**3GPP TSG-RAN WG4 Meeting # 104-e R4-2214286**

**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 |
| CATT | In general, we are fine with the work plan. But we have one question to this WI not just for RRM.In latest WID, RF part will start in RAN4#106 meeting. (Feb in next year. )Usually, the RF will start early because it might affect RRM core requirements. Does it mean some RRM core requirement (if any has dependency on RF session) can only be discussed after Feb, 2023? |
| Nokia | Work plan is fine. RAN4 can start initial discussions on some of these aspects even if RAN2 has not fully matured. |

## 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**  |
| **Issue 1-1: Work plan proposals***In first round discussion, some companies have some concern on the work plan in R4-2211550**Recommendations for 2nd round:* comment on the revised work plan in the 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| *R4-2211550* | *To be revised* |

## Discussion on 2nd round (if applicable)

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

*In first round discussion, some companies have some concern on the work plan in R4-2211550.*

*For 2nd round:* comment on the revised work plan in the 2nd round.

*Note: please comment on the dedicated Email thread for work plan.*

# 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. |
| CATT | Fine with MTK’s proposal. |
| Nokia | We want to clarify from the scope of the Objective. The WI indicates that the following sequence of events should be assumed:* **Access is initiated by the UE** (including based on receiving paging) and UE performs possible improved measurements when requesting connection setup.
* The UE reports such possible improved measurements once those have been performed.

We would like to clarify that “access is initiated by UE” which may be somewhat ambiguous, but our intent when discussing the WI text was to consider the earliest time when UE is aware of RRC connection initiation. For MT call, this would be when UE receives a paging request, and for MO call this would be when NAS indicates to AS that an RRC connection is required. * For MT-originating calls, RRC clause 5.3.2.3 (paging reception, see below) indicates that UE forwards the paging to the upper layers (covering receiving paging in either RRC\_IDLE and RRC\_INACTIVE), which will then eventually initiate the RRC connection attempt via MO-originating process. Hence, UE shall be considered as initiating connection when receiving a network paging request that is forwarded to upper layers.
* For MO-originating calls, RRC clause 5.3.3.2 and 5.3.13.2 (RRC connection establishment and resume, respectively, see below), are triggered when upper layers request RRC connection. Those parts can obviously be used as the timing for MO-originating calls.

From the discussion and results we have presented in our paper, it is clear that any enhancement that can help reducing the FR2 SCell/SCG setup delay can bring significant benefit on the system level and TP performance. Reduction of the delay will benefit both the UE and the network. |

#### 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. |
| CATT | We are fine with option 2a/2b and 2c. |
| Nokia  | We do not see these options as exclusive but more or less addressing the same. Both option 1 and option 2 are fine with us. On the detailed level we understand that the UE know when there is a need for establishing a connection. We agree with QCs comment that we should not exclude enhancements based on the existing EMR framework.And to clarify our proposal, we suggest that the network can configure the UE to continue measurements on one or more carriers during the connection setup and potentially during a period of time while in connected mode. As discussed in our paper. The point of time when this is done can be precisely defined in RRC procedures, and RAN4 requirements can then be defined according to that. And we do not expect that enhancements should lead to a delay in the connection setup (as discussed by CMCC). |

#### 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. |
| CATT | Open to option 1/2/3. |
| Nokia  | We are open to discuss all the proposed options. We see them as complementary and can help improving the setup delay. We are open for solutions that reduce the measurement delay and reduce CA/DC setup time. We would like to note that one aspect with the Rel-16 EMR solution is that it is not possible to use search thresholds, to enable additional UE power saving in idle mode, together with EMR. Reason for this is that it leads to that the UE in good conditions does not measure configured EMR carriers except once every Thigher\_priority\_search. This issue was discussed a lot during Rel-16, and current behavior is to account for the UE complexity and impact on legacy behavior. As the current work addresses only FR2 cell we suggest discussing removing the current limitation. We suggest that an FR2 carrier solely configured for idle mode CA/DC measurements can be configured without search thresholds.We do not see that there is anything in the WID objective that excludes using EMR framework |

#### 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. |
| CATT | Option 1.  |
| Nokia | We are fine with both options, but we assume that it is also possible that any cell measurement is available. Hence, scenarios are not limited to above two mentioned options.We can discuss about scenarios, but the baseline should be that any scenario that bring enhancements to establishment / resume delays should be considered. We would like to note that to improve the user throughput as well as data transmission latency (e.g., reducing packet queuing/buffering delay), and reliability, it is important to reduce secondary link establishment/resume delay(s) for PSCell/ SCell setup in DC/CA operation scenarios. Therefore, we don’t see a reason why we should be down scoping scenarios at this stage. We should not be limited to options 1&2. |

### 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. |
| CATT | Option 2.  |
| Nokia | It is feasible to assume multiple (≥ 2) RF Chains. The discussion should be around how many RF chains UE is using for performing the measurements. It is not clear if the RF chains are FR1 or FR2. We agree with other companies that this is scenario based and needs more discussion. |

#### 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 | Our proposal in issue 2-1-4 is essentially similar as Option 1. Base on the assumption that there is much short available duration can be used for measurement, maybe it could be considered to perform a quick measurement (e.g. one-shot measurement) on the EMR carries that have already measured in early measurement. Regarding ‘FFS how to select the EMR carriers to be measured for improved measurement’ from xiaomi, our point is, the signal quality could be considered as one of the selection criterions. That means we can just focus on the cells with top quality, which is to further check whether the quality of cell is still strong to be used for FR2 CA/DC configuration. |
| CATT | FFS. The delay can be decreased if number of carriers is reduced. Open to discuss in which scenario the number can be reduced.  |
| Nokia | In Rel-16 we allowed for an EMR configuration which could include a large number of EMR carriers. It is obvious that more carriers cause more measurement delay. However, the network can already reduce the latency by reducing the number of carriers in the EMR configuration.We are open for looking into this if it is possible to reduce the delay. Also check our response in 2-2-3. |

#### 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. |
| CATT | Prefer to not change the number of samples unless it shows it can work in some special scenario. For the common case, we think the number of samples should be the same as legacy. |
| Nokia | This is a tradeoff between guaranteed accuracy and getting CA/DC up fast. We should investigate this, but also keep in mind that less accurate measurement may also have negative impacts. We should note that: A UE that supports *idleInactiveNR-MeasReport-r16* shall be capable of monitoring at least 14 carrier frequencies, including 7 NR inter-carrier frequencies for DC/CA purposes. While timer T331 is running, the UE is required to search and measure CA configured carriers for EMR and prepare for potential reporting. Based on the measurement configurations and measured camped cell values, the following cases may occur: * If SnonIntraSearchx thresholds are configured, when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, the user is required to search and measure idle-mode DC/CA configured inter-carrier frequencies based on the requirement specified in [2] section 4.2.2.4, table 4.2.2.4-1.
* If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, the UE is required to search for idle-mode DC/CA frequencies at least every Thigher\_priority\_search = (60 x Nlayers) seconds, where Nlayers is the combined total number of higher priority NR and E-UTRA carrier frequencies broadcasted in system information and carriers configured for idle mode CA measurements.
* If SnonIntraSearchx thresholds are not configured (SnonIntraSearchx is infinite) the same requirements as when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ applies.

if SnonIntraSearchx thresholds are configured and Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ the UE shall be able to detect a new cell and perform SS-RSRP and/or SS-RSRQ measurements on carrier configured for idle mode DC/CA measurements according to the below presented table 4.2.2.4-1 [2]. The UE shall filter the measured RSRP/RSRQ over the minimum of two measurement instances where the measurements are spaced by at least Tmeasure,NR\_inter/2. |

#### 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. |
| CATT | Support option 1 in conditions. We are fine with leave conditions as FFS for companies’ concern.  |
| Nokia | We are open to option 1. The scaling factor has significant impact on delay and we are open to discuss about the reduction. In our contribution, we provide the following: scaling\_factor = 8 for FR2 * **Tdetect,NR\_Inter + Tmeasure,NR\_Inter =** (36\*8\*1.5 + 4\*scaling\_factor\*1.5)\*320 = **153600 msec** for an **FR2** carrier frequency.
* **Tdetect,NR\_Inter + Tmeasure,NR\_Inter =** (36 \*1.5 + 4\*1.5)\*320 = **19200 msec** for an **FR1** carrier frequency.
 |

#### 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. |
| CATT | For non-DRX, we are fine.  |
| Nokia | Yes, we agree that DRX is not used during connection setup / resume. We also think that it is important to understand what the impact is of not assuming DRX has and look into both SMTC and SSB occasion.  |

#### 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. |
| CATT | Fine with option 1.  |
| Nokia | Option 1 & Option 2 re complementing each other. We think that network can configure the UE to continue measurements on one or more carriers during the connection setup and potentially during a period of time while in connected mode. UE being aware of the measurement configuration before being configured with such after entering connected mode. Assuming UE can perform the measurements in FR2 independently from FR1, the UE which conditions have not changed significantly (still within coverage of the same FR2 cell) can reduce the overall measurement delay.  |

### 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. |
| Nokia | We should understand first whether UE is able to finish measurements once RRC setup/resume is completed if measurement that are impacting the delay are enhanced. UE may be able to provide existing / fast measurements within this 20ms time window.We also agree with Ericsson that we shouldn’t exclude to have short and accurate measurements to improve delay.  |

#### 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.

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| 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. |
| Nokia | We see that this needs more discussion, but the issue raised by Huawei is very relevant. As mentioned by Qualcomm this depends on the scenario.As we also state in our paper, we assume that the focus is on enabling enhancements related to one cell in FR2 – the first cell in an FR2 band. Hence, the UE is accessing the serving cell in FR1 (or LTE). |

#### 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 |
| CATT | Fine with Option 1.  |
| Nokia | We think that we should discuss this as it is defined in the work plan. 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. |

## 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.*

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| --- | --- |
| **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.*

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

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| **Status summary**  |
| **Issue 2-1-1: Carification on time point of “when UE has initiated access”***No tentative agreements.**Candidate options:** + Option 1(Ericsson, 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.
		- Paging
		- Initiation (UE receives SIB1 and apply default MAC cell group configuration)
		- RRC connection resume
	+ Option 2(MTK, CMCC, Apple, xiaomi, HW, vivo, CATT): Discuss the starting point for improved measurement directly.

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-1-2: Potential direction for further study: measurement enhancement when UE is about to enter connected mode**

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| *Further clarification from CMCC for Option 1*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. |

*No tentative agreements.**Candidate options:** + Option 1(CMCC): UE perform enhanced measurement closely before RRC connection setup/resume.
		- For MT originating call, the measurement is performed during the period between paging reception and UE send *RRCResumeRequest/ RRCSetupRequest*.
		- For MO originating call, the measurement is performed after upper layers request establishment of an RRC connection and before UE send *RRCResumeRequest/ RRCSetupRequest*.
	+ Option 2: 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 (MTK, vivo, Ericsson ): after receiving paging for MT originating call
		- Option 2c (MTK, HW, vivo): after first RACH preamble transmission, i.e. Msg1
		- Option 2d (Ericsson): Initiation (UE receives SIB1 and apply default MAC cell group configuration) for MO originating call
		- Option 2e (Apple, xiaomi, QC): FFS

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-1-3: Potential direction for further study: enhancement on R16 EMR, i.e. measurement enhancement in idle/inactive mode***No tentative agreements.**According to the 1st round discussion, the most diverge on this issue is whether further enhancement on R16 EMR (measurement during green part) is in the scope. Moderator suggests to align the understanding on this at first before go to more details.**Candidate options:** + Option 1 (MTK, Apple, xiaomi, HW, vivo): further enhancement on Rel-16 EMR (measurement during green part) is out of scope
	+ Option 2 (CMCC, QC, Ericsson, Nokia, LGE, CATT): further enhancement on Rel-16 EMR (measurement during green part) is in the scope

 *Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-1-4: Applicable scenarios** *All the companies have no concern on option 1. Some companies raise to consider other possible scenarios either.**Tentative agreements:* The enhanced measurement (if feasible) at least applies to scenarios that the EMR measurement results are unavailable or invalid.*Candidate options:** + Revised Option 2 (QC, vivo, LGE, Nokia): Further study whether enhanced measurement is applicable to scenarios that EMR measurement results are available and valid
		- e.g. On the cells that have been detected/measured in early measurement

 *Recommendations for 2nd round:* *Further discussion.* |

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

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| **Status summary**  |
| **Issue 2-2-1: Assumption for feasibility study: RF chain status when performing enhanced measurement***Majority companies support option 2. Two companies point out that one RF chain shall also be allowed for UE only capable of intra-band CA. One company proposes multiple (≥ 2) RF Chains may also be feasible.**Candidate options:** + Option 1 (Apple, HW): One active RF chain
	+ Option 2 (CMCC, xiaomi, MTK, Ericsson, vivo): Two active RF chains
	+ Option 3 (Nokia): more than two active RF chains

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-2-2: Assumption for feasibility study: number of frequency layers***Majority companies think “Reduce the number of EMR carriers to be measured for improved measurement” is a potential direction. Some companies point out that there are some issues for further discussion, i.e. how to select the frequency layers for improved measurement, how many frequency layers to measure, which scenario that is applicable.* *As option 2 in issue 2-2-6 “UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes” is about how to select the frequency layers for improved measurement. Moderator suggests to merge it in this issue.**Candidate options:** + Revised Option 1: Reduce the number of EMR carriers to be measured for improved measurement.
		- FFS: how to select the frequency layers for improved measurement, how many frequency layers to measure and which scenario that is applicable.
			* Option 1a (Nokia): UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-2-3: Assumption for feasibility study: Reduced number of samples***Majority companies have concern on measurement accuracy with reduced number of samples. Almost all the companies emphasize that measurement accuracy should be guaranteed.**Candidate options:** + Option 1: Yes
	+ Option 2 (MTK, Apple, HW, CATT ): No
	+ (new) Option 3 (CMCC, xiaomi, QC, Ericsson, vivo, Nokia): FFS how to reduce number of samples without measurement accuracy degradation.

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-2-4: Assumption for feasibility study: Reduce the scaling factor of Rx beam sweeping***No tentative agreements.**Candidate options:** + Option 1(CATT, Nokia): Reduce the scaling factor of Rx beam sweeping
		- Option 1a (CMCC): use Rx beam sweeping factor of R17 HST FR2 or R17 positioning
			* 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}.
		- Option 1b (xiaomi, Ericsson, vivo): Use prior information on the UE Rx beam to reduce the scaling factor of Rx beam sweeping
	+ Option 2 (MTK, Apple, HW): Not to reduce the scaling factor of Rx beam sweeping
	+ Option 3 (QC): Further discussion

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-2-5: Assumption for feasibility study: Configuration assumption***All companies support that DRX is not in use during RRC connection setup/resume procedure for enhanced measurement.* *Tentative agreements:* DRX is not in use during RRC connection setup/resume procedure for enhanced measurement.*Regarding not using SMTC, there is no tentative agreements.**Candidate options:** + Option 1 (vivo): use SMTC when specifying the requirements
	+ Option 2 (Ericsson ): use SSB period when specifying the requirements
	+ Option 3 (CMCC, MTK, HW): Further discussion

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-2-6: Assumption for feasibility study: others***As option 1 is covered by issue 2-2-2 and 2-1-3 based on Ericsson’s clarification. Moderator suggests to discuss in issue 2-2-2 and 2-1-3 and not to discuss in this issue in the 2nd round.*

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| *Clarification from Ericsson on Option 1*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. *(Moderator: discussed in issue 2-2-2)*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. *(Moderator: discussed in issue 2-1-3)* |

*Regarding Option 2, there is no tentative agreements. In my understanding, option 2“UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes” is about how to select the frequency layers for improved measurement. Moderator suggests to merge it in issue 2-2-2.**Recommendations for 2nd round:* *No further discussion.* |

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

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| **Status summary**  |
| **Issue 2-3-1: Whether RRC connection setup delay is very short for improvement on FR2 Scell/SCG setup delay***All companies agree that RRC connection setup delay is very short for improvement on FR2 Scell/SCG setup delay. Two companies propose to further study short and accuracy measurement during RRC connection setup/resume.**Tentative agreements:* RRC connection setup/resume delay is very short for improvement on FR2 Scell/SCG setup delay*.* *Candidate options:** + Option 1 (Ericsson, Nokia): Study short and accuracy measurement during RRC connection setup/resume.

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-3-2: Impact on RACH due to measurement during RRC connection setup/resume***It seems no company opposes that MSG2/MSG4 during RACH procedure may be lost due to Rx beam sweeping for measurement on FR2* ***intra-band inter-frequency*** *during RRC connection setup/resume. Two companies also point out that FR2 intra-band CA is not the target scenario of enhanced measurement.**Some company proposes “Msg2/3/4/5 may be impacted if there are more than one frequency to measure during RRC connection setup/resume due to RF retuning”. In my understanding, the latter is mainly focus on* ***inter-band inter-frequency*** *measurement.* *Some company also propose to study potential mitigation schemes.* *Tentative agreements:* MSG2/MSG4 during RACH procedure may be lost due to measurement on FR2 intra-band inter-frequency during RRC connection setup/resume.*In the 2nd round, moderator recommends to further discuss on the new options.**Candidate options:** + Option 1 (MTK): For inter-band inter-frequency measurement, Msg2/3/4/5 may be impacted if there are more than one frequency to measure during RRC connection setup/resume due to RF retuning.
	+ Option 2 (vivo, Nokia): FR2 intra-band CA is not the target scenario of enhanced measurement.
	+ Option 3 (Ericsson): Study potential mitigation schemes to avoid/mitigate the impact on RACH due to measurement during RRC connection setup/resume.

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 2-3-3: Feasibility of improvement in FR2 SCell/SCG setup delay***Tentative agreements:* Further discuss the feasibility of improvement in FR2 SCell/SCG setup delay*Recommendations for 2nd round:* *No further discussion.* |

### CRs/TPs

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

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

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

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

*No tentative agreements in 1st round.*

*Please provide further comments on the following options*

* + Option 1(Ericsson, 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.
		- Paging
		- Initiation (UE receives SIB1 and apply default MAC cell group configuration)
		- RRC connection resume
	+ Option 2(MTK, CMCC, Apple, xiaomi, HW, vivo, CATT): Discuss the starting point for improved measurement directly.

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| **Company** | **Comments** |
| Apple | Prefer option 2. Option 1 is overlapped with issue 2-1-2 as different options under issue 2-1-2 capture different part of option 1 here. It could be simpler for us to focus on one issue. |
| Qualcomm | Although we understand the point of Option 1, we don’t think such a clarification is essential. |
| CMCC | OK with option 2. |
| Xiaomi | Option 2 |
| Ericsson | Option 1. We think it is very important to clarify when UE has the initiated access to understand the potential issues before directly have the solution how to improve the measurement. |
| MTK | Option 2. |
| vivo | Option 2. Prefer to discuss directly the possible starting points for enhanced measurement. The clarification for ‘when UE has initiated access’ in Option 1 seems to be highly overlapped with Issue 2-1-2. |
| Huawei | Option 2 |
| Nokia  | Option 1. We think that clarification is needed, and it makes discussion about “when UE has initial access” less ambiguous. Also, clauses 5.3.2.3, 5.3.3.2 or 5.3.13.2 (38.331) should be included in the description to enhance the study item description. We would also like to note that from the discussion and results we have presented in our paper, it is clear that any enhancement that can help reducing the FR2 SCell/SCG setup delay can bring significant benefit on the system level and TP performance. Reduction of the delay will benefit both the UE and the network. |

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

*No tentative agreements in 1st round.*

*Please provide further comments on the following options*

* + Option 1(CMCC): UE perform enhanced measurement closely before RRC connection setup/resume.
		- For MT originating call, the measurement is performed during the period between paging reception and UE send *RRCResumeRequest/ RRCSetupRequest*.
		- For MO originating call, the measurement is performed after upper layers request establishment of an RRC connection and before UE send *RRCResumeRequest/ RRCSetupRequest*.
	+ Option 2: 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 (MTK, vivo, Ericsson ): after receiving paging for MT originating call
		- Option 2c (MTK, HW, vivo): after first RACH preamble transmission, i.e. Msg1
		- Option 2d (Ericsson): Initiation (UE receives SIB1 and apply default MAC cell group configuration) for MO originating call
		- Option 2e (Apple, xiaomi, QC): FFS

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| **Company** | **Comments** |
| Apple | We think RAN4 may need more time to identify/compare the gain of different options. At current stage option 2 is preferred. Option 2b could be the earliest point for MT call and option 2c could be the earliest point which can be verified for MO call.In option 1 the measurement time is limited to the window between paging (upper layers request establishment) and RRC request. We think the window may be too short for accurate measurement even for a single carrier, not to mention the case wherein UE needs to measure multiple carriers as commented by some other companies. |
| Qualcomm | We do not disagree with any particular option at the moment. However, Option 1 seems to be limiting the way RAN4 can discuss for the enhancement too much just based on the wording in the option. |
| CMCC | The motivation of option 1 is that we try to avoid the impact on RRC connection setup/resume procedure. It is not expected to improve FR2 SCell/SCG setup delay at the expense of prolonging RRC connection setup/resume delay. Option 1 could avoid the impact on RRC connection setup/resume procedure and can also guarantee that the measurement results are valid when they are reported. But we also agree that the available time used for measurement is limited. We are also open to other solutions.  |
| Xiaomi | If RAN4 agree to introduce the enhanced measurement, we are fine with option 2b and 2c. |
| Ericsson | Option 2 |
| MTK | We are fine to use option 2b or option 2c to evaluate the feasibility of measurement enhancement. We share similar opinion with apple that option 2b is the earliest point for MT call and option 2c is the earliest point for MO call.Regarding 2d, we think it is difficult to verify.  |
| vivo | Support Option 2b and 2c. According to our observation, the starting point of enhanced measurement in Option 1 is the same as Option 2b/2c. The only difference is about the ending point. As point out from CMCC, the motivation of option 1 is to avoid to prolong RRC connection setup/resume delay. Whereas the available time in Option 1 is too limited to perform measurement. From this perspective, we fail to get the point why we need to split the scenario of enhanced measurement into ‘between paging reception and UE send RRCResumeRequest/ RRCSetupRequest’ and ‘after RRCResumeRequest’. It seems that we could gain more available time to perform enhanced measurement without limiting to perform the measurement only closely before RRC connection setup/resume. |
| Huawei | We are fine for both option 1c and option 1b which respectively corresponds to MO and MT call. |
| Nokia | Option 2. We do not see these options as exclusive but more or less addressing the same. Both option 1 and option 2 are fine with us. On the detailed level we understand that the UE know when there is a need for establishing a connection. And to clarify our proposal, we suggest that the network can configure the UE to continue measurements on one or more carriers during the connection setup and potentially during a period of time while in connected mode. As discussed in our paper. The point of time when this is done can be precisely defined in RRC procedures, and RAN4 requirements can then be defined according to that. And we do not expect that enhancements should lead to a delay in the connection setup (as discussed by CMCC). |

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

*According to the 1st round discussion, the most divergence on this issue is whether further enhancement on R16 EMR (measurement during green part) is in the scope. Moderator suggests to align the understanding on this at first before go to more details.*



* + Option 1 (MTK, Apple, xiaomi, HW, vivo): further enhancement on Rel-16 EMR (measurement during green part) is out of scope
	+ Option 2 (CMCC, QC, Ericsson, Nokia, LGE, CATT): further enhancement on Rel-16 EMR (measurement during green part) is in the scope

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| **Company** | **Comments** |
| Apple | In our understanding the objective in this WI is mainly for the case wherein EMR measurement becomes inaccurate after T331 expires. Otherwise, if the T331 is still running, NW can use EMR result and thereby no need introduce new measurement. We are open to study if RAN4 can borrow some outcome of EMR procedure. However, it doesn’t mean we need to optimize EMR procedure. That is out of scope of this WI. |
| Qualcomm | Echo Apple’s comment.And we are not sure if companies are on the same page about the definition of “enhancement on Rel-16 EMR.” If Option 1 precludes a possibility of UE utilizing the measurement results obtained during EMR during RRC connection procedure, we oppose Option 1. |
| CMCC | 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).  |
| Xiaomi | Similar view as Apple, if the EMR measurement results are valid, there is no need to introduce new measurement. Since when the UE enter to RRC connected mode is unpredictable, the UE may complete the EMR measurement long before UE request the RRC connection request, and the EMR measurement results become invalid. In this case, we do not think further tighten Rel-16 EMR measurement delay is helpful.  |
| Ericsson | Option 2. |
| MTK | Option 1. In our understanding, option 1 is not precluding using the measurement results obtained during EMR for measurement during RRC connection procedure. “Enhancement on R16 EMR (measurement during green part)” refers to that the enhanced measurement is still performed in idle/inactive mode and before UE initiating access. |
| vivo | Support Option 1. Thanks Apple for this illustration. If we understand it correctly, Option 1 means the enhancement on EMR (the orange block) is out of scope and R18 only focus on the new measurement (the green block). @QC: In our understanding, so far Option 1 does not preclude the possibility of UE utilizing the measurement result/prior information obtained during EMR to the new measurement during RRC connection and this is related to the discussion on revised Option 2 in Issue 2-1-4 and Option 1b in Issue 2-2-4. |
| LGE | We support option 2 and agree with the last sentence in QC’s comment as “If Option 1 precludes a possibility of UE utilizing the measurement results obtained during EMR during RRC connection procedure, we oppose Option 1.” |
| Huawei | Option 1. We think further enhancement on the R16 EMR measurement scheme is out of scope. If option 2 means that the measurement result obtained from EMR measurement can be used in RRC connection procedure, we are open to further discuss to see if there is feasible solution. |
| Nokia | Option 2. If EMR measurements are valid, we don’t see why they shouldn’t be used. We think EMR enhancements are in scope, but we also should consider enhancements for UEs that do not support EMR.  |

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

*Tentative agreements in the 1st round:* The enhanced measurement (if feasible) at least applies to scenarios that the EMR measurement results are unavailable or invalid.

*Please provide further comments on the following option*

* + Revised Option 2 (QC, vivo, LGE, Nokia): Further study whether enhanced measurement is applicable to scenarios that EMR measurement results are available and valid
		- e.g. On the cells that have been detected/measured in early measurement

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| **Company** | **Comments** |
| Apple | More justification is needed on option 2. In our view, when EMR result is still available, NW can directly use EMR result for CA/DC configuration. |
| Qualcomm | Support Option 2.Regarding the wording “available,” our interpretation is that UE has managed to finish measurements on EMR carriers and has the results in a memory. The question would be about whether the result is “valid” or not from UE perspective and NW perspective, e.g. the result may or may not be valid by the time from NW perspective when UE goes into Connected mode. The details can be further discussed in the next meeting. |
| Xiaomi | More justification is needed on option 2, if the EMR measurement results are available and valid, there is no need to introduce new measurement. |
| MTK | Share the same opinion with apple and xiaomi. Regarding “valid”, it is not easy to have an accurate definition and kind of up to UE implementation and movement speed from our point. So we suggest assuming EMR measurement results invalid for further discussion. |
| vivo | Support the Revised Option 2. One thing needs to be aligned is about the definition of ‘valid’ or ‘invalid’. Does ‘valid’ measurement result mean ‘All prior information including the beam information and cell information are available to use for enhanced measurement’ **or** ‘Due to the possible long delay between the ending point of EMR and the starting point of the enhanced measurement, the measurement results are out-of-date whereas the beam information is still available’. If we follow latter definition of ‘valid’, then in our understanding, it also needs to perform a quick measurement (e.g. one-shot measurement) on the cell that has already measured in early measurement, which is to further check whether the quality of cell is still strong to be used for FR2 CA/DC configuration. |
| LGE | Support option 2. |
| Huawei | Share the similar view as Apple, xiaomi and MTK. The reason of introducing this obj is because some companies think the EMR measurements are outdated. |
| Nokia | Option 2. We think QC has a valid view on knowing when the measurements are valid. **The main target of this study should be to have good and accurate measurements on FR2 for fast CA/DC establishment.** Therefore, we don’t see a reason why we should be down scoping scenarios at this stage. We can discuss about scenarios, but the baseline should be that any scenario that bring enhancements to establishment / resume delays should be considered. We would like to note that to improve the user throughput as well as data transmission latency (e.g., reducing packet queuing/buffering delay), and reliability, it is important to reduce secondary link establishment/resume delay(s) for PSCell/ SCell setup in DC/CA operation scenarios. Note: If T331 is expired and UE has measurements currently the network cannot trust the measurements as it is up to UE implementation to perform them after timer expires. This may result that good UEs measurements may be wasted because network cannot trust the behaviour after T331 has expired.  |

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

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

*In the 1st round, majority companies support option 2. Two companies point out that one RF chain shall also be allowed for UE only capable of intra-band CA. One company proposes multiple (≥ 2) RF Chains may also be feasible.*

*Please provide further comments on the following options*

* + Option 1 (Apple, HW): One active RF chain
	+ Option 2 (CMCC, xiaomi, MTK, QC, Ericsson, vivo, Nokia): Two active RF chains
	+ Option 3 (Nokia): more than two active RF chains

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| **Company** | **Comments** |
| Apple | Option 1 shall be the baseline assumption. Using multiple RF chains for simultaneous measurement on multiple carriers means result in even tightened RRM requirement than connected mode. We fail to understand the necessity of this. As we mentioned in the 1st round, 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. We consider this as “less ungent” than UE in connected mode. In connected mode, NW shall have better idea on whether and when UE needs to be configured with CA/DC. |
| Qualcomm | Our comment in the first round doesn’t seem to be captured correctly. We are in favor of Option 1 as a starting point.  |
| CMCC | 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. |
| Xiaomi | we are fine with option 2, if one active RF chain is assumed, the RACH procedure will be impacted which is not desired of this objective. |
| Ericsson | Option 2 |
| MTK | Option 2. With one active RF chain, we don’t think measurement during RRC connection setup/resume is feasible as RRC connection setup/resume is more important than measurement and not supposed to be impacted by measurement.We don’t think more than two active RF chains would help to reduce measurement delay as different frequencies need to share the common searcher. |
| vivo | Support Option 2.Considering if one RF chain is used for the general case, performing enhanced measurement during the RRC connection setup/resume may have potential impact on the RACH procedure. From this perspective, we prefer to use Option 2 as the baseline. |
| Huawei | We can not always assume there are multiple active RF chain for one UE. Option 1 can be used as a starting point. |
| Nokia | Option 2 and 3. The baseline assumption is that there is one RF chain for each FR. It is not captured that we are also supporting the Option 2 (2 or more). We agree with other companies that this is scenario based and needs more discussion. Option 3 was proposed because there is a work item for multi-rx chain. It is feasible to assume multiple (≥2) RF Chains. The discussion should be around how many RF chains UE is using for performing the measurements. It is not clear if the RF chains are FR1 or FR2. We also do have UEs that are able to do inter-band CA with independent beam management (IBM).In any case, we think that it is worth to clarify what does two RF chains in this case mean and use that as a baseline. Use cases need to be defined for this, FR1-FR2, FR2-FR2 (same band, different band) We think it is beneficial to explicitly prioritize scenarios and companies could comment these cases for the next meeting.

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| Priority | Use Case  |
| 1 (high) | FR1 – FR2 (any band)  |
| 2 | FR2-FR2 (intra-band contiguous, intra-band non-contiguous) |
| 3 | FR2-FR2 (inter-band non-contiguous) |
| 4 | (others) |

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

*In the 1st round, majority companies think “Reduce the number of EMR carriers to be measured for improved measurement” is a potential direction. Some companies point out that there are some issues for further discussion, i.e. how to select the frequency layers for improved measurement, how many frequency layers to measure, which scenario that is applicable.*

*As option 2 in issue 2-2-6 “UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes” is about how to select the frequency layers for improved measurement. Moderator suggests to merge it in this issue.*

*Please provide further comments on the following options*

* + Revised Option 1: Reduce the number of EMR carriers to be measured for improved measurement.
		- FFS: how to select the frequency layers for improved measurement, how many frequency layers to measure and which scenario that is applicable.
			* Option 1a (Nokia): UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes

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| **Company** | **Comments** |
| Apple | The revised option 1 could be a good starting point when RAN4 discuss corresponding measurement capability, i.e. number of carriers to measure in the new measurement requirements.Regarding option 1a, it is not supported considering UE power consumption. To us it effectively extends T331.  |
| Qualcomm | In principle, Option 1 is okay. Option 1a is not yet clear to us in terms of UE measurement behavior and benefits because it only tells “measurement configuration” |
| Xiaomi | Support option 1. Regarding option 1a, it is a big burden for UE, and NW can configure the carriers containing the precious serving cells as the EMR carriers to be measured.  |
| Ericsson | We are fine with option 1. |
| MTK | Option 1. |
| vivo | We are open to further study revised Option 1. And for Option 1a, we share the same view with QC. |
| Huawei | Fine with revised option 1 |
| Nokia | We are ok with Option 1. We are open for looking into this if it is possible to reduce the delay. It is obvious that more carriers cause more measurement delay. However, the network can already reduce the latency by reducing the number of carriers in the EMR configuration. |

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

*Majority companies have concern on measurement accuracy with reduced number of samples. Almost all the companies emphasize that measurement accuracy should be guaranteed.*

*Please provide further comments on the following options*

* + Option 1: Yes
	+ Option 2 (MTK, Apple, HW, CATT ): No
	+ Option 3 (CMCC, xiaomi, QC, Ericsson, vivo, Nokia): FFS how to reduce number of samples without measurement accuracy degradation.

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| **Company** | **Comments** |
| Apple | Support option 2. Option 3 is interesting. We are open to it. |
| Qualcomm | To us, Option 3 is more or less a question rather than something that we support.What is the domain when we say “number of samples”? Is it the number of SSB bursts or UE Rx beam sweeping or something else? And RAN4 spec only specifies the worst latency, not the number of SSB bursts for the measurement. UE can measure more samples as needed within the latency. |
| CMCC | We are open to discussion. 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 reduce the number of samples in order to reduce the delay. |
| Xiaomi | Option 3, we are open to discuss this. |
| Ericsson | Option 3. |
| MTK | Option 2. For FR2, we use a single value M which also includes Rx beam sweeping factor in the measurement requirements. This issue is kind of overlapped with issue 2-2-4. We prefer using the same M value as L3 intra-frequency measurement.

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| Take L3 intra-frequency measurement period without gap as an example:

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| DRX cycle | T SSB\_measurement\_period\_intra  |
| No DRX | max(400ms, ceil(Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |

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| vivo | Option 2 in principle. And we are open to further study for Option 3. |
| LGE | We support Option 3. |
| Huawei | Option 2. 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. |
| Nokia | Option 3. This should be studied. This is a tradeoff between guaranteed accuracy and getting CA/DC up fast. We should investigate this, but also keep in mind that less accurate measurement may also have negative impacts. @MTK comment: We should study this and we don’t need to decide a precise solution now.  |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1(CATT, Nokia): Reduce the scaling factor of Rx beam sweeping
		- Option 1a (CMCC): use Rx beam sweeping factor of R17 HST FR2 or R17 positioning
			* 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}.
		- Option 1b (xiaomi, Ericsson, vivo): Use prior information on the UE Rx beam to reduce the scaling factor of Rx beam sweeping
	+ Option 2 (MTK, Apple, HW): Not to reduce the scaling factor of Rx beam sweeping
	+ Option 3 (QC): Further discussion

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| **Company** | **Comments** |
| Apple | Support option 2 and 3. We are not clear at current stage based on what we can reduce the scaling factor of Rx beam sweeping compared to the connected mode. In other word, if we can reduce it in this procedure, could we also reduce it in connected mode in legacy requirements? that sounds more like an enhancement on FR2 measurement, rather than an enhancement particular during RRC connection setup. |
| Qualcomm | Okay with Option 1b as a candidate mechanism. But it is too early to agree on it without “FFS” or “may” in it. |
| CMCC | In order to reduce the impact on RRC connection setup/resume procedure, it is preferred to reduce the measurement delay, one way is to reduce the RX beam sweeping factor. And the agreements on reduction for RX beam sweeping factor in rel-17 can be used s baseline. |
| Xiaomi | Option 1b is preferred |
| Ericsson | We think both Option1 and option 3 are fine with us.  |
| MTK | Option 2. Similar view as apple, we should focus on measurement enhancement during RRC connection setup/resume instead of enhancement on FR2 measurement. |
| vivo | Support Option 1b. Maybe one thing needs to further discussion is about the definition of ‘valid’ or ‘invalid’ measurement result during EMR (as we comment in Issue 2-1-4). Further, we need to determine whether the measurement results (including beam/cell information) could be used as the prior information for the enhanced measurement. If the beam information obtained during EMR is available, we still see the gain to use this information to reduce the sweeping factor. |
| Huawei | Option 2. From UE implementation perspective, the common RX beam sweeping behavior for UE regardless UE in which state (idle/inactive/connected or some transition duration). |
| Nokia | Option 1. We should study this; we don’t need to decide a precise solution at the moment. The scaling factor has significant impact on delay and we are open to discuss about the reduction. In our contribution, we provide the following: scaling\_factor = 8 for FR2 * **Tdetect,NR\_Inter + Tmeasure,NR\_Inter =** (36\*8\*1.5 + 4\*scaling\_factor\*1.5)\*320 = **153600 msec** for an **FR2** carrier frequency.
* **Tdetect,NR\_Inter + Tmeasure,NR\_Inter =** (36 \*1.5 + 4\*1.5)\*320 = **19200 msec** for an **FR1** carrier frequency.
 |

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

*All companies support that DRX is not in use during RRC connection setup/resume procedure for enhanced measurement.*

*Tentative agreements in the 1st round:* DRX is not in use during RRC connection setup/resume procedure for enhanced measurement.

*Regarding not using SMTC, there is no tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (vivo): use SMTC when specifying the requirements
	+ Option 2 (Ericsson ): use SSB period when specifying the requirements
	+ Option 3 (CMCC, MTK, HW): Further discussion

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| **Company** | **Comments** |
| Apple | Further discussion is needed, especially for the potential impact on RRC connection setup due to measurement on other carriers. |
| Qualcomm | For now, not comfortable with Option 2. Can we assume UE will know actual SSB periodicity of non-serving cell during RRC connection procedure? |
| Xiaomi | Option 3 |
| Ericsson | Option 2 and Option 3.Echo Qualcomm : we suggested SSB periodicity instead of SMTC is for the purpose of fast measurement. Our understanding if UE can read SIB1, SSB position and periodicity can be known.We are still open for discussion of course |
| MTK | Option 3. Slightly prefer using SMTC. No matter SMTC or SSB period, it is the really value that matters and this is up to NW configuration. |
| vivo | Support Option 1. And for Option 2, we share the same view with QC. |
| Huawei | Need further discussion on SMTC and SSB. |
| Nokia | Option 3, we should agree to study thisWe think it is important to understand the impact of not assuming DRX, and look into both SMTC and SSB occasions.  |

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

*As option 1 is covered by issue 2-2-2 and 2-1-3 based on Ericsson’s clarification. Moderator suggests to discuss in issue 2-2-2 and 2-1-3 and not to discuss in this issue in the 2nd round.*

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| *Clarification from Ericsson on Option 1*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. *(Moderator: discussed in issue 2-2-2)*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. *(Moderator: discussed in issue 2-1-3)* |

*Regarding Option 2, there is no tentative agreements. In my understanding, option 2“UE can be configured to maintain measurement configuration of previous serving cells for EMR purposes” is about how to select the frequency layers for improved measurement. Moderator suggests to merge it in issue 2-2-2.*

*Recommendations for 2nd round:* *No further discussion.*

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

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

*In the 1st round, all companies agree that RRC connection setup delay is very short for improvement on FR2 Scell/SCG setup delay. Two companies propose to further study short and accuracy measurement during RRC connection setup/resume.*

*Tentative agreements in the 1st round:* RRC connection setup/resume delay is very short for improvement on FR2 Scell/SCG setup delay*.*

*Please provide further comments on the following option*

* + Option 1 (Ericsson, Nokia): Study short and accuracy measurement during RRC connection setup/resume.

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| **Company** | **Comments** |
| Apple | Open for further study. It is challenging to achieve accurate measurement during such a short time in FR2. |
| Qualcomm | It is unclear whether Option 1 aims for a quick cold start measurement or not, i.e. no previous measurement results or side information to be utilized at all? |
| Xiaomi | RAN4 need to study how long is the improved measurement assuming the accuracy is guaranteed. |
| Ericsson | Option 1.Echo Qualcomm, our view this short and accurate measurement can be with or without previous measurement results. |
| MTK | We are open for further study. To us, RRC connection setup/resume delay is too short for any measurement. |
| vivo | OK with Option 1 if considering to use the prior information obtained during EMR. |
| Huawei | The tentative agreement is fine to us. Open to further discuss possible solution. |
| Nokia | Option 1, and Note about the agreement: Yes, the connection setup is very short, but it shouldn’t exclude any improvements. We should understand first whether UE is able to finish measurements once RRC setup/resume is completed if measurement that are impacting the delay are enhanced. UE may be able to provide existing / fast measurements within this 20ms time window.We also agree with Ericsson that we shouldn’t exclude to have short and accurate measurements to improve delay. |

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

*In the 1st round, it seems no company opposes that MSG2/MSG4 during RACH procedure may be lost due to Rx beam sweeping for measurement on FR2* ***intra-band inter-frequency*** *during RRC connection setup/resume. Two companies also point out that FR2 intra-band CA is not the target scenario of enhanced measurement.*

*Some company proposes “Msg2/3/4/5 may be impacted if there are more than one frequency to measure during RRC connection setup/resume due to RF retuning”. In my understanding, the latter is mainly focus on* ***inter-band inter-frequency*** *measurement.*

*Some company also propose to study potential mitigation schemes.*

*Tentative agreements in the 1st round:* MSG2/MSG4 during RACH procedure may be lost due to measurement on FR2 intra-band inter-frequency during RRC connection setup/resume.

*In the 2nd round, moderator recommends to further discuss on the new options.*

* + Option 1 (MTK): For inter-band inter-frequency measurement, Msg2/3/4/5 may be impacted if there are more than one frequency to measure during RRC connection setup/resume due to RF retuning.
	+ Option 2 (vivo, Nokia): FR2 intra-band CA is not the target scenario of enhanced measurement.
	+ Option 3 (Ericsson): Study potential mitigation schemes to avoid/mitigate the impact on RACH due to measurement during RRC connection setup/resume.

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| **Company** | **Comments** |
| Apple | Option 1 is more like an observation, which is valid. We are open to discuss how to avoid/mitigate the impact as included in option 3. |
| Qualcomm | Do not disagree with Option 1 and 2.Option 3 is too much open ended to agree it in this meeting. |
| Xiaomi | Option to discuss for option 1 and option 3, FFS on option 2. |
| Ericsson | Thank you MTK for the observation.We support option 3. |
| MTK | Support Option1 and open to option 3.Regarding Option 2, we don’t think we need to discuss it any more. Even if FR2 intra-band CA is one of the target scenario, it is not feasible for enhanced measurement on FR2 intra-band cells as RRC connection setup/resume procedure should not be impacted by measurement. |
| vivo | Support Option 2. According to the current requirement on SCell activation, for intra-band CA in FR2, we can know that the activation delay is TFirstSSB+ 5ms. It seems there have little gain to perform enhanced measurement.

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| 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: |

And for inter-band CA in FR2, considering UE can be configured for IBM operation for the band pair, there is no impact on RACH. |
| Huawei | Support option 1. Option 2 needs more input from moderator. We are open to option 3. |
| Nokia | Option 2, we provided a prioritisation table in the response of 2-2-1.We should clearly understand what scenarios are included / excluded. *As we also state in our paper, we assume that the focus is on enabling enhancements related to one cell* ***in FR2 – the first cell in an FR2 band****. Hence, the UE is accessing the serving cell in FR1 (or LTE).* We should discuss technical details of the proposed agreement before agreeing. We propose this is a topic for the next meeting.  |

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

*Tentative agreements in the 1st round:* Further discuss the feasibility of improvement in FR2 SCell/SCG setup delay

*Recommendations for 2nd round:* *No further discussion.*

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

## Companies’ contributions summary

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| **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 |
| CATT | Option 1 is generally fine. Agree that it depends on RAN2 progress. |
| Nokia  | Support option 1: In our view the existing HO interruption time would set a maximum limit for any interrupt time due L1/L2 centric mobility/cell change:* RRC procedure delay consists of RRC signal processing related to decoding of handover command and L2/L3 reconfiguration of the protocol layers:
* Tprocessing which includes the delay for RF/baseband retuning, derivation of target gNB security keys and configuration of the security algorithm to be used in the target cell.
* TΔ is time for fine time tracking and acquiring full timing information of the target cell.
* Tmargin is the time for SSB post-processing and can be up to 2 ms.
* TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell. In addition, there are the interruptions of sending PRACH preamble and receiving the RACH response (RAR).

Figure 1: Components contributing to service interruption during L3 baseline handover of NR Rel. 17. |

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

* Proposals
	+ Option 1(CATT, Ericsson, Nokia): 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.  |
| CATT | Option 1 is generally fine. Agree that it depends on RAN2 progress. |
| Nokia | Option 1.Proposal from our contribution: We expect that an interrupt (if any) related to a cell change performed by use of the L1/L2 mobility procedure would need to significantly shorter than the existing L3 Handover interrupt time. Otherwise, this will negatively impact the gain from L1/L2 mobility feature.How to define any cell change interrupt due to L1/L2 mobility and the detailed delay components needs further discussions in RAN4. |

#### 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 not contradicting each other. We can further study. |
| CATT | Fine to wait further RAN2 income. |
| Nokia | We don’t think the options are necessarily contradicting. We think that using existing measurements as a baseline is only reasonable. We expect that L1/L2 centric mobility will likely be based on L1 measurements. These will be reported by the UE to the network. Currently RAN4 has defined measurement accuracies for L1 measurements in section 10 which covers intra-frequency measurement and inter-frequency measurements. We note that already in Rel-17 RAN4 defined L1-RSRP measurement requirements for a cell with different PCI than serving cell. We believe these requirements could also apply for L1 measurements for L1/L2 mobility. RAN4 has defined L1-RSRP measurement accuracy requirements for a cell with different PCI than serving cell.This can be discussed further |

#### 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. |
| CATT | Fine to wait further RAN1/RAN2 income. |
| Nokia | We should assume that cells are not collocated. We should discuss this further while RAN1 / RAN2 is progressing.  |

#### 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.

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| **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.  |
| CATT | FFS |
| Nokia | We think this needs clarification.  |

### 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.

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| **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 |
| CATT | Fine with option 1. |
| Nokia | We would like to understand what is exactly meant with this, and we should still discuss about it.  |

#### 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. |
| CATT | Option 1.  |
| Nokia | We support Option 2 and agree observations from Ericsson. Multi-panel is important aspect of FR2 and therefore should be already included in studies.  |

#### 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.

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| --- | --- |
| **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 |
| CATT | FFS |
| Nokia | We can discuss this more. Option 1 is ok.  |

#### 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. |
| CATT | Support option 2. It is included in WID.  |
| Nokia | WID states “*Both intra-frequency and inter-frequency”* The intra-frequency requirements in FR1 and FR2 for L1-RSRP measurement and reporting have been defined in the latest TS 38.133 document, which covers L1 measurement from a cell with different PCI than serving cell. As mentioned, these could be used as the baseline for L1/L2 mobility intra-frequency requirements. However, inter-frequency measurement accuracies on non-serving neighbor cells seems not considered. We see that such requirements would be needed for L1/L2 mobility as inter-frequency scenario is considered in L1/2 mobility. We think that Inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell need to be defined. |

#### 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. |
| CATT | Fine with option 3. It is too early to the conclusion. |
| Nokia | Yes, support Ericsson view |

#### 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.  |
| CATT | Fine to discuss it.  |
| Nokia | Yes, we support the option 1 to discuss more.  |

### 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 |
| CATT | Although we think the measurement accuracy should be the same as legacy value without enhancement. But it can be concluded further.  |
| Nokia  | We expect that L1/L2 centric mobility will likely be based on L1 measurements. These will be reported by the UE to the network. Currently RAN4 has defined measurement accuracies for L1 measurements in section 10 which covers intra-frequency measurement and inter-frequency measurements. We note that already in Rel-17 RAN4 defined L1-RSRP measurement requirements for a cell with different PCI than serving cell. We believe these accuracy requirements could also apply for L1 measurements for L1/L2 mobility. We also notice that the current measurement accuracies for SSB-based measurements is rather relaxed especially for FR2. Hence, we propose to discuss the L1-RSRP measurement accuracies and whether they can be improved now when they are to be used for L1/L2 mobility.We think that we should discuss the L1-RSRP measurement accuracies and whether they can be improved for L1/L2 mobility. |

#### 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

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| **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 |
| CATT | Similar comment in Issue 3-3-1 |
| Nokia | The intra-frequency requirements in FR1 and FR2 for L1-RSRP measurement and reporting have been defined in the latest TS 38.133 document, which covers L1 measurement from a cell with different PCI than serving cell. As mentioned, these could be used as the baseline for L1/L2 mobility intra-frequency requirements. However, inter-frequency measurement accuracies on non-serving neighbor cells seems not considered. We see that such requirements would be needed for L1/L2 mobility as inter-frequency scenario is considered in L1/2 mobility as shown above. Therefore, Inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell need to be defined. |

## 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.*

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

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| **Status summary**  |
| **Issue 3-1-1: L1/L2 inter-cell mobility delay requirements***All the companies support Option 1. Majority companies propose it is too early to go to the detailed discussion.**Tentative agreements:*Specify L1/L2 inter-cell mobility delay and analyse each component of L1/L2 inter-cell mobility delay.*Recommendations for 2nd round:* *No* *further discussion.* |
| **Issue 3-1-2: inter-cell mobility interruption requirements***No companies oppose Tinterrupt in mobility delay requirements is considered in issue 3-1-1*. *Ericsson clarifies interruption due to MG for inter-frequency measurement may need to be considered. Since interruption due to MG is well captured in spec, Moderator recommends not to discuss this issue in 2nd round.**Recommendations for 2nd round: No* *further discussion.* |
| **Issue 3-1-3: L1-RSRP measurement delay requirements** *Majority companies propose to further discuss this issue when the procedure and supported scenario is clear. Moderator recommends to come back to this issue after the procedure and supported scenario is clear.**No tentative agreements.**Recommendations for 2nd round:* *No further discussion.* |
| **Issue 3-1-4: Timing management requirements***Tentative agreements:* Wait for RAN1/2 input and then discuss whether and how to define timing management requirements.*Recommendations for 2nd round:* *No further discussion.* |
| **Issue 3-1-5: Timing requirements**

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| *Clarification from 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.  |

*No tentative agreements**Candidate options:** + Revised Option 1 (Ericsson): Specify MRTD of serving cell and neighbour cell if covering the scenario that time offset of serving cell and neighbour cell is more than CP.

*Recommendations for 2nd round: Further discussion* |

#### Sub-topic 3-2: Sceniarios

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| **Status summary**  |
| **Issue 3-2-1: Whether to consider simultaneous Rx/Tx with both source cell and target cell***Majority companies support Option 1. One company asks for more clarification on Option 1.* *Candidate options:** + Option 1 (MTK, Apple, vivo, QC, HW, Ericsson, LGE, CATT): Not consider simultaneous Rx/Tx with both source cell and target cell.

*Note: Proponents of option 1 should clarify more on “simultaneous Rx/Tx with both source cell and target cell” in the 2nd round.**Recommendations for 2nd round:* *Further discussion.* |
| **Issue 3-2-2: Whether to consider simultaneous multi-panel in FR2***No tentative agreements**Candidate options:** + Option 1 (MTK, Apple, vivo, QC, HW, LGE): Not consider simultaneous multi-panel in FR2
	+ Option 2 (Ericsson, Nokia): Consider simultaneous multi-panel in FR2

*Recommendations for 2nd round: Further discussion* |
| **Issue 3-2-3: Definition of intra-frequency/inter-frequency in inter-cell operation***No tentative agreements**Candidate options:** + Option 1 (vivo, Ericsson, CATT, Nokia): RAN4 to discuss the definition of intra-frequency/inter-frequency in inter-cell operation
		- Option 1a (MTK): For SSB L1-RSRP measurement, follow the definition of L3 measurement.

*Recommendations for 2nd round: Further discussion* |
| **Issue 3-2-4: Whether to cover inter-frequency***No tentative agreements**Candidate options:** + Option 1(MTK, vivo, QC, apple): Further discuss the necessity, feasibility, and pros/cons of specifying inter-frequency L1-RSRP measurement.
	+ Option 2 (CMCC, HW, Ericsson, Nokia): Yes

*Recommendations for 2nd round: Further discussion* |
| **Issue 3-2-5: Whether to cover non-synchronous scenarios***No tentative agreements**Candidate options:** + Option 1: Not consider non-synchronous scenarios.
	+ Option 2 (Ericsson, Nokia): Consider non-synchronous scenarios.
	+ Option 3 (HW, CATT): FFS
		- Option 3a (MTK, vivo): discuss the definition of synchronous and non-synchronous
		- Option 3b (Apple, QC): wait for RAN2’s progress

*Recommendations for 2nd round: Further discussion* |
| **Issue 3-2-6: Whether to support L1 measurement on multiple cells with PCI different from serving cell***Tentative agreements:* Further discuss the number of supported cells with PCI different from serving cell.*Candidate options:** + Option 1(Apple, HW, vivo, Ericsson, CATT, Nokia): to discuss the number of supported cells with PCI different from serving cell.
		- Option 1a (MTK): To discuss the number of supported cells with PCI different from serving cell on a FR2 band
		- Option 1b (QC): To discuss the total number of cells to be monitored on all bands

*Recommendations for 2nd round: Further discussion* |

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

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| **Status summary**  |
| **Issue 3-3-1: Intra-frequency L1-RSRP measurement accuracy requirements***No tentative agreements.* *Candidate options:** + Option 1 (Ericsson, Nokia, vivo): Discuss whether intra-frequency L1-RSRP measurement accuracy can be improved for L1/L2 mobility
	+ Option 2 (MTK, Apple, QC, CATT): reuse the legacy intra-frequency L1-RSRP measurement accuracy for L1/L2 mobility.

*Recommendations for 2nd round:* *Further discussion.* |
| **Issue 3-3-2: Inter-frequency L1-RSRP measurement accuracy requirements***No tentative agreements.* *Candidate options:** + Option 1 (Ericsson, Nokia): Define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell
		- Option 1a (QC, CATT): reuse the legacy intra-frequency L1-RSRP measurement accuracy requirements.
	+ Option 2 (Apple, vivo): Further discuss whether and how to define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell in performance part.

*Recommendations for 2nd round: Further discussion.* |

### CRs/TPs

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

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

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

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

*All the companies support Option 1. Majority companies propose it is too early to go to the detailed discussion.*

*Tentative agreements in the 1st round:*

Specify L1/L2 inter-cell mobility delay and analyse each component of L1/L2 inter-cell mobility delay.

*Recommendations for 2nd round:* *No* *further discussion.*

**Issue 3-1-2: inter-cell mobility interruption requirements**

*No companies oppose Tinterrupt in mobility delay requirements is considered in issue 3-1-1*. *Ericsson clarifies interruption due to MG for inter-frequency measurement may need to be considered. Since interruption due to MG is well captured in spec, Moderator recommends not to discuss this issue in 2nd round.*

*Recommendations for 2nd round: No* *further discussion.*

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

*Majority companies propose to further discuss this issue when the procedure and supported scenario is clear. Moderator recommends to come back to this issue after the procedure and supported scenario is clear.*

*No tentative agreements in the 1st round.*

*Recommendations for 2nd round:* *No further discussion.*

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

*Tentative agreements in the 1st round:* Wait for RAN1/2 input and then discuss whether and how to define timing management requirements.

*Recommendations for 2nd round:* *No further discussion.*

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

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| *Clarification from Ericsson in the 1st round*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.  |

*Please provide further comments on the following option*

* + Revised Option 1 (Ericsson): Specify MRTD of serving cell and neighbour cell if covering the scenario that time offset of serving cell and neighbour cell is more than CP.

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| **Company** | **Comments** |
| Apple | Further discussion is needed. currently MRTD requirements only apply for serving cells. Even with the clarification in the 1st round, it is still unclear to us why RAN4 needs to define MRTD between serving cell and neighbour cell, as most companies support not to consider simultaneous Rx/Tx during this procedure. |
| Qualcomm | Not clear yet.Whether serving and the candidate cells for L1/L2 mobility are in the same carrier, band, FR, etc is not clear. |
| Ericsson | We think UE can be configured with multiple candidate cells/TRPs, and they can be in same frequency or different frequency. Assuming, UE need to measure L1-RSRP on them for L1/L2 mobility, don’t we need to consider defining timing requirements? Maybe we are assuming multi-RX chain and different QCL type-D. We are open for further discussion. |
| vivo | We are OK to discuss timing offset assumption if there is LS from RAN1/2, or if it is related to the other RRM requirements which is in the scope. However, saying ‘Specify MRTD’ at this stage is not good for us. |
| MTK | We are open for further discussion.  |
| Huawei | The term MRTD is used for different serving carrier. So option 1 is not clear to us. We are open to further discuss whether more than CP case between TRP is supported. |
| Nokia | We are not against studying this and we think further clarification is needed. FFS |

### Sub-topic 3-2: Scenarios

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

*In the 1st round, majority companies support Option 1. One company asks for more clarification on Option 1.*

 *Please provide further comments on the following option*

* + Option 1 (MTK, Apple, vivo, QC, HW, Ericsson, LGE, CATT): Not consider simultaneous Rx/Tx with both source cell and target cell.

*Note: Proponents of option 1 should clarify more on “simultaneous Rx/Tx with both source cell and target cell” in the 2nd round.*

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| **Company** | **Comments** |
| Apple | Support option 1. We are not sure which part needs to be clarified. In our view, option 1 means UE is not expected to conduct simultaneous Rx/Tx with both source cell and target cell during the mobility procedure. In other word, UE only needs to conduct Rx/Tx with one single cell. |
| Qualcomm | Not clear the definition of “simultaneous Rx/Tx.” While UE receives signals/channels or transmits signals/channels from/to the current PCell, if the UE can measure SSB from the candidate cell, is this considered “simultaneous Rx/Tx”? What about the case one of the candidate cells is actually the UE’s current SCell? This is also one of scenarios in the scope in RAN2. |
| Ericsson | We are in general fine with option 1. |
| vivo | We support option 1. For QC’s question, in our understanding, it means ‘Rx from to different cells in the same OFDM symbol’ or ‘Tx to difference cells in the same OFDM symbol’ within one carrier. Operations like inter-frequency L3 meas. w/o gaps or CA, are of course not related to this. |
| MTK | Support option 1. We think “simultaneous Rx/Tx” here is not referring to “While UE receives signals/channels or transmits signals/channels from/to the current PCell, if UE can measure SSB from the candidate cell”. Considering the target cell maybe UE’s current scell, we may change “target cell” to neighbour cell or non-serving cell. |
| Huawei | Option 1 |
| Nokia | This is not clear at the moment, and it should be clarified if this is RAN4 decision.  |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (MTK, Apple, vivo, QC, HW, LGE): Not consider simultaneous multi-panel in FR2
	+ Option 2 (Ericsson, Nokia): Consider simultaneous multi-panel in FR2

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| **Company** | **Comments** |
| Apple | Support option 1 as for baseline UE. Multi-panel is being discussed in other R18 WIs. It is premature to conclude at current stage that we will include the outcome of other ongoing WI. |
| Qualcomm | Support Option 1. |
| Ericsson | Option 2. Our thinking is when the Rel-18 UE supports multi-panel, it supports for all the features. Moreover, multi-RX chain is extension to FeMIMO and this WI also extension to FeMIMO. Due to this it is reasonable to consider this capability in two WI in parallel. If there are overlapping issues, we can try to discuss them at one place instead of discussing them in two places. |
| vivo | Prefer option 1. No need for parallel discussion. |
| MTK | Option 1. Parallel discussion should be avoided. |
| Huawei | Option 1 |
| Nokia  | Option 2: Multi-panel in this case means simultaneous reception from non-collocated sources.  |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (vivo, Ericsson, CATT, Nokia): RAN4 to discuss the definition of intra-frequency/inter-frequency in inter-cell operation
		- Option 1a (MTK): For SSB L1-RSRP measurement, follow the definition of L3 measurement.

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| --- | --- |
| **Company** | **Comments** |
| Apple | Open for further discussion. |
| Qualcomm | No view on Options yet. To us, this is a second level of details that can be discussed later. |
| Ericsson | OK to disucss |
| vivo | Support option 1. For option 1a, as commented in the 1st round, we are not sure whether NCD-SSB within active BWP needs to be considered as inter-frequency. In R15 there is no intra-/inter-frequency defined for L1 measurement. In our understanding, all L1 measurements within active BWP can be done. Therefore, option 1a is slightly different from R15 restriction of L1 measurements.To QC: This issue is not related to RAN1/2 design in our understanding. RAN4 can make conclusion on what is defined as intra-frequency. Similar to the issue in option 1a, we have two options to discuss:* Option 1a: For SSB L1-RSRP measurement, follow the definition of L3 measurement.

Option 1b: For SSB L1-RSRP measurement, intra-frequency is defined as long as the SSB-based L1 measurement is performed within active BWP(s) of the UE. |
| MTK | We are open for further discussion. We prefer to align with L3 measurement to avoid too much different intra-frequency definitions.  |
| Huawei | Open to further discuss. |
| Nokia | Option 1. We should discuss this more |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (MTK, vivo, QC, apple): Further discuss the necessity, feasibility, and pros/cons of specifying inter-frequency L1-RSRP measurement.
	+ Option 2 (CMCC, HW, Ericsson, Nokia): Yes

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| --- | --- |
| **Company** | **Comments** |
| Apple | Open for further discussion. |
| Qualcomm | We don’t think this is “yes” or “no” question at least for now. |
| CMCC | According to the WID, both intra-frequency and inter-frequency are included. And the requirements need to be specified.  |
| Ericsson | As per the WID it supports both. Further L1/L2 mobility supposed to replace L3 mobility in some scenarios and scenarios for L3 mobility should be considered. |
| vivo | Same view as Qualcomm and Apple. |
| MTK | Option 1. |
| Huawei | Option 2. In R18 mobility enhancement WI, both intra-frequency and inter-frequency L1/L2 mobility are in the work scope. Moreover operators are interested in this scenario.  |
| Nokia | Option 2. It is in WID so it shouldn’t be excluded.  |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1: Not consider non-synchronous scenarios.
	+ Option 2 (Ericsson, Nokia): Consider non-synchronous scenarios.
	+ Option 3 (HW, CATT): FFS
		- Option 3a (MTK, vivo): discuss the definition of synchronous and non-synchronous
		- Option 3b (Apple, QC): wait for RAN2’s progress

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| **Company** | **Comments** |
| Apple | Support option 3a and 3b. This can be revised after the procedure becomes stable and clear. For instance, if the procedure requires tight synchronization, probably async would be out of the scope. But of course the definition of sync and async needs to be discussed. |
| Qualcomm | Option 3b |
| Ericsson | OK with option 2 and 3. |
| vivo | Support 3a and 3b. |
| MTK | Support option 3a and also fine to wait for RAN2’s progress. |
| Huawei | Option 3. |
| Nokia | Option 2, Yes, and 3b. We should ask this from RAN2?  |

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

*Tentative agreements in the 1st round:* Further discuss the number of supported cells with PCI different from serving cell.

*Please provide further comments on the following options*

* + Option 1(Apple, HW, vivo, Ericsson, CATT, Nokia): to discuss the number of supported cells with PCI different from serving cell.
		- Option 1a (MTK): To discuss the number of supported cells with PCI different from serving cell on a FR2 band
		- Option 1b (QC): To discuss the total number of cells to be monitored on all bands

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| **Company** | **Comments** |
| Apple | Open to further discussion. Existing requirement for L3 measurement is per layer. Maybe we can start from that. |
| Qualcomm | Do want to discuss this level of details for now. |
| Ericsson | **multiple cells with PCI different from serving cell** may be called something else in Rel-18, e.g., like candidate cells or some other terminology RAN2 comes up with. For mobility, candidate cells shall be measured obviously. Ofcourse it depends on L1 or L3 measurement is used as report quantity for measurement results.  |
| MTK | Open to further discussion. |
| Huawei | Option 1. 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. |
| Nokia | Option 1, RAN2 needs to also discuss this first? We are open to discuss this. It should be understood how long and complex these measurements would be, and what is the UE impact? It is not clear how this would be configured.  |

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

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (Ericsson, Nokia, vivo): Discuss whether intra-frequency L1-RSRP measurement accuracy can be improved for L1/L2 mobility
	+ Option 2 (MTK, Apple, QC, CATT): reuse the legacy intra-frequency L1-RSRP measurement accuracy for L1/L2 mobility.

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| **Company** | **Comments** |
| Apple | This shall be discussed in performance part.Anyway, if side condition is same a legacy, we need to apply the legacy accuracy requirement. |
| Qualcomm | The issue can be discussed later. If the group agrees to consider a better side condition in terms of SNR just in L1/L2 mobility context, the accuracy may be improved. Otherwise, Option 1 doesn’t seem to be the one that the group needs to discuss. This WI is not about L1-RSRP measurement improvement. |
| Ericsson | Agree this can be discussed later. |
| vivo | OK to further discuss. |
| MTK | Option 2. Agree with QC that this is not in the scope. |
| Huawei | Option 2 can be used a starting point if the side condition is unchanged. |
| Nokia | Option 1. Further discuss The intra-frequency requirements in FR1 and FR2 for L1-RSRP measurement and reporting have been defined in the latest TS 38.133 document, which covers L1 measurement from a cell with different PCI than serving cell. As mentioned, these could be used as the baseline for L1/L2 mobility intra-frequency requirements. However, inter-frequency measurement accuracies on non-serving neighbor cells seems not considered. We see that such requirements would be needed for L1/L2 mobility as inter-frequency scenario is considered in L1/2 mobility as shown above. Therefore, Inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell need to be defined. |

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

*No tentative agreements in the 1st round.*

*Please provide further comments on the following options*

* + Option 1 (Ericsson, Nokia): Define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell
		- Option 1a (QC, CATT): reuse the legacy intra-frequency L1-RSRP measurement accuracy requirements.
	+ Option 2 (Apple, vivo): Further discuss whether and how to define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell in performance part.

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| **Company** | **Comments** |
| Apple | Option 2. This shall be discussed in performance part. So far we don’t know whether the L1-RSRP measurement on inter-frequency is expected to be same as intra-frequency, e.g. side condition, measurement latency and etc. |
| Qualcomm | Let’s skip this sort of discussion. We do not want to spend time/effort discussing such a high level topic without any detailed context in terms of many. |
| Ericsson | Agree this can be discussed later. |
| vivo | Same view as QC. Need to agree on the scenario firstly, and SNR side condition can be one important aspect of the scenario. |
| MTK | Agree to discuss after we have agreement on the scenarios or discuss in performance part. |
| Huawei | Option 2. |
| Nokia | Discuss this further and check answer in 3-3-1. |

# Topic #4: CHO/CPAC Enhancement

## Companies’ contributions summary

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| --- | --- | --- |
| **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.

|  |  |
| --- | --- |
| **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 |
| CATT | Support option 1.  |
| Nokia | 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 |
| CATT | Support option 1. |
| Nokia  | 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.*

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

|  |
| --- |
| **Issue 4-1-1: RRM requirements for subsequent CPAC***All companies are fine to wait for RAN2 input to further discuss RAN4 impact.**Tentative agreements:* wait for RAN2 input to further discuss RRM requirements for subsequent CPAC.*Recommendations for 2nd round:* *No further discussion.* |

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

|  |
| --- |
| **Issue 4-2-1: RRM requirements for CHO with CPAC***All companies are fine to wait for RAN2 input to further discuss RAN4 impact.**Tentative agreements:* wait for RAN2 input to further discuss RRM requirements for CHO with CPAC.*Recommendations for 2nd round:* *No further discussion.* |

### 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 Further NR Mobility Enhancements | MediaTek Inc. |  |
|  |  |  |  |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| *R4-2211550* |  | Work Plan for Further NR Mobility Enhancements | MediaTek Inc., Apple | Revised |  |
|  |  |  |  |  |  |
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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