**3GPP TSG-RAN WG4 Meeting # 104-e R4-2214348**

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

**Title:** WF on Further NR Mobility Enhancements

**Agenda Item:** 11.16

**Source:** MediaTek Inc.

**Document for:** Approval

# Topic #1: General and work plan

## Sub-topic 1-1: Work plan

**<Way forward/Agreement>**: **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

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

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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*

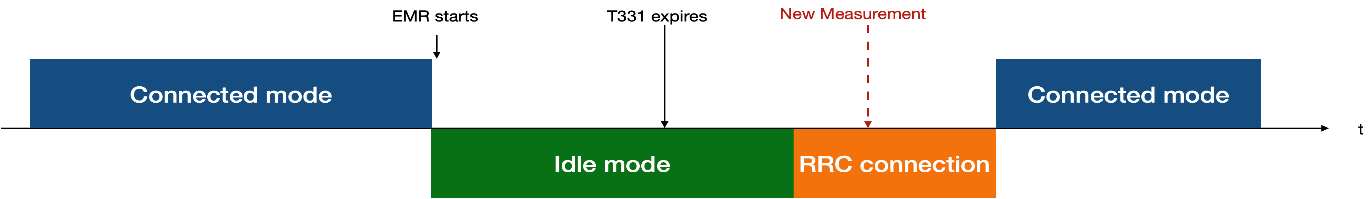
* + Option 1(CMCC): UE perform enhanced measurement closely before RRC connection setup/resume.
    - For MT originating call, the measurement is performed during the period between paging reception and UE send *RRCResumeRequest/ RRCSetupRequest*.
    - For MO originating call, the measurement is performed 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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

|  |  |
| --- | --- |
| **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 this  We think it is important to understand the impact of not assuming DRX, and look into both SMTC and SSB occasions. |

**<Way forward/Agreement>**: **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.*

|  |
| --- |
| *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.*

*No further discussion.*

## Sub-topic 2-3: Feasibility discussion

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.

*No further discussion.*

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

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

**<Way forward/Agreement>**: **Issue 3-1-1: L1/L2 inter-cell mobility delay requirements**

*Tentative agreements in the 1st round:*

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

*No further discussion.*

**<Way forward/Agreement>**: **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.*

*No* *further discussion.*

**<Way forward/Agreement>**: **Issue 3-1-3: L1-RSRP measurement delay requirements**

*In the 1st round, 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 further discussion.*

**<Way forward/Agreement>: Issue 3-1-4: Timing requirements**

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

*No further discussion.*

**<Way forward/Agreement>**: **Issue 3-1-5: Timing management requirements**

|  |
| --- |
| *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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.*

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>: 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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>: 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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>: 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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

|  |  |
| --- | --- |
| **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? |

**<Way forward/Agreement>: 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

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

**<Way forward/Agreement>**: **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.

*(The below table is to be moved to 2nd round summary and removed in the formal WF)*

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

## Sub-topic 4-1: subsequent CPAC

**<Way forward/Agreement>**: **Issue 4-1-1: RRM requirements for subsequent CPAC**

*In the 1st round, 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.

*No further discussion.*

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

**<Way forward/Agreement>**: **Issue 4-2-1: RRM requirements for CHO with CPAC**

*In the 1st round, 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.

*No further discussion.*