMCC | Can be discussed in Issue 2-1-2 |
| Apple |  Similar view with MTK and CMCC. This is about the starting point of measurement window. |
| Xiaomi | Share the similar view with MTK and apple, it is about the starting point for improved measurement. |
| Huawei | Similar view with MTK, CMCC, Apple and QC. |
| Ericsson | We agree with the view “When UE has initial access” is serve for the purpose of potential measurement enhancement.However, for the sake of study we shall still clarify as we understand Option 1 includes options* Paging 5.3.2.3
* Initiation (UE receives SIB1 and apply default MAC cell group configuration) 5.3.3.2
* RRC connection resume 5.3.13.2

 While in issue 2-1-2 we fail to see the Initiation.  |
| vivo | Share the similar view with MTK. |

#### Issue 2-1-2: Potential direction for further study: measurement enhancement when UE is about to enter connected mode

* Proposals
	+ Option 1(CMCC): UE perform enhanced measurement closely before RRC connection setup/resume.
	+ Option 2 (CMCC): UE perform enhanced measurement during RRC connection setup/resume.
		- Option 2a (Nokia): perform FR2 cell measurements during connection setup (i.e. paging, RRC connection establishment, RRC connection resume)
		- Option 2b (vivo): after receiving paging
		- Option 2c (vivo): after first RACH preamble transmission, i.e. Msg1
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | Option 2b for MT originating calls, Option 2C for MO originating calls.For MT, the earliest time that UE knows it needs to request for RRC setup/resume is after receiving paging. The enhanced measurement (if feasible) cannot start earlier than receiving paging.For MO, UE knows it needs to request for RRC setup/resume when there is UL data to transmit. Considering the testability, the enhanced measurement (if feasible) cannot start earlier than Msg1.Anyway, we don’t think there is much difference for Option 2b and Option 2c. As stated in TS37.910 clause 5.7.2.1, the latency is only 20ms which starts from Msg1 and ends at RRC setup/resume complete. This 20ms latency is the actually latency for option2c. For option 2b, the latency is only prolonged by some uncertainty time in acquiring the first RACH occasion. The time is too short for any L3 measurement.Regarding option 1, we think it is difficult to define “closely”. |
| CMCC | For option 2, UE perform enhanced measurement during RRC connection setup/resume, it will extend the RRC connection setup/resume delay. However, when UE requests RRC connection setup/resume (no matter MT originating call or MO originating call), it is expected that UE could switch to connected mode as soon as possible, which means that RRC connection setup/resume is expected to be completed quickly. From this point of view, we are not sure whether it is a good way to improve FR2 SCell/SCG setup delay at the expense of prolong RRC connection setup/resume delay. The impact on RRC connection setup/resume procedure need to be considered. We would like to hear companies’ views on this issue.As for MTK’s comments that it is difficult to define “closely”, we would like to clarify our consideration. For MT originating call, “closely before RRC connection setup/resume” means that the measurement is performed during the period between paging reception and UE send *RRCResumeRequest/ RRCSetupRequest*. For MO originating call, “closely before RRC connection setup/resume” means that the measurement is performed after upper layers request establishment of an RRC connection and before UE send *RRCResumeRequest/ RRCSetupRequest*.The details can be further discussed. Anyway, the motivation of “closely before RRC connection setup/resume” is to avoid the impact on RRC connection setup/resume procedure and can also guarantee that the measurement results are valid when they are reported. We are open to discussion and would like see companies’ views |
| Apple | As elaborated in our contribution, there are several options on the table regarding when to start measurement, e.g.:A screenshot of a computer screen  Description automatically generated with medium confidenceTechnically speaking, the earlier UE starts measurement, the earlier UE can get measurement result. However, we don’t see too much difference among each options considering connection setup procedure is much shorter than FR2 measurement period. We are open for further discussion.  |
| Xiaomi | We share the similar view that there is no much difference among the possible starting point for the improved measurement. In addition, UE may miss the reception on Msg2 and Msg4 if the improved measurement is performed with a different Rx beam, thus, RAN4 need to consider a proper starting point for improved measurement. |
| Qualcomm | Options do not seem mutually exclusive. We are open to further discussion, but it should be clarified that they shouldn’t be completely independent from or exclude enhancements based on the current EMR framework. |
| Huawei | In this WID, the following description is for the starting point measurement window.

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| * The following sequence of events should be assumed.
	+ - The UE initiates and performs improved measurements when it requests RRC connection setup/resume.
		- After acquiring those improved measurements, the UE subsequently reports those measurements to the network to support SCell/SCG setup.
 |

In our understanding, the RRC connection setup/resume shall start from UE transmitting PRACH (option 2c). We also think there is no big time difference between option 2b and option 2c, as only additional time duration after paging received and MSG1 transmission.  |
| Ericsson | Thanks Apple for the clarification figure.We would like to point out between Option1 and Option2 there is also a potential starting point as the work item describe The UE initiates and performs improved measurements. As point out by CMCC “*when UE requests RRC connection setup/resume (no matter MT originating call or MO originating call), it is expected that UE could switch to connected mode as soon as possible, which means that RRC connection setup/resume is expected to be completed quickly*” We also observe from real network measurement that * 50% of the UE stays in idle for around 25-30s
* Over 80% of the UE stays in idle for less than 100s

If we can re-use the known condition boundary 5s to quickly switch with an enhanced measurement requirement, we still believe this is feasible. |
| vivo | Support Option 2a and 2b.Regarding the concern raised from CMCC: ‘the enhanced measurement during RRC connection setup/resume will extend the corresponding delay’. For this, we would like to provide some views and possible options:a) The first option is, the enhanced measurement is only allowed to be performed during the process of RRC connection setup/resume. The ending point of enhanced measurement could be before the reception of the *RRCSetupComplete* by network or before the reception of the *SecurityModeComplete* by network. That means, the RRC connection setup/resume delay is not considered to be extended due to enhanced measurements.b) The second option is, allowing the reasonable extension on RRC connection setup/resume delay considering the case in which the enhanced measurement will be completed soon. Compared with the longer FR2 SCell/SCG setup delay when the UE switches to connected mode, it still can be seen benefits from the RRC connection setup/resume delay is extended appropriately.For Option 1, We have similar concern as MTK. For the explanations from CMCC, our concern is about the available time can be used for measurement during the period between paging reception and UE send *RRCResumeRequest*/ *RRCSetupRequest* (For MT originating call). It seems much shorter than the RRC connection setup delay. And even for the latter, most companies think that is very short for improvement on FR2 Scell/SCG setup delay. If we have inaccurate understanding for ‘closely before’, welcome companies to point it out.For Option 2, the intention to further extension of the assumption is for the earlier measurement. From this perspective, we think Option 2b or Option 2c can be the starting point of the further discussion on the feasibility of enhanced measurement. |

#### Issue 2-1-3: Potential direction for further study: enhancement on R16 EMR, i.e. measurement enhancement in idle/inactive mode

* Proposals
	+ Option 1 (Nokia): Enable simultaneous use of EMR and Search threshold, i.e. UE can be requested to perform EMR even with the search thresholds.
	+ Option 2 (Ericsson): Study the potential FR2 measurement requirements enhancement based on current Early Measurement Procedure defined in Rel-16.
	+ Option 3 (Ericsson): Study what potential network/UE procedure can clarify the UE behavior with respect to the T331 timer setup with the support potential from other RAN group e.g. RAN2
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | We don’t think further enhancement on R16 EMR is in scope, as in WID it clearly states “UE initiates and performs improved measurements when it requests RRC connection setup/resume”.

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| To study the following, with completion targeted by RAN#98 meeting [RAN4]:* The impact of FR2 RRM mobility measurement acquisition and reporting on FR2 SCell/SCG setup/resume delay for a UE connecting from idle/inactive mode.
* The level of feasible improvement in FR2 SCell/SCG setup delay from defining new UE measurement procedures and RRM core requirements, and whether additional information from the network would help the UE to perform those measurements effectively. The following sequence of events should be assumed.
	+ - The UE initiates and performs improved measurements when it requests RRC connection setup/resume.
		- After acquiring those improved measurements, the UE subsequently reports those measurements to the network to support SCell/SCG setup.
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| CMCC | From requirements point of view, we observe that following updates need to be considered taking Rel-16 EMR requrements as baseline:* If the CA/DC measurement is performed during RRC connection setup/resume, the requierments can not be specified based on DRX, SMTC or SSB periodicity need to be considered (in our view, DRX is not in use during RRC connection setup/resume procedure)
* If the CA/DC measurement is performed during RRC connection setup/resume, in order to reduce the impact on RRC connection setup/resume procedure, reduced delay requirements need to be considered (existing Rel-16 EMR requrements are very long)

For the case that CA/DC measurement is performed during RRC connection setup/resume, if we want to reuse the existing Rel-16 EMR requrements (i.e. the number of samples), another way is to consider the possible UE architecture. If two RF chains are used, one RF chain is used for SCG/Scell setup/resume, while the other RF chain is used for CA/DC measurement. In this way, CA/DC measurement and RRC connection setup/resume are performed independently, performing measurement will not have impact on RRC connection setup/resume procedure.For the case that CA/DC measurement is performed closely before RRC connection setup/resume (option 1 in Issue 2-1-2), since the measurement has no impact on RRC connection setup/resume procedure, it is possible to reuse existing Rel-16 EMR requrements (i.e. the number of samples). |
| Apple | If companies are targeting at enhancement on EMR, then we agree with MTK that enhancement on EMR is not in the scope. New measurement in obj 7 is targeting at enhancement during orange block above. Enhancement on EMR cannot provide accurate result when UE enters RRC connection if T331 expires long time ago.Regarding proposal from CMCC on reducing measurement period and using multiple RF chains for measurement, we should be very careful. In our view this is about tradeoff between UE power saving and measurement efficiency. Since the new measurement is only for potential CA/DC operation, it is likely that NW isn’t urgent to use CA/DC after RRC connection setup. The measurement is configured when UE leaves connected mode. However, network cannot predict there will be huge traffic data after UE sleep in idle. Therefore, blindly increasing UE measurement activity may result in unnecessary power consumption.  |
| Xiaomi | We agree with MTK’s view that the further enhancement on Rel-16 EMR is out of scope. The intention of obj#7 is to study the feasibility on introducing the improved measurement during the FR2 SCG/SCell setup procedure, the further enhancement on Rel-16 EMR requirements may not help to improve the FR2 SCG/SCell setup delay, since the EMR measurement result may be invalid when UE transitions from idle/inactive to connected. |
| Qualcomm | Open to all three options. We support an enhancement based on the existing EMR framework, e.g. the measurement results obtained during EMR can be utilized as much as possible during RRC connection procedure. Additionally, NW assistant information based measurement enhancement will be one area the group can explore for the item. |
| Huawei | In R18 the objective of improvement on FR2 scell/SCG setup/resume is to let UE perform FR2 L3 measurement during a transition duration from idle/inactive mode to connected mode. We don’t think RAN4 shall study further enhancement on R16 EMR, as in R16 UE perform EMR during idle/inactive mode.Regarding the two RF chains solution, we have similar view as Apple, it highly depends on UE implementation. Besides, according to self-evaluation in TS37.910 clause 5.7.2.1: the latency of RRC connection delay from RRC\_Idle/RRC\_INACTIVE state to RRC\_CONNECTED state is only about 20ms. Even there is a spare RF chain to perform measurement, we are afraid that whether the time is sufficient to obtain an accurate measurement result. |
| Ericsson | Support option 1,2 and 3.We think there could be multiple enhancements considered at multiple stages of the figure shown by Apple (Thank you Apple for nice illustration ).1. In Green portion of the figure and before T331 expiry
	1. May be some X ms before the T331 expiry, UE can perform enhanced measurements (lets say faster measurements) to complete measurements. If UE takes M number of samples and need few more samples to complete measurement UE may extend the measurement to shorter period.
2. After T331 expiry and before new measurement start UE can take one sample for each 5 sec on the already measured carriers in the step a (green colour of the figure)

Orange portion of the figure, when the new measurement start, UE can take faster measurements (may be something like connected mode) |
| vivo | Actually, the enhancement on R16 EMR is out of scope in this release. We think it would not be considered before the feasibility of enhanced measurement has been fully discussed. |
| LGE | Open to all three options. We have similar view as QC. EMR framework can be baseline and early measurement can continue after/during when it request RRC connection setup/resume. |

#### Issue 2-1-4: Applicable scenarios

* Proposals
	+ Option 1(xiaomi): Scenarios that the EMR measurement results are not available or invalid
	+ Option 2 (vivo): On the cells that have been detected/measured in early measurement
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | Option 1. If the EMR measurement results are available and valid, UE does not need to perform any improved measurement during RRC connection setup/resume. |
| Apple | Option 1 makes sense to us. |
| Xiaomi | Support option 1 |
| Qualcomm | Okay with both options. |
| Huawei | Option 1. The reason of introducing this obj is because some companies think the EMR measurements are outdated. |
| Ericsson | We are open to the discussion which scenario EMR is not applicable as we understand IDLE mode measurement could be a tradeoff between performance and power saving. |
| vivo | In fact, Option 1 and Option 2 are not mutually exclusive. In our understanding, option 1 discusses about under which condition, the enhanced measurement will be performed. Whereas the Option 2 aims to discuss which cells/carriers will be measured if the enhanced measurement is going to be initiated. For Option 1, we think it could be used as a candidate condition to initiate enhanced measurement. Besides, for the scenario that there is no limitation on the initiate conditions of the enhanced measurement, it should not be excluded in the early stage.Actually, Option 2 is aimed to achieve the similar intention to issue 2-2-2. Maybe it is more proper to discuss this part in issue 2-2-2. |
| LGE | Both options are fine to us. |

### Sub-topic 2-2: Assumptions for feasibility study

*Some companies have proposed RRC connection setup latency is too short for further measurement enhancement during RRC connection setup/resume. Moderator suggests to align some basic assumption at first and then make a comparison between RRC connection setup latency and measurement delay. The list assumptions are based on the proposed candidate solutions. Companies also are encouraged to discuss the feasibility of these solutions.*

#### Issue 2-2-1: Assumption for feasibility study: RF chain status when performing enhanced measurement

* Proposals
	+ Option 1 (CMCC): One active RF chain
	+ Option 2 (CMCC): Two active RF chains
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | Option 2. It is reasonable to assume two active RF chains as UE is supposed to support corresponding CA/DC band combination. |
| CMCC | We are OK with option 2. With two RF chain, one RF chain is used for SCG/Scell setup/resume, while the other RF chain is used for CA/DC measurement. In this way, CA/DC measurement and RRC connection setup/resume are performed independently, performing measurement will not have impact on RRC connection setup/resume procedure. |
| Apple | One RF chain shall also be allowed, e.g for UE only capable of intra-band CA. |
| Xiaomi | Fine with option 2 |
| Qualcomm | For option 2, it is up to scenarios, e.g. bands for PCell and target measurement cells. Needs more specific context for the option 2. |
| Huawei | Similar view as Apple. We can not always assume there are multiple RF chain for one UE. |
| Ericsson | We think based on the scenario of operation both can be possible. As other companies mentioned for inter-band CA and DC two RF chains can be assumed.  |
| vivo | Support Option 2. And regarding apple’s comment for the scenario of intra-band CA, we think it also shall be supported. |

#### Issue 2-2-2: Assumption for feasibility study: number of frequency layers

* Proposals
	+ Option 1(xiaomi): Reduce the number of EMR carriers to be measured for improved measurement
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | The more frequency to measure, the longer measurement delay is. Even assuming 2 active RF chains during RRC connection setup/resume, Rx/Tx at serving cell may be interrupted if there are more than one frequency to measure due to RF retuning. Therefore it is not feasible to measure more than one frequency during RRC connection setup/resume. |
| Apple | Same view as MTK. We shall be very careful of number of carriers to measure during this procedure.  |
| Xiaomi | We are open to discuss, our intention is not to expect the UE to measure all the configured EMR carriers during RRC connection procedure. FFS how to select the EMR carriers to be measured for improved measurement. |
| Qualcomm | During part of measurement procedures, for particular procedures, reduced number of carrier can be considered. |
| Huawei | Same view as MTK and Apple. If companies agree that the to-be-measured frequency layer is very limited, then the next question is how to choose this/these frequency?  |
| Ericsson | We understand that with too many carriers to be measured within limited time can be very unreasonable. We would like to further discuss which baseline to start as this reduce.Also we would like to open the discussion instead of reduce EMR carriers, Network shall have good knowledge about the priority between different carriers which can be included in the measurement configuration. |
| vivo | Considering to reduce the scaling factor here is based on the principle that there may have some prior information on Rx beam after the early measurement has been performed. That’s the reason why we proposed that in enhanced measurement, the priority shall be given to measuring the cells that have been detected/measured in EMR. |

#### Issue 2-2-3: Assumption for feasibility study: Reduced number of samples

* Proposals
	+ Option 1(CMCC): Yes
		- Option 1a (xiaomi): based on L1-RSRP measurement
	+ Option 2(Apple): No
* Recommended WF
	+ Need more discussion

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| --- | --- |
| **Company** | **Comments** |
| MTK | Option 2. We suggest to use L3 intra-frequency measurement requirements as a baseline here, i.e. 24 samples for cell identification and 24 samples for measurement (including Rx beam sweeping factor and number of samples to average). We don’t agree to use fewer samples to average as measurement accuracy cannot be guaranteed. Regarding Rx beam sweeping factor, as all the legacy measurement requirements are defined based on single-panel assumption and simultaneous multi-panel is just in discussion in R18, we think we should stick to single-panel assumption here and keep Rx beam sweeping factor unchanged. |
| CMCC | We are open to discussion. As we discussed in Issue 2-1-3. Whether it is necessary to enhance the number of samples pending on the scenario. If the measurement has impact on RRC connection setup/resume procedure, in order to reduce the impact, it is better to enhance the number of samples. |
| Apple | Number of measurement samples is essential to guarantee accuracy. With reduced number of samples, accuracy cannot be guaranteed, which is problematic if NW configures CA/DC based on the inaccurate result. |
| Xiaomi | We are open to discuss, our intention is to reduce the measurement delay for the improved measurement, as the time of RRC connection procedure can be very short. |
| Qualcomm | Depending on the usefulness of the measurement results if the reduced number of measurement samples leads to performance degradation in terms of accuracy. |
| Huawei | We don’t prefer to use one or less physical measurement samples to present of the cell quality as such measurement accuracy is low and it would degrade the performance robustness. |
| Ericsson | We are open to discuss, we understand the FR2 RX beam sweeping factor is the main cause for the long IDLE mode measurement time. But we don’t think reduce measurement accuracy would be a good starting point. |
| vivo | Sacrificing accuracy for less measurement delay is not a priority. |

#### Issue 2-2-4: Assumption for feasibility study: Reduce the scaling factor of Rx beam sweeping

* Proposals
	+ Option 1 (CATT, CMCC, xiaomi, vivo): Yes
* Recommended WF
	+ Moderator would like the proponents to propose candidate feasible solutions to reduce scaling factor of Rx beam sweeping for further discussion.

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| **Company** | **Comments** |
| MTK | Not agree with option 1. As all the legacy measurement requirements are defined based on single-panel assumption and simultaneous multi-panel is just in discussion in R18, we think we should stick to single-panel assumption here. |
| CMCC | Option 1. In Rel-17, enhancement of scaling factor on RX beam sweeping is introduced. For FR2 HST, the value of scaling factor is 2 or 6 pending on the different deployment. In Rel-17 positioning WI, the candidate Rx beam sweep numbers for reduced Rx beam sweeping factor (<8) UE capability are {1, 2, 4, 6}. Both of the reduced RX beam sweeping factor can be considered as baseline for further discussion. |
| Apple | We have concern on option 1. Same scaling factor needs to be assumed considering all kinds of UE implementation. The scaling factor indeed was reduced in FR2 HST. However, that is for CPE type of UE.From measurement urgency point of view, we don’t think measurement during RRC connection setup is more urgent than that in connected mode. The new measurement is only for potential CA/DC operation, it is likely that NW isn’t urgent to use CA/DC after RRC connection setup. The measurement is configured when UE leaves connected mode. However, network cannot predict there will be huge traffic data after UE sleep in idle.  |
| Xiaomi | Option 1, since the UE has measured on the EMR carriers when T331 is running, UE may have the prior information on the UE Rx beam, when the UE initial the improved measurement during the RRC connection procedure, the UE may not need to use all assumed Rx beam to measure the selected carrier(s). |
| Qualcomm | Open to Option 1. Do not disagree with Xiaomi’s argument in the above comment. However, even if it is considered, it should be limited to very specific conditions. For example, the reduction of scaling factor based on previous measurements hasn’t been considered for any measurement requirements in RRC connected mode. |
| Huawei | We have concern on option 1. From UE implementation perspective, the common RX beam sweeping behavior for UE regardless UE in which state (idle/inactive/connected or some transition duration).  |
| Ericsson | We think option 1 is pretty much possible. When UE is entered from connected to IDLE mode or inactive mode, most probably NW may configure subset of carriers UE was measuring in connected mode. If this is configured, UE could reuse the previous measurement information to avoid the measurement restart from scratch. For example, if CC0 is configured in both connected mode and IDLE or inactive mode, UE can take one sample before each 5sec so that UE can maintain cell known condition and do not have to perform cell search. We think details can be further discussed. Further, if network inidcate UE with prior information or configure before measured carriers, this scaling factor reduction possible. |
| vivo | Support Option 1. Considering to reduce the scaling factor here is based on the principle that there may have some prior information on Rx beam after the early measurement has been performed. That’s the reason why we proposed that in enhanced measurement, the priority shall be given to measuring the cells that have been detected/measured in EMR. |

#### Issue 2-2-5: Assumption for feasibility study: Configuration assumption

* Proposals
	+ Option 1(CMCC, vivo): The requirements cannot be specified based on DRX, SMTC(DRX is not in use during RRC connection setup/resume procedure)
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | Fine with assuming DRX is not in use during RRC connection setup/resume. It is ok to us to use either SMTC or SSB period during feasibility evaluation. We suggest to use the typical value 20ms. |
| CMCC | In our understading, DRX is not in use during RRC connection setup/resume procedure, updates are necessary. As for to use SMTC or SSB periodicity, we are open to discuss. |
| Apple | Fine with using non-DRX requirements as a starting point. |
| Xiaomi | Fine with non-DRX assumption. |
| Qualcomm | Not sure about “SMTC” |
| Huawei | We agree in option 1 that DRX is not used. SMTC/SSB configuration may be achievable for UE, so we can further discuss. |
| Ericsson | We think UE measuring in non-DRX mode is a good starting point for measurement enhancements. We also think instead of SMTC occasion, UE can measure each SSB occasion to fast track the measurements.  |
| vivo | Support Option 1. The value range of SMTC period could be further discussed. |

#### Issue 2-2-6: Assumption for feasibility study: others

* Proposals
	+ Option 1(Ericsson): Study the potential UE measurement enhancement that whether certain additional information or procedure can help UE to measure in a more effective way.
	+ Option 2 (Nokia): UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes
* Recommended WF
	+ Moderator thinks it will be easier to converge if proponent of Option 1 can further clarify what additional information or procedure option 1 is referring to.
	+ Need more discussion.

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| **Company** | **Comments** |
| MTK | Regarding option 2, we think it is a method of how UE determines which frequencies to measure. This should be discussed after confirming the feasibility of improved measurement during RRC connection setup/resume. |
| Apple | We are open to study what additional information can facilitate the procedure. |
| Qualcomm | Open to Option 1.For Option 2, unclear how much/ until when/ what specific information need to be maintained. |
| Huawei | RAN4 needs to have a whole picture of how the measurement during connection setup/resume works before discuss the additional information. |
| Ericsson | Open to both options.For Option 1 as we discuss in Issue 2-2-2: Assumption for feasibility study: number of frequency layers, potential priority of configuration can be provided from network side.Also, as EMR is associate with T331 timer, as time adaptive enhanced measurement requirement can be introduced to guarantee network can use the measurement results at least of UE measurement effort. |
| vivo | We are open to Option 1.And for option 2, we are not very clear about ‘maintain measurement configuration’. Does it mean to maintain ‘*VarMeasIdleConfig*’ after T331 expiry? If that’s what that means, we are fine with Option 2 |
| LGE | Both options are fine to us. |

### Sub-topic 2-3: Feasibility discussion

*Some companies provide solid analysis to show the necessity for improvement in FR2 SCell/SCG setup delay. Moderator thinks RAN4’s work is to study the feasibility. So we only focus on feasibility discussion in this thread.*

*Some companies propose their concerns on the feasibility of improvement in FR2 Scell/SCG setup delay. Moderator encourages companies to comment on their concerns.*

#### Issue 2-3-1: Whether RRC connection setup delay is very short for improvement on FR2 Scell/SCG setup delay

* Proposals
	+ Option 1 (Apple, HW, MTK, vivo): Yes
* Recommended WF
	+ Need more discussion

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| --- | --- |
| **Company** | **Comments** |
| MTK | Agree with option 1. As stated in TS37.910 clause 5.7.2.1, the latency is only 20ms which starts from Msg1 and ends at RRC setup/resume complete. Even UE starts measurement after receiving paging, the latency is only prolonged by some uncertainty time in acquiring the first RACH occasion. Considering the typical SSB period is 20ms, RRC connection setup/resume delay is too short for improved measurement during RRC connection setup/resume procedure. |
| CMCC | Agree with option 1. And the impact on RRC connection setup/resume procedure also need to be considered. It is not expected to prolong the RRC connection setup/resume procedure. |
| Apple | Agree with observation of issue 2-3-1. We also agree with CMCC that RRC connection setup/resume shall not be prolonged just because of the new measurement procedure. |
| Xiaomi | Option 1, we also agree with CMCC that the RRM connection setup/resume procedure should not be impacted. |
| Qualcomm | Agree with Option 1. |
| Huawei | Agree with option 1.The latency of RACH procedure (control plane latency) was ever widespread evaluated from RRC\_Idle/RRC\_INACTIVE state to RRC\_CONNECTED state in R16 study on self evaluation towards IMT-2020 submission [2]. The conclusion is achieved in TS37.910 clause 5.7.2.1: “It is observed that NR fulfils the control plane latency requirement of 20ms in a wide range of configurations. If, in control plane procedure, the latency of step 7 and step 9 can be further reduced, the 10ms target as encouraged by ITU-R can be achieved in some cases.” |
| Ericsson | We agree with that RRC connection setup delay is very short.However this doesn’t exclude a short and accurate measurement can enhance FR2 Scell or SCG setup delay. |
| vivo | Agree with Option 1. However, for the evaluated latency information, maybe 20ms could not be the reference latency for the RACH procedure to some extent. It only calculates the latency from the control latency. The actual latency will be longer considering the uncertainties. |
| LGE | Agree with option 1. |

#### Issue 2-3-2: Impact on RACH due to measurement during RRC connection setup/resume

* Proposals
	+ Option 1 (HW): Due to RX beam sweeping for FR2 measurement, there is a risk that MSG2/MSG4 during RACH procedure are lost.
* Recommended WF
	+ Need more discussion

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| --- | --- |
| **Company** | **Comments** |
| MTK | Agree with option 1. Even assuming 2 active RF chains during RRC connection setup/resume, Msg2/3/4/5 may be impacted if there are more than one frequency to measure due to RF retuning. |
| Apple | Observation can option 1 can happen, which results in limited gain of the new measurement procedure. |
| Xiaomi | Agree with the observation in option 1. |
| Qualcomm | Agree with Option 1, if UE is required to measure cells in the same band as the cell that UE attempts to connect to. |
| Huawei | Support option 1.UE shall sweep the RX beams to perform FR2 L3 mobility measurement. However during the RACH procedure, UE shall receive MSG2 and MSG4. If UE has tuned its beam to perform neighbour cell measurement, there is a risk that MSG2/MSG4 is not correctly received. |
| Ericsson | Open to discuss the impact and potential mitigation schemes. |
| vivo | Regarding the concern from HW, we would like to provide some views on the possible scenarios for CA/DC.* Scenario 1 (EN-DC PCell (FR1) +PSCell (FR2))

In this scenario, there is no impact on RACH procedure due to measurement.* Scenario 2 (FR2 inter-band CA)

Considering UE can be configured for IBM operation for the band pair, there is no impact on RACH. And for CBM, it is not supported in FR2 inter-band CA.* Scenario 3 (FR2 intra-band CA)

For this scenario, referring to the current requirement on SCell activation above, it can be inferred that there is no need to perform EMR and the enhanced measurement.

|  |
| --- |
| 8.3.2 SCell Activation Delay Requirement for Deactivated SCell If the SCell being activated belongs to FR2 and if there is at least one active serving cell on that FR2 band, then Tactivation\_time is TFirstSSB+ 5ms provided:- The UE is provided with SMTC for the target SCell, and - The SSBs in the serving cell(s) and the SSBs in the SCell fulfil the condition defined in clause 3.6.3,- The parameter ssb-PositionsInBurst is same for the serving cell(s) and the SCell.- SSB is in the same half-frame on the SCell and the contiguous FR2 active serving cell |

According to the analysis on every possible scenario above, we think there is no impact on RACH due to measurement during RRC connection. |

#### Issue 2-3-3: Feasibility of improvement in FR2 SCell/SCG setup delay

* Proposals
	+ Option 1 (Apple, HW, MTK, vivo): further discuss the feasibility of improvement in FR2 SCell/SCG setup delay
* Recommended WF
	+ Need more discussion

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| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1.  |
| CMCC | Agree with option 1. |
| Apple | Support option 1. |
| Xiaomi | Fine with option 1 |
| Huawei | Support option 1. |
| Ericsson | We are open to discuss with this. |
| vivo | Fine with Option 1. |
| LGE | Option 1 |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | 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.*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: L1/L2 based inter-cell mobility

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2212671 | vivo | **Observation 1** From RRM perspective, to specify requirements to support R18 L1/L2 mobility, RAN4 would need consider the following extensions to R17 inter-cell L1 measurements and R17 inter-cell TCI switching* Serving cell is changed, while
	+ BWP of target cell can be either same (i.e. target cell is R17 CDP) or different from source cell.
	+ The SSB frequency of source cell and target cell can be either same or different
* The inter-cell operation can be applicable to both sync case and the async case between source cell and target cell.
* For those UEs with higher capability, further discuss whether to support L1 measurements on more than 1 candidate cells per SSB frequency layer, whose timing difference can be larger than CP per frequency layer.

**Observation 2** RAN4 would be responsible for providing the definition of ‘intra-frequency/inter-frequency’ in L1/L2 centric inter-cell operation, which is mentioned in the WID.**Proposal 1** RAN4 to start the discussion of RRM impacts of L1/L2 mobility early in R18, at least focus on the following* Define/Clarify the ‘intra-frequency/inter-frequency’ of inter-cell operation mentioned in the WID.
* Further discuss the necessity, feasibility, and pros/cons for introducing ‘inter-frequency’ L1 measurements to support R18 L1/L2 mobility.
* Further discuss the case when Rx timing difference between different candidate cells on the same frequency layer is larger than CP, is supported by UEs with higher capability in R18 or not.
 |
| R4-2213012 | Huawei, HiSilicon | **Proposal 1**: Both intra-frequency and inter-frequency L1/L2 measurement are supposed to be supported.**Proposal 2**: RAN4 would specify L1/L2 inter-cell mobility delay and each component of L1/L2 inter-cell mobility delay would be analyzed.**Proposal 3**: For R18 L1/L2 inter-cell mobility, the number of supported cells with PCI different from serving cell is supposed to be discussed.**Proposal 4**: If more than 1 non-serving cell are supported to perform L1/L2 mobility, the R17 scaling factor between serving cell L1 measurement and non-serving cells, i.e., Psc and PCDP, needs update correspondingly. |
| R4-2211686 | CATT | **Proposal 1**: RAN4 to define RRM requirements for L1/L2 based inter-cell mobility. The RRM requirements will cover all scenarios. **Proposal 2**: The main impact RRM requirements for L1/L2 based inter-cell mobility may include:* handover delay requirements/interruption requirements
* Cell change requirements
* L1 measurement and reporting requirements
* Timing management requirements

Wait for further progress from RAN2.**Observation 1**: For handover delay/interruption requirements, replace RRC commands component with L1/L2 signalling, TCI switching delay requirements can be referred.**Observation 2**: For timing management requirements, the source cell TA part can be reused. For neighbor cell, the other part can be discussed for adjustment after conclusion of the TA mechanism.  |
| R4-2211911 | Apple | **Proposal 1**: at current stage, RAN4 shall focus on feasibility study for L1/L2 based inter-cell mobility.**Proposal 2**: depending on working group, if UE needs to perform L1 measurement on inter-frequency neighbour cells, a measurement gap shall be configured. RAN4 needs to discuss feasibility of measurement gap based L1 measurement.**Observation 1**: L1/L2 based DAPS handover cannot bring significant gain on top of existing RRC based DAPS handover.**Proposal 3**: simultaneous Rx/Tx with both source cell and target cell is not considered in L1/L2 based inter-cell mobility. At least not as baseline assumption for UE to support this feature. |
| R4-2212409 | MediaTek Inc. | **Proposal 1**: We suggest to define RRM requirements assuming single panel in FR2.**Proposal 2**: We suggest to deprioritize the discussion on inter-frequency L1/L2-based inter-cell mobility.**Proposal 3**: For intra-frequency L1 measurement on neighbor cell, we can use the requirements for L1 measurement on NSC in R17 as a start point:* + single FFT assumption
	+ the timing offset of serving cell and neighbor cell is within CP
 |
| R4-2212870 | Nokia, Nokia Shanghai Bell | **Proposal 1:** RAN4 to discuss which delay component would be expected when performing an L1/L2 mobility cell change.**Observation 1:** Cell change interrupt related to a cell change by L1/L2 mobility should aim at being shorter than existing interrupt due to L3 handover to enable gains from L1/L2 mobility over existing L3 mobility.**Observation 2:** RAN4 has defined L1-RSRP measurement accuracy requirements for a cell with different PCI than serving cell.**Proposal 2:** Discuss if existing L1-RSRP measurement requirements for a cell with different PCI than serving cell can apply for L1 measurements for L1/L2 mobility.**Proposal 3:** Discuss the L1-RSRP measurement accuracies and whether they can be improved for L1/L2 mobility.**Observation 3:** Inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell need to be defined. |
| R4-2213959 | Ericsson | **Proposal 1**: L1/L2 mobility shall be discussed as a new feature compared to inter-cell BM and do not consider inter-cell BM requirements as baseline for L1/L2 mobility.**Proposal 2**: UE capability of supporting multi-RX chain and simultaneous RX from different QCL type-D should be considered in L1/L2 mobility.**Proposal 3**: RAN4 to study L1-RSRP measurement on L1/L2 mobility candidate cells impact to L3 mobility measurements.**Proposal 4**: RAN4 to consider both intra-frequency and inter-frequency candidate cells for defining the requirements for L1 measurements.**Proposal 5**: RAN4 to study of the possibility to use any type of gaps for inter-frequency L1 measurements.**Proposal 6**: RAN4 to study and define the following requirements * L1/L2 mobility delay requirements
* L1/L2 mobility interruption requirements
* Measurement’s requirements and measurement accuracy requirements
* Timing requirements
	+ MRTD and MTTD
 |

## Open issues summary

### Sub-topic 3-1: RRM requirements to specify

#### Issue 3-1-1: L1/L2 inter-cell mobility delay requirements

* Proposals
	+ Option 1(HW, CATT, Nokia, Ericsson): To specify L1/L2 inter-cell mobility delay and each component of L1/L2 inter-cell mobility delay would be analysed.
* Recommended WF
	+ Need more discussion

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| **Company** | **Comments** |
| MTK | We agree with option 1. But as the requirements are highly depending on the design in RAN2, we can start the work after RAN2 has specified concrete procedures. |
| CMCC | OK with option 1. |
| Apple | Fine with option 1 in principle. Details can be discussed once procedure becomes stable in other working group. At current stage, RAN4 can focus on feasibility discussion, if requested by other working groups. |
| vivo | We think the discussion is already on-going in RAN2. We are not sure what is the expected outcome if RAN4 start this discussion. It would be slightly early to discuss the HO delay requirements since the procedure is still not clear in RAN1. |
| Qualcomm | Although Option 1 will be anyway the case, it is too early to open the floor to the detailed discussion in RAN4 without much context from RAN2. |
| Huawei | Support option 1.In R18 mobility enhancement WI, both intra-frequency and inter-frequency L1/L2 mobility are in the work scope. To support L1/L2 based inter-cell mobility, it is straight forward to support intra-frequency and inter-frequency L1/L2 measurement. Moreover inter-frequency is a typical scenario for handover. Not supporting inter-frequency would loss a part of essential deployment scenario from network deployment perspective. |
| Ericsson | Agree with option 1 and share similar views as MTK |

#### Issue 3-1-2: L1/L2 inter-cell mobility interruption requirements

* Proposals
	+ Option 1(CATT, Ericsson): To specify L1/L2 inter-cell mobility interruption requirements
* Recommended WF
	+ Moderator would like to check whether the interruption requirements here are Tinterrupt in mobility delay requirements. If yes, this issue is covered by issue 3-1-1 and no more discussion on this issue.

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| **Company** | **Comments** |
| Apple | Agree with moderator that this can be covered by issue 3-1-1. |
| vivo | We can agree to delay discussion of this issue in future meetings. |
| Huawei | If the mobility interruption refers to Tinterrupt in handover, this issue is covered by issue 3-1-1. |
| Ericsson | We think there can be one or more type of interruptions based on the further agreements on the other issues.1. Tinterrupt

If the inter-frequency measurement and/or measurement gaps are considered, then interruptions due to MG may need to be considered.  |

#### Issue 3-1-3: L1-RSRP measurement delay requirements

* Proposals
	+ Option 1(CATT, Ericsson): Specify L1-RSRP measurement delay requirements
		- Option 1a (HW): If more than 1 non-serving cell are supported to perform L1/L2 mobility, the R17 scaling factor between serving cell L1 measurement and non-serving cells, i.e., Psc and PCDP, needs update correspondingly.
		- Option 1b (Ericsson): Study L1-RSRP measurement on L1/L2 mobility candidate cells impact to L3 mobility measurements.
	+ Option 2 (Nokia): Discuss if existing L1-RSRP measurement requirements for a cell with different PCI than serving cell can apply for L1 measurements for L1/L2 mobility.
* Recommended WF
	+ Need more discussion.

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| **Company** | **Comments** |
| MTK | This issue is highly pending on the outcome of issue 3-2-3/3-2-4/3-2-5/3-2-6. We suggest to discuss this issue after RAN4 has agreement on issue 3-2-3/3-2-4/3-2-5/3-2-6. |
| Apple | In general we agree with most options that some update/further discussion is needed on top of existing RAN4 requirements. however, it might be too early to draw any conclusion since the procedure and supported scenario is unclear now. |
| vivo | Agree with MTK and Apple that it is slightly early to draw conclusions on this. |
| Qualcomm | Wait until more progress has been made in RAN2 |
| Huawei | Option 1a. and we are fine to discuss the details after we had conclusions on supported scenarios. |
| Ericsson | We think option 1 and option 2 are contradicting each other. We can further study. |

#### Issue 3-1-4: Timing management requirements

* Proposals
	+ Option 1 (CATT): Specify timing management requirements
		- For timing management requirements, the source cell TA part can be reused. For neighbor cell, the other part can be discussed for adjustment after conclusion of the TA mechanism.
* Recommended WF
	+ Need more discussion.

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| --- | --- |
| **Company** | **Comments** |
| MTK | As this issue is highly depending on the design in RAN1/2, we can wait for RAN1/2 input. |
| Apple | Further study is needed. more RAN1/2 input is expected. |
| vivo | We are OK to discuss TA issue in RAN1/2 firstly. |
| Qualcomm | Wait until more progress has been made in RAN2. Not clear what “source cell TA can be reused” really means. |
| Huawei | Depends on RAN1/2 conclusion. |
| Ericsson | Same view as MTK |
| LGE | Wait RAN1/2 decision. |

#### Issue 3-1-5: Timing requirements

* Proposals
	+ Option 1 (Ericsson): Specify timing requirements
		- MRTD and MTTD
* Recommended WF
	+ Need more discussion. Moderator would like the opponent to clarify whether MRTD and MTTD here refers to MRTD and MTTD between serving cell and target cell.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | We don’t get what MRTD and MTTD requirements and why these requirements are to be specified here. Maybe Ericsson can clarify? |
| Apple | Option 1 is unclear to us. Does it imply simultaneous connection between source and target cell? |
| Qualcomm | Is this about timing different between source and candidate cells for L1/L2 based mobility? |
| Huawei | Is this for the RX time difference between serving cell and target cell? |
| Ericsson | In inter-cell BM, as only intra-frequency carrier was considered, we assumed that RTD between TRP are within the CP. When the inter-frequency measurements are considered, we are not sure if it can be within CP or can be more than CP. IF it can be more than CP, we need to specify MRTD applicability for measurements.  |

### Sub-topic 3-2: Scenarios

#### Issue 3-2-1: Whether to consider simultaneous Rx/Tx with both source cell and target cell

* Proposals
	+ Option 1 (Apple): No
* Recommended WF
	+ Need more discussion.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Agree with option 1. In our understanding, this WID does not intend to study L1/L2 based DAPS handover. Simultaneous Rx/Tx with both source cell and target cell requires high UE complexity. In this WI, a CG can be switched. UE complexity would scale up with the number of cells in a CG if consider simultaneous Rx/Tx with both source cell and target cell. |
| Apple | Support option 1. Considering we already have RRC based DAPS handover, the benefit of L1/L2 based DAPS is very limited. DAPS handover is not that sensitive to handover delay and interruption since UE can still do business with network during handover. |
| vivo | Agree with option 1. In our understanding this is out-of-scope of this WI. |
| Qualcomm | Support Option 1 for now. |
| Huawei | Agree with option 1.  |
| Ericsson | Agree with option 1.  |
| LGE | Support option 1 |

#### Issue 3-2-2: Whether to consider simultaneous multi-panel in FR2

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

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| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1. Since all the legacy RRM requirements are defined based on single panel assumption in FR2 and there is a R18 WI especially for multi-panel (RP-221753), the discussions on RRM requirements related to multi-panel should wait for the outcome of RP-221753. Therefore, we should focus on single panel in this WI. |
| Apple | Support option 1 to allow more UE to enjoy this feature. |
| vivo | Agree with option 1. In our understanding this is out-of-scope of this WI. |
| Qualcomm | Support Option 1 for now. |
| Huawei | Support option 1. We would not like to mix two R18 feature together.  |
| Ericsson | Option 2. We think multi-rx discussion and L1/L2 mobility are quite related and extension to inter-cell BM we think we can define requirements for both of these features in parallel. Moreover, when a rel-18 UE supports multi-panel, it can support for all features of Rel-18. |
| LGE | Support option 1. |

#### Issue 3-2-3: Definition of intra-frequency/inter-frequency in inter-cell operation

* Proposals
	+ Option 1(vivo): RAN4 to discuss the definition of intra-frequency/inter-frequency in inter-cell operation
* Recommended WF
	+ Need more discussion.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | We think the definition of intra-frequency and inter-frequency is used for L1-RSRP measurement. For SSB L1-RSRP measurement, we can follow the definition of L3 measurement. For CSI-RS L1-RSRP measurement, we think further discussion is needed on the definition after RAN1/2 and RAN4 have confirmed to use CSI-RS L1-RSRP measurement for L1/L2 inter-cell mobility. |
| vivo | Support option 1.To MTKEven for SSB based measurement, whether the SSB frequency to be measured can be different from serving cell, but within the active BWP of the UE. In R17 RAN4 has discussed NCD-SSB and we are not sure whether such SSB can be configured for L1 measurements.  |
| Qualcomm | Without explicit new suggested definition, difficult to share our views on it. |
| Ericsson | We are fine with option 1 |

#### Issue 3-2-4: Whether to cover inter-frequency

* Proposals
	+ Option 1(MTK, vivo): Further discuss the necessity, feasibility, and pros/cons
	+ Option 2 (HW, CATT, Nokia, Ericsson): Yes
		- Option 2a (Apple): cover inter-frequency measured using measurement gap
		- Option 2b (Ericsson): Study of the possibility to use any type of gaps for inter-frequency L1 measurements
* Recommended WF
	+ Need more discussion.

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| **Company** | **Comments** |
| MTK | Option 1. For inter-frequency L1-RSRP measurement, UE is supposed to measure in MG. Measurement opportunities are shared among L1/L3 measurement. The measurement delay will be very long. The intention to use L1 measurement for L1/L2 mobility is to get the channel state change timely to switch to a better beam. Due to long measurement delay of inter-frequency, the benefit will be marginal compared to cell switch based on L3 measurement. |
| CMCC | Option 2. According to the WID, it is clearly stated that both intra-frequency and inter-frequency are included.  |
| Apple | We are open to study the pros/cons. However, inter-frequency is explicitly captured in the scope.  |
| vivo | Option 1. We are not sure whether the WID clearly stated that inter-frequency L1 measurement needs to be supported. We have the same view as MTK. If we follow the same assumptions as in R17, inter-frequency L1 measurements would be performed by UE based on the fine timing, similar to the L1-measurement for TCI activation. It would be quite challenging for UE to perform such inter-frequency L1 measurement within a limited gap period, while ensuring the measurement performance same as serving cell. |
| Qualcomm | Agree that inter-freq is already in WID. If the discussion is about whether to define the requirements for the case, okay with Option 1. |
| Huawei | Support 2. In R18 mobility enhancement WI, both intra-frequency and inter-frequency L1/L2 mobility are in the work scope. |
| Ericsson | Option 2. L1/L2 mobility is supposed to be used for replacing L3 mobility in some (deployment) scenarios of operation. Only way it can be facilitated in a full-fledged manner is by supporting inter-frequency and intra-frequency HO. How to support inter-frequency measurements can be discussed in next meetings. |

#### Issue 3-2-5: Whether to cover non-synchronous scenarios

* Proposals
	+ Option 1 (MTK): No
	+ Option 2 (CATT): Yes
	+ Option 3 (vivo): FFS
* Recommended WF
	+ Need more discussion.

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| --- | --- |
| **Company** | **Comments** |
| MTK | We don’t think the definition of synchronous and non-synchronous is clear now. The definition for L1-RSRP measurement and cell switch delay may be different. For L1-RSRP measurement, non-synchronous is referring to that the time offset between serving cell and to-be-measured neigbour cell is larger than CP in our understanding. |
| Apple | It is better to come back to this issue when handover procedure become stable.  |
| Vivo | We are OK to further discuss the network synchronization assumption for this WI. Less than CP can be one potential option for the assumption, but we are not sure the applicability of such assumption, e.g. whether it applies for both UL and DL. We are open to discuss but see the benefit to start the discussion early.Options to be studied can be:* SFN synchronized and timing difference for UL/DL is within CP.
* SFN synchronized and timing difference for UL/DL is within MRTD/MTTD.
* SFN non-synchronized (e.g. FDD)
 |
| Qualcomm | Although the definition of sync vs. async is not clear yet, the extent of A-synchronousness will be also up to RAN2 progress, e.g. within DU/CU. |
| Huawei | Needs further discussion. |
| Ericsson | Since L1/L2 mobility is to replace L3 mobility for some scenarios we should have same scenarios considered. |

#### Issue 3-2-6: Whether to support L1 measurement on multiple cells with PCI different from serving cell

* Proposals
	+ Option 1(HW, vivo): to discuss the number of supported cells with PCI different from serving cell
* Recommended WF
	+ Need more discussion.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | We think it is whether to support L1 measurement on multiple neighbor cells in a FR2 band to discuss. Due to CBM limitation, UE is supposed to measure different neighbor cells on the same FR2 band in a TDM way.We prefer to deprioritize multiple cells in a FR2 band. The more cells to perform L1 measurement, the more interruptions on serving cells or longer measurement delay is expected. In our understanding, NW is supposed to configure cells to perform L1 measurement based on L3 measurement results. We think it is reasonable that NW reconfigures the cell to perform L1 measurement if needed instead of asking UE to measure a bunch of cells. |
| Apple | Agree with option 1 in principle. We also agree with MTK that supporting large number of neighbor cells with L1 measurement would result in longer delay. That’s why we need to discuss the number and define corresponding capability/restriction in RAN4. Usually in RAN1/2 design network can configure much more than RAN4 capability.  |
| vivo | We think for the mobility case, it is reasonable to consider slightly larger number of supported cell, in both FR1 and FR2. Therefore we support option 1. |
| Qualcomm | The issue will be anyway discussed towards the end of Core part. It should be also noted that UE supporting L1/L2 based mobility will still need to perform measurements for L3 based traditional handover and so on. So RAN4 needs to make sure the total number of cells to be monitored should not increase too much. |
| Huawei | Support option 1, this issue needs to be discussed. If more than 1 non-serving cell are supported to perform L1/L2 mobility, the R17 scaling factor between serving cell L1 measurement and non-serving cells, i.e., Psc and PCDP needs update correspondingly. |
| Ericsson | We support the proposal.  |

### Sub-topic 3-3: Measurement accuracy

#### Issue 3-3-1: Intra-frequency L1-RSRP measurement accuracy requirements

* Proposals
	+ Option 1 (Nokia): Discuss whether they can be improved for L1/L2 mobility
* Recommended WF
	+ Need more discussion

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| --- | --- |
| **Company** | **Comments** |
| MTK | Not agree with option 1. We don’t think this is in the scope. |
| Apple | Same view as MTK. Besides, accuracy belongs to performance part and shall not be discussed during core part design. |
| vivo | We are OK to further discuss the impact to core part requirements for this accuracy enhancements, e.g by using larger number of samples. However, we are not sure it is right time now to start the discussion. |
| Qualcomm | For the accuracy, the SNR regime will also matter as well as the number of measurement samples. We believe target/candidate cells for L1/L2 based mobility won’t be in a low SNR regime. |
| Huawei | Option 1 is not clear to us. |
| Ericsson | We are fine to study this |

#### Issue 3-3-2: Inter-frequency L1-RSRP measurement accuracy requirements

* Proposals
	+ Option 1 (Nokia): Define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell
* Recommended WF
	+ Come back when we have conclusion on issue 3-2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Accuracy belongs to performance part and shall not be discussed during core part design. |
| vivo | This should be discussed in perf part. Same view as Apple. |
| Qualcomm | For the accuracy, the SNR regime will also matter as well as the number of measurement samples. We believe target/candidate cells for L1/L2 based mobility won’t be in a low SNR regime. |
| Ericsson | Support the proposal |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | 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.*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #4: CHO/CPAC Enhancement

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211686 | CATT | **Proposal 3**: RAN4 to define RRM requirements for NR-DC selective activation of the cell groups requirements. Depend on RAN2/RAN3 outcomes. PSCell change and CPC requirements for EN-DC and NR-DC can be referred as start point.**Proposal 4**: RAN2 and RAN3 finished supporting CHO including target MCGs and target SCGs. RAN4 to reuse current RRM requirements for CHO including target SCG. **Proposal 5**: For CHO including target MCG and candidate SCGs for CPC/CPA in NR-DC, it depends on RAN2/RAN3 outcomes. RAN4 requirements of CHO/CPC CPA can be referred to. |
| R4-2211911 | Apple | **Observation 2**: whether candidate SCGs are considered as neighbor cells or deactivated SCGs has impact on RAN4 requirements.**Observation 3**: most of the existing CPC/CPA requirements in RAN4 can be reused to support subsequent cell group change. Some clarification/change on CPC/CPA starting point may be needed.**Proposal 4**: RAN4 shall wait for RAN2 input on procedure design of selective SCG activation and subsequent cell group change to further discuss RAN4 impact. |
| R4-2213014 | Huawei, HiSilicon | **Proposal 1**: If RAN4 would like to define delay requirements of R18 CPAC with subsequent CPC, how to the starting point of the 2nd time CPC needs further discussion. -Option 1: from UE 2nd triggering the CPC;-Option 2: using the legacy starting point and define the delay includes both the 1st time CPAC and subsequent CPC**Proposal 2**: When CHO and associated CPA are executed simultaneously, the CHO delay with PSCell may need to be specified.**Proposal 3**: Whether RAN4 needs to define requirements for non-simultaneous CHO and CPA depends on RAN2 progress. |
| R4-2213019 | vivo | **Proposal 1:** The RRM requirements of CHO and CPAC will be discussed until RAN2 has specified concrete scenarios and procedures.**Proposal 2:** For subsequent CPAC, whether there are concrete effects on the current CPAC delay requirements depend on RAN2’s conclusions. |

## Open issues summary

### Sub-topic 4-1: subsequent CPAC

**Issue 4-1-1: RRM requirements for subsequent CPAC**

* Proposals
	+ Option 1 (CATT, Apple, vivo): wait for RAN2 input to further discuss RAN4 impact.
	+ Option 2 (HW): Further discussion the starting point of the 2nd time CPC if to define RRM requirements for subsequent CPAC
* Recommended WF
	+ Moderator suggests to start the discussion when RAN2 has specified concrete scenarios and procedures.

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| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1.  |
| Apple | Option 1. |
| Qualcomm | Option 1. |
| Huawei | We are open on this issue. The aim of this R18 mobility enhancement objective is to enable subsequent CPC after SCG change without reconfiguration and re-initiation of CPC/CPA. Then UE executes the subsequent CPC autonomously rather than network-control handover triggering. So the framework of this obj is clear. RAN4 can start the discussion on the starting point of subsequent CPC/CPA delay if RAN4 agree to define requirements. We agree that the details of the procedure depends on RAN2 input. |
| Ericsson | Option 1 |
| vivo | Support Option 1. |
| LGE | Option 1 |

### Sub-topic 4-2: CHO with CPAC

**Issue 4-2-1: RRM requirements for CHO with CPAC**

* Proposals
	+ Option 1 (CATT, HW, vivo): wait for RAN2 input to further discuss RAN4 impact.
* Recommended WF
	+ Moderator suggests to start the discussion when RAN2 has specified concrete scenarios and procedures.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1. |
| Apple | Option 1 |
| Qualcomm | Option 1. |
| Huawei | Option 1. |
| Ericsson | Option 1 |
| vivo | Option 1 |
| LGE | Option 1 |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | 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.*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

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