**3GPP TSG-RAN Meeting #92-e RP-21xxxx**

**Electronic Meeting, September 14th – 18th 2020**

**Agenda item:** TBA

**Source:** Moderator (RAN4 VC, Intel Corporation)

**Title:** Moderator's summary for email discussion [92-e-23-RRM-Enh]

**Document for:** Discussion

# Introduction

This document is the summary of the email discussion [92-e-23-RRM-Enh] on potential additional RRM objectives to be included in the Rel-17 work scope. Based on the discussions the recommendations will be provided. The following documents are covered in this email thread.

|  |  |  |
| --- | --- | --- |
| **Tdoc** | **Title** | **Source** |
| RP-211149 | New WID on legacy RRM requirements improvements | vivo |
| RP-211150 | Views on RRM requirements improvements | vivo |
| RP-211392 | Discussion on handling of RRM requirements related to R16 features | Huawei, HiSilicon |
| RP-211416 | Views on RAN4 RRM TEI Topics | Intel Corporation |
| RP-211417 | New WID: RRM TEI requirements | Intel Corporation |
| RP-211348 | Motivation: Measurement Requirements for “NeedForGap” | Ericsson, Huawei, HiSilicon |
| RP-211461 | Views on postponed RAN4 RRM issues | MediaTek Inc. |
| RP-211161 | Views on scope of further RRM enhancements | vivo |
| RP-211427 | Proposal to expand R17 FeRRM WI scope | Apple |

## Summary of proposals

The summary of companies’ proposals is provided below:

|  |  |  |
| --- | --- | --- |
| **Tdoc** | **Source** | **Observations and proposals** |
| RP-211161 | vivo | Proposal 1: Add the three new scenarios into the scope of the HO with PSCell in FeRRM WI.   * from NR SA to NE-DC * from NR SA to NR-DC * from LTE SA to EN-DC   Proposal 2: No TU change is needed by adding the new scenarios.  Proposal 3: Whether NR-U is in the scope of HO with PSCell in FeRRM WI needs to be clarified. |
| RP-211150 RP-211149 | vivo | Proposal 1: RRM requirements for FR1+FR1 NR-DC in Rel-16 are to be improved by creating a new WI in Rel-17.  Proposal 2: The improved RRM requirements for FR1+FR1 NR-DC are specified in release independent from Rel-16.  Proposal 3: RRM requirements for FR1+FR1 NR-DC are specified for   * PSCell addition delay requirements * NR-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed outside gaps * NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps   Proposal 4: RRM requirements for UE capability ‘NeedForGap’ are to be specified in a new WI in Rel-17.  Proposal 5: Whether RRM requirements for UE capability ‘NeedForGap’ are specified in release independent from Rel-16 are decided in WI phase.  Proposal 6: Objectives for RRM requirements for UE capability ‘NeedForGap’ are   * RRM requirements for UE capability ‘NeedForGap’ are applied to NR SA only. * The measurements related to ‘NeedForGap’ are limited to SSB based measurements only. * Study whether the additional interruption is allowed when UE reporting ‘no gap’.   + Specify interruption requirements, if interruption is allowed. * Study CSSF for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed. * Study scheduling restriction for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed. * Study measurement period for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed. * Decide if requirements are specified in release independent from Rel-16. |
| RP-211392 | Huawei, HiSilicon | Proposal 1: RAN4 RRM to develop requirements for the following features in R17 TEI and release independent from R16:   * per-BC indication of per-FR measurement, * needforgap, * non-co-located deployment for FR1 intra-band NR-CA/EN-DC |
| RP-211416 RP-211417 | Intel Corporation | Observation: In the previous RAN4 meetings, several RRM-relevant ‘TEI16’ topics were raised by companies, which received echo in the group that they should be addressed in the future   * NeedForGap RRM requirements [1] * Intra-band non-contiguous CA/EN-DC MRTD requirements [2] * FR1+FR1 NR-DC RRM requirements [3] * Per-FR gap UE capability enhancement [4]   Proposal: Further discuss and decide on how to handle each of the candidate RRM ‘TEI’ topics   * Option 1: Allow a limited NR Rel-17 scope extension to fit additional RRM objectives   + Option 1A: Schedule work to start in Q4’2021 and aim to complete by March’2022.   + Further discuss whether to extend the scope of the existing Rel-17 FeRRM WI, Rel-17 MG Enh WI or create a separate WI * Option 2: Consider the objectives as candidate objectives for Rel-18 |
| RP-211348 | Ericsson, Huawei, HiSilicon | Work scope:   * Limited to SSB based measurements configured via measurement objects in NR-SA only * Study whether the additional interruption is allowed when UE reporting ‘no gap’   + Further define the interruption length, occasion and ratio, if the interruption is allowed * Study the related requirements, such as CSSF, measurement period, scheduling restriction etc. * No impact to other WG is expected.   Release:   * Specify UE requirements in R16 under TEI16.   Timeline/TU:   * 1 TU in total:   + 0.5 TU per RAN4 meeting over 2 RAN4 meetings (see next slide). |
| RP-211461 | MediaTek | Proposal 1: Whether to start the RAN4 discussions for additional topics should also take into account the current RAN4 workload assessment from RAN4 chairman.  Proposal 2: Subject to RAN4 workload, merge NeedForGap requirements into NCSG in Rel-17 NR\_MG\_enh and increase the TU allocation by to 1.5 per meeting.  Proposal 3: Subject to RAN4 workload, the requirements for FR1 intra-band non-contiguous NR-CA/NR-DC are to be included in a new (or existing) RF WI with RRM and Demod objectives.  Proposal 4: Subject to RAN4 workload, create a new RAN4 TEI for introducing per-BC indication of per-FR gap. |
| RP-211427 | Apple | Proposal: Select up to 3 candidate scopes from following list to expand the R17 FeRRM WI, and no need to have  any new RAN4 led WI:  - Candidate scope 1: CMTC for CSI-RS L3 measurement  - Candidate scope 2: TCI switching enhancement  - Candidate scope 3: Collision between SSB/CSI-RS based L1 and CSI-RS L3  - Candidate scope 4: CGI reading requirement for NR-U cell  - Candidate scope 5: FR1+FR1 NR-DC RRM  - Candidate scope 6: Study and, if necessary, to specify New MR-DC Scenario for HO with PSCell in R17 FeRRM  - Candidate scope 7: RRM requirement with NeedForGap  - Candidate scope 8: Study and, if necessary, to specify Per-BC indication of per-FR MG UE capabilities in R17 FeRRM |

## Topics for discussion

* Topic 1: New RRM-related objectives
* Topic 2: Clarification of FeRRM WI objectives (NR-U for HO with PSCell)

# Topic #1: New RRM-related objectives

Several new RRM-related objectives were proposed to be handled in RAN4 and further decision on how to handle those shall be made:

* Objective #1: RRM requirements for FR1+FR1 NR-DC
* Objective #2: RRM requirements for UE capability ‘NeedForGap’
* Objective #3: Enhanced indication of UE per-FR gap capabilities
* Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC
* Objective #5: HO with PSCell requirements for additional scenarios
  + from NR SA to NE-DC
  + from NR SA to NR-DC
  + from LTE SA to EN-DC
* Objective #6: CMTC for CSI-RS L3 measurement
* Objective #7: TCI switching enhancement
* Objective #8: Collision between SSB/CSI-RS based L1 and CSI-RS L3
* Objective #9: CGI reading requirement for NR-U cell

For Topic #1 moderator recommends the following plan of the discussion:

1. GTW discussion (Mon)
   1. Identify whether and how many new RRM-related objectives can be added into the scope taking into account RAN4 Chair TU assessment
   2. If any new objectives can be handled, then further clarify
      1. Whether the proposals can be handled as TEI17 or shall be included into a certain Rel-17 WI
      2. Whether TEI16 approach can be used for specific objectives
      3. Note: Possibility of using TEI16/17 approach should be further confirmed in GTW session based on feedback from RAN4 Chair, RAN Chair and MCC.
2. Initial round
   1. Collect views on prioritization of candidate objectives
   2. Collect views on how to organize the work in case any objectives are approved.
   3. Collect views on detailed objectives.
3. Intermediate round
   1. Stabilize the set of new RRM-related objects (if any)
   2. Decide whether objectives shall be handled in a specific WI or in the TEI scope
   3. Discuss detailed objectives
4. Final round
   1. Conclude on detailed objectives
   2. Update WIDs if needed

## Initial Round

For the initial round moderator recommends to:

1. Collect companies views on prioritization of candidate objectives
2. Collect companies views on how to organize the work in case any objectives are approved.
3. Collect companies views on detailed objectives.

Moderator’s view is that exact set of objectives can be decided taking into account companies support of individual objectives as well GTW discussion on available RAN4 capacity.

### Open issues and companies views’ collection

**Sub-topic 1-1. Prioritization of candidate RRM-related objectives**

*Moderator: Companies are encouraged to share 1) proposals on the prioritization of proposed candidate RRM objectives general views on the objectives (please indicate your support on the specific objectives); 2) general views on the prioritization process (e.g. how many new objectives can be approved, whether any down-scoping is required, timelines of work).*

* Objective #1: RRM requirements for FR1+FR1 NR-DC
* Objective #2: RRM requirements for UE capability ‘NeedForGap’
* Objective #3: Enhanced indication of UE per-FR gap capabilities
* Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC
* Objective #5: HO with PSCell requirements for additional scenarios
  + from NR SA to NE-DC
  + from NR SA to NR-DC
  + from LTE SA to EN-DC
* Objective #6: CMTC for CSI-RS L3 measurement
* Objective #7: TCI switching enhancement
* Objective #8: Collision between SSB/CSI-RS based L1 and CSI-RS L3
* Objective #9: CGI reading requirement for NR-U cell

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | 1. First priority: objective # 2, second priority: objective #4 and third priority: objective #1. We prefer objective #2 as release independent from Rel-16. 2. In our view not more than 2 new objectives can be accommodated in Rel-17 while considering significant Rel-16 RRM performance maintenance work in Q3/Q4. |
| Apple | * We see the motivations for all of them. However, due to TU limitation, our top 3 preferences are objectives #6, #9 and #1 * No more than 3 new objectives should be considered. * Based on the discussion in GTW as well as the guidance from RAN and RAN4 chairs, shall we allow the study phase for the new objectives? |
| SoftBank | We prefer that objective#4 is the first priority and objective#1 is the second priority. |
| China Telecom | Support objective #2. Work can be done in Rel-17 and the requirements will be release independent from Rel-16. |
| Intel | One general comment for all the proposals is that we have to take the ones which had already reached consensus in RAN4. Those are #1 2 3 4. |
| CMCC | Objective#5 is the first priority, they are practical mobility scenarios and should not take much additional work.  Objective#3 is the second priority, this issue had been discussed under the UE feature list discussion for several meetings, due to the lack of technical discussion, and this issue had not been concluded in Rel-16. So adding objective 3 just moves the discussion from 1 email thread to another. We don’t think much additional work added by this objective.  Objective#2 is the 3rd priority.  Objective#1, we prefer to discuss this under TEI16. |
| OPPO | Agree to limit the extended RRM objectives. We support objective #1 as high priority, and consider #6, #7 which have been raised for several RAN meetings. |
| MTK | According to current TU assessment, RD session has 3, 1, 0.5, 0.5 TUs for the up-coming 4 meetings. At the same time, companies have comments to increase TUs for some particular items. Therefore, it is still a bit uncertain whether the RD session still have sufficient TU to accommodate new objectives. On the other hand, according Chair’s guidance in GTW session, we should focus on items with urgent deployment need. We should not just add objectives as long as we see some TU margin.  Therefore, we suggest to first discuss the following 2 aspects for every objective.   * Urgency: We think only #1, 2, 3, 4, 5 should be should be prioritized according to current operator input. * Workload: #1, 3, 5 have relative smaller workload than the other 2.   + Objective 2 is not a small work. Besides interruption requirement, UE behavior detail also need to be discussed. For an example, when UE supports no gap in band A but needs gap for band B, but network still configures measurement gap, the measurement for band A should be considered in CSSF within or outside gap? No mention that scenarios get even more complicated after considering NCSG.   Objective 4 requires some RF discussion on the fundamental UE/BS RF architecture to be concluded first, according to the noted WF in last RAN4 meeting. Also some potential Demod test cases for power imbalance. We are not sure if this is a purely RRM issue, although we did have some interest in knowing what extra requirement UE needs to consider in order to support the scenario. |
| KDDI | First priority: objective #4, Second priority: objective #1 |
| Samsung | We do not have strong preference on priority but considering the current work load in RAN4. We agreed with Ericsson, no more than 2 new objectives can be accommodated in RAN4 including both TEI16 (if agreed) and Rel-17. |
| LGE | We think industrial urgency for the deployment should be considered as discussed in GTW. 1~2 items seems feasible considering the remaining TUs in Rel-17 so operators input is necessary for the decision. In that sense, the objective#4 could be a higher priority. |
| Huawei | 1) Our priority topics are objectives #2, #3, #4. If we need to limit to 2 items: #2, #3 are the first priority topics.  2) For the prioritization process and considering the workload, we may first focus on features which are already partially implemented in Rel-16 specs, like the NeedForGap. Secondly, we can identify high interest topics for the Rel-17 WID revision on RRM enhancements. |
| vivo | From our perspective, the priority of the objectives are as follows.   1. Objectives #1 and #2 – First priority   The importance and the urgency of the two objectives is that there are already partial RRM requirements for the two objectives in Rel-16. However, if the missing RRM requirements are not added then the features of FR1+FR1 NR-DC and NeedForGap in Rel-16 are broken.  FR1+FR1 NR-DC is also one of the potential scenarios for HO with PSCell. Without complete requirements for FR1+FR1 NR-DC, HO with PSCell cannot be supported for this scenario either.  NeedForGap and NCSG have similarities from functionality point of view. Having full set of requirements for NeedForGap in Rel-16 would provide possibilities that UE can support such functionality in Rel-16. If the requirements for NeedForGap are specified from Rel-17 then we are wondering whether we need to support two similar features from RRM requirements perspective.  It is therefore worthy of completing the missing requirements for the two features. The requirements should be specified in release independent manner from Rel-16.   1. Objectives #3 and #5 – 2nd priority   The two objectives have second priority because the standardization efforts of the two objectives are minimized. For the HO with PSCell requirements for the three new scenarios, only applicability rules are needed in our understanding. For instance, the requirements for scenario from NR-DC to NR-DC can be reused for scenario from NR SA to NR-DC. For enhanced indication of per-FR capability, there may be no further RRM requirements at all are needed depending on discussions during Rel-16 phase.   1. Objective #4 – 3rd priority   There is operator request to have this feature. So, this may also be considered if there is TU room in RAN4. We also share MTK’s view that this is not just RRM related. RF requirements and demodulation requirements would also be needed. |
| ZTE | During Rel-17 entry stage, 3 objectives were carefully selected out of a long list of candidate proposals with 1.5 TUs allocated. If we add more than 3 new objectives in this week under the assumption the TUs will be similar more or less, then it means either we have severely underestimated the workload in the beginning, or we have made unexpected progress in this WI so some TUs can be freed for more new objectives. In our views neither of them is the case. So we tend to agree to limit the number of new objectives to 1 or 2 if essential issues with moderate workload can be identified in this week. With such consideration, we think Objective #1 may have the highest priority. |
| LG Uplus | Our first priority is objective #4 (Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC) where #2 and #5 as the next priority. |
| Spreadtrum | We support objective #1 and #3 as high priority. |
| Nokia | Overall, in view of the negative TU situation in RAN4, most of these items should be considered non-essential and postponed. If anything is included in Rel-17, highest priority would be objectives #5 and #1 (as these are related to ongoing work in RAN4, so it is more natural to address these than to start new topics). |
| NTT DOCOMO, INC. | From operator point of view, first priority is #4, second priority is #1. If TU budget is allowed, #3, #5, and #7 are medium priority for performance enhancement. |
| CATT | We think 3 objectives can be considered. And we prefer that objective #6 as first priority, objective #3 as second priority and objective #1 as third priority. |

**Sub-topic 1-2. Whether the requirements for objectives in issue 1-1 shall be defined in Rel-16/Rel-17 and how to organize the work for each of supported individual objectives**

*Moderator: Multiple proposal on how to handle the new objectives were provided. It is recommended to collect companies views on the preferred approaches. Companies are encouraged to provide views on how to handle each additional objective. Feasibility of using TEI16/17 approach should be further confirmed in GTW session based on feedback from RAN4 Chair, RAN Chair and MCC.*

* Option 1: Include the work in Rel-17
  + Option 1A: Extend existing WI (e.g. FeRRM WI, MG Enhancements WI, other?)
  + Option 1B: Create new Rel-17 WI
  + Option 1C: Handle in TEI17
* Option 2: Rel-16
  + Option 2A: Handle in TEI16
* Other

|  |  |
| --- | --- |
| Company | Comments collection |
| Ericsson | Option 1A. However, if needed some requirements can be release independent from Rel-16 (see our response on issue 1-1). |
| Apple | Option 1A. TEI16 does not seems appropriate for any of them due to the scope and cross-WG impacts. It is suggested to only consider the option to expand the existing WI scope. |
| China Telecom | Option 1A with a clear scope. |
| Intel | We can compromise with Option 1A. we think it is a better approach than anything else on the table, considering the current RAN4 workload. Possibly #1 and #3 can be fit into FeRRM, #2 in MG\_enh, #4 in FR1 RF. But we don’t think there is enough room for all four at the same time. Let’s choose 2 or 3. |
| CMCC | This should be discussed in a case to case manner. For most of the objectives, prefer option1A, for objective like FR1+FR1 DC, prefer to handle in TEI16. Of course, if the release independent is a common understanding for Rel-16 features, then we are OK with option 1A for all the objectives. |
| OPPO | Prefer option 1A, e.g., FeRRM WI. |
| MTK | Option 1A is more preferred in general, if RAN4 still has the TU to do it. |
| Samsung | How to organize the work is related to which release these requirements are applicable. For requirements companies prefer to apply in Rel-16, TEI16 is clear way instead of defining in Rel-17 but “release independent” from REl-16. The concept of “release independent” shall be very restricted to band and band specific requirements. |
| LGE | Prefer option 1A. |
| Huawei | TEI16 for NeedForGap, as there is already RAN2 signalling specified in Rel-16.  For per-FR gap with BC, option 1A with early implementation since R16 is suggested.  For other requirements, revise the existing WI (FeRRM or MG Enhancements WI depending on the topic). |
| vivo | We think how the work is done should be discussed case by case and it also has dependency of release independent RRM requirements.  For the objectives #1 and #2, we think it’s more like of fixing Rel-16 broken RRM requirements than enhancing RRM requirements in Rel-17. The two objectives are supposed to be completed in TEI16. In addition, if RRM requirements for NeedForGap is only targeted for Rel-17 then we think we may not need such requirements as NSCG could fulfill the same functionality already. There is not much value for both gNB and UE to support the two similar functionalities.  For objective #4, it was also proposed in TEI16 in the last RAN4 meeting. So, it is also one potential Rel-16 feature. There are more other requirements than RRM for this objective.  So, we still think it may be better to create a new WI for objective #1, #2 and maybe #4 if any of the objectives are agreeable, which is targeting of fixing Rel-16 missing RRM requirements rather than Rel-17 RRM enhancement.  For the objective #5, scope of HO with PSCell in FeRRM WI should be revised to capture the new scenarios while no TU adjustment is needed.  For the objective #3, it can be treated in TEI-17 or added into FeRRM WI without TU adjustment. |
| ZTE | Option 1A seems more reasonable. |
| LG Uplus | Option 1A for #4 and #5 while #2 can be considered with option 2A(TEI16) if possible |
| Nokia | If anything is included in Rel-17, it should be with option 1A. Objectives #1 and #5 can be included in the existing FeRRM WI. Options 1C and 2 are definitely not acceptable. |
| CATT | Option 1A. We think all the objectives can be regarded as the enhancement of the current requirements and can be included in the existing R17 WI. |

**Sub-topic 1-3: Whether requirements can be introduced in a release independent manner**

*Moderator: Several companies proposed to define requirements in release independent manner (FR1+FR1 NR-DC, ‘NeedForGap’). Companies are encouraged to provide views on how to handle each additional objective and whether it is feasible to define objectives in a release-independent manner.*

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| **Apple** | It should be discussed and decided after the corresponding features and requirements becomes available. This is also the typical procedure how release independent is treated.  Combining sub-topic 1-1 and 1-3 makes the overall discussion even more complicated. |
| China Telecom | Yes |
| Intel | YES with case by case discussion.  Anyway RRM has to discuss this aspect as several releases have passed since Rel-15. NR has not seen any release independent RRM requirements. We suggest that we discuss this aspect in general so that the outcome provides guidance in future works. |
| **CMCC** | **Yes. Can be discussed in a case by case manner.** |
| OPPO | Prefer to discuss the features case by case after their requirements are completed. |
| MTK | It is too early to make this decision. RAN4 requirements needs to be stable first in order to understand if the feature can really be deployed without additional RRC or UE capability support.  Also agree with some companies that we need to have a case-by-case discussion in RAN4. |
| Samsung | No, as commented in sub topic 1-3, TEI16 can be used for requirements applied in Rel-16. |
| Huawei | Based on the GTW discussion and feedback received, better to focus on other approaches, like TEI16, or Rel-17 WI extension. |
| vivo | It should be discussed case by case.  As our comments above, we think objectives #1 and #2 should be specified in release independent manner. For objective #2, having Rel-16 requirements can provide possibility to support this functionality for a Rel-16 UE. When it comes to Rel-17 only then the value to support both NCSG and NeedForGap is not obvious.  For the other objectives, we think they should be targeting Rel-17. |
| ZTE | Yes with case by case discussion, similar views as other companies. |
| LG Uplus | Open to be discussed as mentioned it is case be case. |
| Nokia | Objectives 1 and 5 can be part of existing FeRRM WI, but Objective 1 may also be in a separate new Rel-17 WI. As such, neither of these would necessarily need any discussion related to release independence. |
| CATT | We think it should be considered case by case after the requirements are decided. |

**Sub-topic 1-4: Detailed objectives**

*Moderator: Companies are encouraged to share general views on each objective and proposals on the detailed scope for each identified objective.*

**Issue 1-4-1: RRM requirements for FR1+FR1 NR-DC**

* Option 1 (vivo):
  + PSCell addition delay requirements
  + NR-DC mode: carrier-specific scaling factor for SSB-based and CSI-RS based L3 measurements performed outside gaps
  + NR-DC: carrier-specific scaling factor for SSB-based and CSI-RS-based L3 measurements performed within gaps
* Option 2 (Intel):
  + Specify missing FR1+FR1 NR-DC RRM requirements
    - Specify general RRM requirement applicability: number of serving carriers configured under NR-DC
    - Specify delay requirements for PSCell procedures
      * PSCell addition and release
      * PSCell change and conditional PSCell change
    - Specify scheduling availability of UE during RLM and BFD
    - Specify or update CSSF for NR-DC
    - Specify if needed, release independency of this objective from Rel-16

Note: this objective applies only to NR SA and only to SSB-based measurements.

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | This will be significant amount of work. If this objective is included then it should be limited to SSB based L3 measurements. |
| **Apple** | The same as other objectives, if this one is agreed to be included in R17, the exact scope can be discussed and decided in WG level. We probably do not need to go to details in the plenary. |
| Intel | Option 2 is more comprehensive.  In practice many of the subobjectives here don’t impose much of workload as it seems, since most of the RRM requirements have corresponding references from existing ones. Note that this objective applies only to NR SA and only to SSB-based measurements. |
| **CMCC** | **Option 2 is prefered** |
| OPPO | Agree this issue is significant for the integrity of RRM requirements. The difference of the two options is mainly about the exact scope, e.g., either the baseline PSCell addition requirement or full set of RRM requirements for FR1+FR1 NR-DC. It should be decided in RAN-P level at first, and then the details could be further discussed.  Both options are fine to us, but slightly prefer option 1 due to relatively small scope. |
| MTK | Option 2 is more comprehensive. We should also allow RAN4 to identify any new critical aspects during WG discussion if any. So that we do not need to comeback to plenary to revise the WI again and again. |
| Huawei | For the initial discussion, it is proposed to focus on topics prioritization first, i.e. no need to discuss if FR1+FR1 NR-DC does not get much interest. |
| vivo | There are additional items in option 2.  For PSCell release, PSCell change, conditional PSCell change and scheduling availability of UE during RLM and BFD, the existing requirements already covers FR1-FR1 NR-DC. There are no further requirements being needed.  With option 2, it seems the scope is quite large, which is not true.  So, option 1 with general RRM requirements applicability rule additionally would be the objectives for FR1-FR1 NR-DC. |
| ZTE | Option 2 preferred to address the missing piece. |
| Nokia | Defining RRM requirements for FR1-FR1 NR-DC will of course increase the workload in RAN4; however, it is not expected to be a significant increase and it may be possible to use existing RRM requirements as starting point which should help to limit the work. |
| CATT | Same as other objectives, this should be considered after the priority is decided. And this should be discussed in WG level. |

**Issue 1-4-2: RRM requirements for UE capability ‘NeedForGap’**

* Option 1 (vivo):
  + RRM requirements for UE capability ‘NeedForGap’ are applied to NR SA only.
  + The measurements related to ‘NeedForGap’ are limited to SSB based measurements only.
  + Study whether the additional interruption is allowed when UE reporting ‘no gap’.
    - Specify interruption requirements, if interruption is allowed.
  + Study CSSF for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed.
  + Study scheduling restriction for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed.
  + Study measurement period for measurements with ‘no gap’ in ‘NeedForGap’ reporting, and specify requirements if needed.
  + Decide if requirements are specified in release independent from Rel-16.
* Option 2 (Intel)
  + Specify RRM requirements for UE supporting gap-less RRM measurements
  + Discuss and specify if needed, possible interruptions or scheduling restrictions due to UE retuning the vacant chain for gap-less measurements
  + Specify or update RRM measurement requirements related to gap-less measurements
    - CSSF
    - Measurement period
    - Scheduling or measurement restrictions/availabilities
  + Specify if needed, release independency of this objective from Rel-16
* Option 3 (E///, Huawei, HiSilicon)
  + Limited to SSB based measurements configured via measurement objects in NR-SA only
  + Study whether the additional interruption is allowed when UE reporting ‘no gap’
    - Further define the interruption length, occasion and ratio, if the interruption is allowed
  + Study the related requirements, such as CSSF, measurement period, scheduling restriction etc.

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Fundamentally all options are similar. We prefer scope as agreed in RAN4 WF (R4-2108039):   * Potential new objective - NeedForGap for NR-SA only   1. Limited to SSB based measurements configured via measurement objects   2. Study whether the additional interruption is allowed when UE reporting ‘no gap’      1. Further define the interruption length, occasion and ratio, if the interruption is allowed   3. Study the related requirements, such as CSSF, measurement period, scheduling restriction etc.   4. RAN4 to further consider the relation with other UE capabilities, such as NCSG etc.   5. Analyse other WG impact although impact is not expected. |
| **Apple** | Agree to take agreed WF in RAN4#99e as the baseline. Once this topic is agreed, details can be further discussed and finalized. |
| Intel | OK to go with the agreeable WF. But release independency has to be discussed. |
| OPPO | Agree to start with a study phase provided in option 3, if this feature was agreed in the extended scope. |
| MTK | Take the WF as the baseline.  Regarding the executive detail in RAN4, we hope the discussion can be handled properly with NCSG in gap enhancement. There are too many similarities between these 2 features. We should try to avoid parallel discussions to waste RAN4 time and try to make the conclusions as consistent as possible. Our preference is to have this discussion together with NCSG in the same Email thread by the same group of people. |
| Huawei | Option 3 and agree with the RAN4 WF (R4-2108039). |
| vivo | All options are similar and basically aligned with the WF in RAN4. For the requirements we think study phase is needed. It is not for sure if all requirements mentioned in the WF are needed. |
| ZTE | The WF in RAN4#99e can be the baseline if the feature is agreed. |
| Nokia | The work related to defining RRM requirements for NeedForGaps may be significant and require careful analysis of existing requirements and new requirements. Legacy network impact would need to be considered, as the current understanding is that when a UE indicates it does not need measurement gaps for performing measurements it does not need gaps and it does not cause any interruptions due to performing measurements. This would most likely also have RAN2 impact. |
| CATT | The options are similar and we are fine to take the agreed WF as baseline. Details should be further studied if this objective is agreed. |

**Issue 1-4-3: Enhanced indication of UE per-FR gap capabilities**

* Option 1 (Intel)
  + Enhance indication of UE per-FR gap capabilities
    - Study and update if needed, RRM requirements for Per-BC indication of per-FR gap capabilities
    - Other indication is not precluded

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Looks fine to us. |
| Intel | The problem for this objective is where to put it. FeRRM is one candidate place. No release independency is assumed for now but still subject to group discussion. |
| MTK | Suggest to make it clear that RAN2 will need to work on the RRC aspects |
| Apple | We are OK to study this in R17. Firstly, we need to understand if per-BC proposal can solve the issue and is the best way to address the problem. Once the corresponding revision is made, we are open to make it release independent.  However, it should be clarified that it is not accurate in some company’s contribution to say there is no technical argument provided during RAN4 discussion. We re-post our questions/comments in RAN4#99e as reference   * + per-FR and per-UE measurement gap capability is introduced to accommodate two type of implementation, discrete RFIC between FR1 and FR2 and single RFIC for both FR1 and FR2.   + Almost all per-FR gap dependent requirements are interruption related either directly (e.g. interruption requirements) or indirectly (multiple SCell activation, multiple CC BWP switching, etc.).     - After several meetings, there is no clear explanation why interruption related requirements are baseband dependent.     - Also, upon the baseband dependent issues are clarified, we also need to understand if per-BC can solve the problem, since baseband capability not only involves a specify band combination but also # of CC, aggregated BW, MIMO capability, etc. |
| Huawei | Option 1 |
| vivo | It seems there may be no further RRM requirements for the new UE capability at all. So, option 1 is fine if it is handled in a WI. Otherwise, no detail objective is needed if it is handled in TEI-17. |
| ZTE | We are fine with the study in Rel-17 if time permitted.  In addition, some RAN2 aspects may need to be clarified if per-BC level indication is agreed:  1. Whether the new per-BC capability will be applicable to only NR band combination (NR CA, NR-DC)? Or all MR-DC cases, e.g. (NG)EN-DC, NE-DC?  2. Impact on MN-SN inter-operation: the current capability can be obtained by both MN and SN. By introducing per-BC indication, how to inform SN about the per-FR gap capability considering SN is unaware of the BC configured in MCG.  3. The current capability bit can be used to indicate the support of LTE->NR FR2 gapless measurement when (NG)EN-DC is not configured. In case per-BC indication is introduced, how to interpret the inter-RAT FR2 measurement gapless capability needs to be clarified. |
| Nokia | Not essential for Rel-17. This will also have RAN2 impact. |
| CATT | Option 1 looks fine and we are fine to study in R17 RRM. |

**Issue 1-4-4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**

* Option 1 (Intel)
  + Study the following aspects to enable UE support of non-collocated intra-band non-contiguous CA and EN-DC
    - Baseline UE RF architecture
    - Baseline BS RF architecture
    - Power imbalance between 2 CCs in the same band
    - MRTD and MTTD requirements
    - Others
  + Specify if needed, any RAN4 requirement according to the above study

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | The scope looks fine. However, only MRTD/MTTD is part of RRM work. |
| Intel | We can remove ‘others’ bullet. Maybe to put this objective in FR1 RF WI is a proper approach. Release independency is not considered for this objective. |
| MTK | As we commented in previous issue, this is not a purely RRM work. In our view, 3 phases are needed. Starting from RF discussion on the architecture, followed by RRM core requirement on MRTD/MTTD and ended by Demod test cases for power imbalance. RRM WI may not be a good place to have this discussion. Some more discussions are needed.  Since this additional requirement may demand a high UE implementation cost, we suggest to add a study on whether UE capability is needed. |
| Huawei | In general we are supportive of the scenario as such. Relation to the RF work requires clarification (and out of scope of this RRM topic?), especially from the workload point of view. Feedback from interested operators would be appreciated. |
| vivo | This needs further discussion on what RF and demodulation requirements are. |
| ZTE | Quite much workload may be required, and we are not sure if there is enough TU including RF session to accommodate the scope. |
| LG Uplus | We are OK with the proposed objectives in general where also we agree that some arrangements are required where some parts are related with RF, some with RRM, and some with Demod. Next round, we hope to see the proposed objectives together in RP-211299(slide 5) from Softbank, KDDI, and NTT docomo. |
| Nokia | Not essential for Rel-17, but could be OK |
| CATT | This is not only related to RRM but also RF scope. We are not sure whether this can be decided in RRM part. |

**Issue 1-4-5: HO with PSCell requirements for additional scenarios**

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| MTK | Fine with the current scope. |
| Huawei | This is more like the revision of the existing objective (very limited RAN4 work is needed according to previous RAN4 discussion) instead of adding a new one. |
| vivo | The scenario would be supported due to minimized standardization efforts by revising existing objectives for HO with PSCell. |
| Nokia | We do not see that including these additional scenarios into the existing WI will increase the WI workload significantly. |

**Issue 1-4-6: Objective #6: CMTC for CSI-RS L3 measurement**

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| MTK | As RAN4 already reached the consensus on how to determine the starting time of the 5ms windows, we think this issue is not urgent anymore. It can be put in low priority. |
| Nokia | Not essential for Rel-17 |
|  |  |

**Issue 1-4-7: TCI switching enhancement**

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| MTK | Please note that RAN1 is in parallel working on a unified TCI-state mechanism in Rel-17 feMIMO. The suggestion is to work on this unified mechanism which is expected to be more efficient in beam management, rather than keep enhancing Rel-15. |
| Nokia | Not essential for Rel-17 |
|  |  |

**Issue 1-4-8: Collision between SSB/CSI-RS based L1 and CSI-RS L3**

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Nokia | Not essential for Rel-17 |
|  |  |
|  |  |

**Issue 1-4-9: CGI reading requirement for NR-U cell**

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Nokia | Not essential for Rel-17 |
|  |  |
|  |  |

### Summary

**Sub-topic 1-1. Prioritization of candidate RRM-related objectives**

Notes from Monday GTW:

* RAN4 chair mentioned that it is preferable to avoid objectives with study stage
* RAN and RAN4 chair that new objectives should address urgent deployments needs and be absolutely necessary

Comments on prioritization

* Companies provided comments on prioritization of candidate objectives
  + Objective #1 has the largest support from the ecosystem
  + Objective #4 has a strong support from the ecosystem, especially from the operator side
  + Objectives #2 and #3 have medium support with more companies indicating support of objective #2 as the 1st preference
  + Objectives #5-9 have low or almost no support

|  |  |  |
| --- | --- | --- |
| **Objectives** | **Supporting companies** |  |
| Objective #1: RRM requirements for FR1+FR1 NR-DC | E///, Apple, Softbank, Intel, CMCC (TEI16), OPPO, MTK, KDDI, vivo, ZTE, LG Uplus, Spreadtrum, Nokia, NTT DCM, CATT  1st preference: OPPO, MTK, vivo, ZTE, Spreadtrum, Nokia, Intel  2nd preference: KDDI, LG Uplus, NTT DCM  3rd preference: CATT, CMCC (TEI16) | 16 |
| Objective #2: RRM requirements for UE capability ‘NeedForGap’ | E///, China Telecom, Intel, MTK, Huawei, vivo, CMCC  1st preference: E///, China Telecom, Intel, MTK, Huawei, vivo  2nd preference:  3rd preference: CMCC | 8 |
| Objective #3: Enhanced indication of UE per-FR gap capabilities | Intel, CMCC, MTK, Huawei, vivo, Spreadtrum, NTT DCM, CATT  1st preference: MTK, Intel, Huawei, Spreadtrum  2nd preference: CMCC, vivo, CATT  3rd preference: NTT DCM | 8 |
| Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC | E///, Softbank, Intel, MTK, KDDI, LGE, Huawei, vivo, LG Uplus, NTT DCM  1st preference: Softbank, KDDI, LGE, Huawei, LG Uplus, NTT DCM Intel, MTK  2nd preference: E///  3rd preference: vivo | 10 |
| Objective #5: HO with PSCell requirements for additional scenarios  from NR SA to NE-DC  from NR SA to NR-DC  from LTE SA to EN-DC | CMCC, MTK, vivo, LG Uplus, Nokia, NTT DCM  1st preference: CMCC, MTK, Nokia  2nd preference: vivo, LG Uplus  3rd preference: NTT DC | 6 |
| Objective #6: CMTC for CSI-RS L3 measurement | Apple, OPPO, CATT (1st preference) | 3 |
| Objective #7: TCI switching enhancement | OPPO, NTT DCM (3rd preference) | 2 |
| Objective #8: Collision between SSB/CSI-RS based L1 and CSI-RS L3 |  | 0 |
| Objective #9: CGI reading requirement for NR-U cell | Apple | 1 |

Number of newly approved objectives:

* Companies provided comments on the reasonable number of newly approved objectives with most companies propose considering 1-3 new objectives.
  + E///, Samsung: not more than 2 new objectives
  + Apple: Not more than 3 new objectives
  + ZTE: 1 or 2 new objectives
  + CATT: 3 new objectives
  + Intel: 2 or 3 new objectives
* Several companies not provided exact number but mentioned several candidate objectives

Other comments:

* One company commented that objectives #1, 3, 5 have relative smaller workload than the 2 and 4
* Several companies mentioned that objective #4 has RF scope as well

**Moderator’s views/proposal**

* Most companies propose to consider 1-3 new objectives.
* Taking into account the RRM session workload and companies feedback on prioritization, urgent deployment needs from several operators it is recommended to downselect objectives #1 and #4 for approval
* Additional discussion whether objective #2 can be additionally considered may take place given a relatively strong support
* For objective #4 companies commented on RF/Demod scope. Given negative TU budget for RF session it is encouraged to minimize the scope (e.g. no RF requirement and provide guidance on possible power imbalance or focus on MRTD requirements only).
* Companies are encouraged to confirm the proposal in the intermediate round and discuss the detailed objectives.
* **Recommendation: Down-select the following objectives for approval**
  + **Objective #1: RRM requirements for FR1+FR1 NR-DC**
  + **Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**
  + **FFS: Objective #2: RRM requirements for UE capability ‘NeedForGap’**

**Sub-topic 1-2. Whether the requirements for objectives in issue 1-1 shall be defined in Rel-16/Rel-17 and how to organize the work for each of supported individual objectives**

Summary of comments

* Option 1: Include the work in Rel-17
  + Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, CMCC (all except #1), OPPO, MTK, LGE, Huawei (all except #2, early implementation for #3), vivo (#5, #3), LG Uplus (#4 and #5), Nokia, CATT
  + Option 1B: Create new Rel-17 WI: No companies
  + Option 1C: Handle in TEI17: vivo (#3),
* Option 2: Rel-16
  + Option 2A: Handle in TEI16: CMCC (# 1), Huawei (# 2), vivo (#1, #2), LG Uplus (#2)
* Depends on specific objective (Samsung)
* Summary of views per objective

|  |  |
| --- | --- |
| **Objectives** | **Companies view** |
| Objective #1: RRM requirements for FR1+FR1 NR-DC | Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, OPPO, MTK, LGE, Huawei, Nokia, CATT  Option 2A: Handle in TEI16: CMCC, vivo |
| Objective #2: RRM requirements for UE capability ‘NeedForGap’ | Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, CMCC, OPPO, MTK, LGE, Nokia, CATT  Option 2A: Handle in TEI16: Huawei, vivo, LG Uplus |
| Objective #3: Enhanced indication of UE per-FR gap capabilities | Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, CMCC, OPPO, MTK, LGE, Huawei (early implementation for #3), vivo, Nokia, CATT  Option 1C: Handle in TEI17: vivo |
| Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC | Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, CMCC, OPPO, MTK, LGE, Huawei, vivo, LG Uplus, Nokia, CATT |
| Objective #5: HO with PSCell requirements for additional scenarios  from NR SA to NE-DC  from NR SA to NR-DC  from LTE SA to EN-DC | Option 1A: Extend existing WI: E///, Apple, China Telecom, Intel, CMCC, OPPO, MTK, LGE, Huawei, vivo, LG Uplus, Nokia, CATT |

Moderator’s views/proposal

* Majority of companies think that new objectives shall be included in Rel-17 work scope. Several companies prefer to handle some of objectives in TEI16.
* Some companies think that the decision also depends on whether the requirements can be defined in release independent manner
* Objective #4 can be confirmed to be introduced in Rel-17.
* Further discussion on Objectives 1 and 2 is required
* **Recommendation: continue discussion in the intermediate round for each objective whether the requirements for objectives in issue 1-1 shall be defined in Rel-16/Rel-17**

**Sub-topic 1-3: Whether requirements can be introduced in a release independent manner**

Summary of comments

* Decide on case by case basis
  + CMCC, Intel, vivo, ZTE, LG Uplus, CATT
  + Once requirements are introduced or at a later stage: Apple, OPPO, MTK
* Introduce requirements in release independent manner: China Telecom
* Do not introduce requirements in release independent manner: Nokia (obj 1 and 5)
* Introduce in selected features in Rel-16: Samsung

Moderator’s views/proposal

* No consensus and discussion shall continue for each specific objective.
* **Recommendation: continue discussion in the intermediate round for each objective whether requirements can be introduced in a release independent manner**

**Sub-topic 1-4: Detailed objectives**

*Moderator: Companies are encouraged to share general views on each objective and proposals on the detailed scope for each identified objective.*

**Issue 1-4-1: RRM requirements for FR1+FR1 NR-DC**

Summary

* E///: focus on SSB-based objectives
* Option 1: vivo, OPPO
* Option 2: Intel, ZTE, MTK, CMCC
* Discuss at WG-level: CATT, MTK, Apple

Moderator’s views/proposal

* Continue discussion in the next round.

**Issue 1-4-2: RRM requirements for UE capability ‘NeedForGap’**

Summary

* Based on R4-2108039: E///, Apple, Intel, OPPO, MTK, Huawei, OPPO, vivo, ZTE, CATT
* Nokia: additional considerations are needed

Moderator’s views/proposal

* Continue discussion in the next round.

**Issue 1-4-3: Enhanced indication of UE per-FR gap capabilities**

Summary

* Option 1: E///, Intel, Huawei, vivo, ZTE, CATT
* MTK, ZTE: RAN2 needs to get involved
* Apple: further discussion is needed

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Issue 1-4-4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**

Summary

* E///: only MRTD/MTTD is part of RRM work
* Intel: can consider FR1 RF WI
* MTK, E///, Huawei, vivo, ZTE, CATT: This includes RF/RRM/Demod

Moderator’s views/proposal

* Continue discussion in the next round.
* The proposal includes RF and Demod scope and further discussion on how to handle this is required

**Issue 1-4-5: HO with PSCell requirements for additional scenarios**

Summary

* Three companies commented that the scope is minimal and does not increase workload

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Issue 1-4-6: Objective #6: CMTC for CSI-RS L3 measurement**

Summary

* Two companies commented that it is not essential/urgent

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Issue 1-4-7: TCI switching enhancement**

Summary

* One company commented that it is not essential
* One company commented that RAN1 is considering additional enhancements to the mechanism

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Issue 1-4-8: Collision between SSB/CSI-RS based L1 and CSI-RS L3**

Summary

* One company commented that it is not essential

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Issue 1-4-9: CGI reading requirement for NR-U cell**

Summary

* One company commented that it is not essential

Moderator’s views/proposal

* Do not continue discussion based on issue prioritization.

**Moderator’s proposal for the intermediate round**

* **Further confirm the following objectives for approval**
  + **Objective #1: RRM requirements for FR1+FR1 NR-DC**
  + **Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**
  + **FFS: Objective #2: RRM requirements for UE capability ‘NeedForGap’**
* **Continue discussion for each objective whether the requirements for objectives shall be defined in Rel-16/Rel-17**
* **Continue discussion for each objective whether requirements can be introduced in a release independent manner**
* **Continue discussion on detailed objectives for down-selected topics**

## Intermediate Round

### Open issues and companies views’ collection

#### **Sub-topic 1-1. Prioritization**

**Moderator’s proposal for the intermediate round**

* **Further confirm the following objectives for approval**
  + **Objective #1: RRM requirements for FR1+FR1 NR-DC**
  + **Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**
  + **FFS: Objective #2: RRM requirements for UE capability ‘NeedForGap’**

*Moderator: Companies are encouraged to share views whether Objective #1 and #4 can be confirmed to be included in the package and whether Objective #2 can be additionally considered*

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | We can compromise to support all three objectives. For us objective #2 is of highest priority. |
| SoftBank | We support the moderator’s proposal. |
| Apple | For objective #4, many companies comment that it is RF architecture related (it means RF TU is needed) and a study phase is needed. It should be confirmed together with detailed scope.  Objectives 1 and 3 are fine too. |
| CMCC | Objective#4 is not only RRM related. Agree with Apple that this should be confirmed together with RF scope.  Objective#1 and 2 are OK |
| Xiaomi | Fine with objective#1 and #2, and Objective#1 is the highest priority from Xiaomi’s perspective. And for Objective#4, share the same view as Apple and CMCC, the RF and RRM scope should be determined together. |
| MTK | According to the current discussion in [92-e-32-RAN4-TUs], RD session has 1.25, 0.5, -0.5, -1.5 remaining TUs for the next 4 RAN4 meetings, while RF remaining TUs are already negative. In this sense, we can at least agree on Objective #1, which has less workload and no RF works. Whether RAN4 still has margin for #2 or #4 may need some more discussion, e.g., in GTW. |
| Qualcomm | Objective#2 has highest priority among the 3 proposals for us. We object to having Objective#4. this kind of scenario cannot be supported with the current RF architectures. this objective would also require a lot of work as pointed out by other companies. |
| LG Uplus | Objective#4 should be in the scope as it is from the commercial perspective. If there is TU issue due to the other parts than RRM from the Objective #4, we should manage them directly rather than ruling whole Objective #4 out entirely. Maybe Qualcomm’s suggestion for 6dB might be the practical alternative solution if the TU issue is unmanageable with the Note that this part may be revisited if time allows. (FYI, There was editoral errror in the summary where we did not pick the Objective #1 as the one of our interests but anyway it does not make big change) |
| China Telecom | Support Objective #2. |
| CATT | Share the similar view as other companies that the objective #4 should be decided together with RF part. Objective #1 and #2 are fine. |
| LGE | Considering remaining TUs, we are not sure that all three objectives are available. So, we prefer objective#4 as higher priority. |
| KDDI | We support the moderator’s proposal. |
| Huawei | Support to address all 3 objectives (priority order #2, #4, #1), with the following clarifications:  - #2: as commented by few companies in the initial round, this feature shall be completed in Rel16 and it is seen that TEI16 is suitable approach.  - #4: As captured by the moderator in the summary “Objective #4 can be confirmed to be introduced in Rel-17”, and we shall have further clarification on the RF discussion dependency (and TU situation). |
| ZTE | We are fine with Objective #1. For Objective #4, since it involves other sessions, and according to the latest RAN4 TU budget, it seems not feasible for the moment. |
| Nokia | In view of the workload situation in RAN4, which companies need to respect, three new objectives is not reasonable.  We can agree to introduce 1 new Objective in Rel-17. Hence, based on company support, Objective #1 can be introduced as new additional objectives in Rel-17.  Objective #4 probably has RF impact, and Objective #2 most likely has RAN2 impact. Objective #2 certainly cannot be additionally considered.  It should be noted that, based on the newly updated TU allocation table, the TU availability is a serious challenge especially in RAN4#101 and afterwards (going to negative TUs already in RAN4#101bis). Having a new objective introduced will need to be reflected in the TU allocation table. |
| vivo | We continue to support Objective #1 and objective #2 as first priority. For Objective #2, we think it should be a Rel-16 feature at least by introducing requirements in a release independent manner. |

#### **Sub-topic 1-2. Objective #1: RRM requirements for FR1+FR1 NR-DC**

**Issue 1-2-1. Whether to treat topic in Rel-17 or in TEI16**

*Moderator: Majority of companies suggested to handle in Rel-17, but several companies preferred TEI16 and further inputs are encouraged*

* Option 1: Include in Rel-17 FeRRM WI
* Option 2: TEI16
* Option 3: Other

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1 |
| Apple | Option 1 |
| CMCC | OK with option 1 |
| Xiaomi | Prefer option 1 |
| MTK | Support Option 1. |
| CATT | Option 1. |
| Huawei | Option 1 |
| ZTE | Fine with Option 1. |
| Nokia | Option 1. It is not acceptable to be starting new TEI16 work after the freeze of the release. |
| vivo | It depends on the scope of the topic. If RAN plenary would not make decision on the exact scope, it is better to treat the topic in a WI. |

**Issue 1-2-2 Whether requirements can be introduced in a release independent manner if objective is included in Rel-17 WI**

* Option 1: Yes
* Option 2: No
* Option 3: Decide during WI stage

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1 or option 3 |
| Apple | It should be discussed after the related work is completed. We need to understand the impact on legacy implementation before being able to agree on the release independent. |
| CMCC | It would be good if we can agree with option1. Otherwise, option3 is also acceptable for us. |
| Xiaomi | Option 3, the impact on implementation should be considered during the WI stage. |
| MTK | Option 3 |
| CATT | Option 3. Need further study after the requirements are defined. |
| Samsung | As we commented in the initial round, it is not clear how the RRM requirement can be introduced in the release independent manner? Are we going to update the 307 specifications by introducing these RRM requirements, or we are going to bring CRs to Rel-16 specifications under this new Rel-17 WI (if option 3 is agreed)? Can proponent clarify how to achieve such target by creating a new Rel-17 WI. Either of above options requires further RAN guideline or approval that RAN4 can do so. In our understanding, if companies would like to apply certain requirements in Rel-16, we have to go for TEI16. |
| Huawei | Based on the initial round discussion, we share Samsung’s concerns for the formal treatment of the “release independent” approach, as it was also commented by MCC during the GTW. |
| ZTE | Option 3. |
| Nokia | Option 3 |
| vivo | For objective 1, it is preferable to have requirements in a release independent manner from Rel-16 since it is to fix missing RRM requirements. |

**Issue 1-2-3 Candidate objectives**

*Moderator: In the initial round there was no consensus on candidate objectives and further discussion is encouraged. Companies are encouraged to provide proposals on detailed objectives as well as sub-issues mentioned below:*

Issue 1-2-3-1 Whether the detailed set of requirements shall be decided

* Option 1: Add a generic objective to “Specify FR1+FR1 NR-DC RRM requirements” to the WID
* Option 2: Decide on detailed set of requirements in plenary

Issue 1-2-3-2 Whether the requirements shall cover SSB-based and/or CSI-RS based L3 measurements

* Option 1: SSB-based measurement only
* Option 2: SSB-based and CSI-RS based L3 measurements

Issue 1-2-3-3 Candidate sub-objectives

* General RRM requirement applicability: number of serving carriers configured under NR-DC
* Specify delay requirements for PSCell procedures
* PSCell addition and release requirements
* PSCell change and conditional PSCell change requirements
* Scheduling availability of UE during RLM and BFD
* CSSF for NR-DC measurements within the gaps
* CSSF for NR-DC measurements outside the gaps
* Specify if needed, release independency of this objective from Rel-16

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Issue 1-2-3-1: Option 2 (to save RAN4 time)  Issue 1-2-3-2: Option 1 (to limit RAN4 work and first focus on essential requirements)  Issue 1-2-3-3: Looks fine. |
| Apple | Issue 1-2-3-1: Option 2 can be tried first. If no agreement can be reached this week, option 1 is fine too.  Issue 1-2-3-2: Option 1  Issue 1-2-3-3: suggested revision is provided as below   * ***Note: No FR1+FR2 CA will be considered as part of FR1+FR1 NR-DC*** * General RRM requirement applicability: number of serving carriers configured under NR-DC * Specify delay requirements for PSCell procedures * PSCell addition and release requirements * PSCell change and conditional PSCell change requirements * Scheduling availability ~~of UE during RLM and BFD~~ * CSSF for NR-DC measurements within the gaps * CSSF for NR-DC measurements outside the gaps * Specify if needed ***and feasible***, release independency of this objective from Rel-16 |
| CMCC | Issue 1-2-3-1: Better to achieve detailed objectives (option 2) if possible.  Issue 1-2-3-2: OK with option 1 considering the workload  Issue 1-2-3-3 : Support the candidate sub-objectives |
| Xiaomi | Issue 1-2-3-1: Option 2  Issue 1-2-3-2: Option 1  Issue 1-2-3-3: Agree with Apple’s version |
| MTK | Since RAN4 workload is already high, we suggest to make the scope as clear as possible in Plenary. So that RAN4 does not need to spend too much time to discuss the scope again.  Issue 1-2-3-1: Option 2  Issue 1-2-3-2: No strong view  Issue 1-2-3-3: Fine with the list |
| CATT | Issue 1-2-3-1: Start as option 2.  Issue 1-2-3-2: Question for option 1: What does this indicate? Does this mean CSI-RS based L3 measurement is totally ignored? For example, whether CSI-RS is considered when defining CSSF? If option 1 means CSI-RS is totally ignored in some requirements e.g. CSSF, then we don’t think option 1 is reasonable.  Issue 1-2-3-3: Fine with Apple’s updates. |
| ZTE | Issue 1-2-3-1: Fine with Option 2.  Issue 1-2-3-2: Option 1. For CSI-RS based, we can revisit if SSB based is completed and there is still TU available for this WI.  Issue 1-2-3-2: We are Ok with the listed sub-objectives. |
| Nokia | Issue 1-2-3-1: Option 1.  Issue 1-2-3-2: Option 1. CSI-RS based L3 can be discussed in a later phase if needed.  Issue 1-2-3-3: sub-objectives can be listed (at least these sub-objectives would need to be discussed). If other impact is identified as part of the RAN4 RRM work such impact would also need to be addressed as part of the work. |
| vivo | Issue 1-2-3-1: Option 2  Issue 1-2-3-2:  It is not clear to us. Does option 1 means no CSI-RS based measurement is not counted in CCSF calculation? We don’t see there is other necessary requirements depending on measurement RS.  Issue 1-2-3-3:  As commented in the 1st round, we think the existing requirements already covers FR1-FR1 NR-DC for PSCell release, PSCell change, conditional PSCell change and scheduling availability of UE during RLM and BFD. There are no further requirements being needed.  With the candidate sub-objective, it seems like we will specify requirements for FR1-FR1 NR-DC from scratch.  So, updated objectives from our side is as follows.   * General RRM requirement applicability: number of serving carriers configured under NR-DC * Specify delay requirements for PSCell procedures   + PSCell addition requirements * Scheduling availability of UE during RLM and BFD, if needed * CSSF for NR-DC measurements within the gaps * CSSF for NR-DC measurements outside the gaps * Specify if needed, release independency of this objective from Rel-16 |

#### **Sub-topic 1-3. Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**

**Issue 1-3-1. In which WI the objective shall be included**

*Moderator: Companies are encouraged to suggest in which WI the new objectives shall be included. There were no proposals to include it in Rel-16, so we need to decide the appropriate WI.*

* Option 1: Include in Rel-17 FeRRM WI
* Option 2: Other

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1. |
| SoftBank | Option 1 is preferable. |
| Apple | many companies comment in the initial round that it is RF architecture related (it means RF TU is needed) and a study phase is needed. To have this one approved, we propose to   * Introduce a study phase on the feasibility from both RF architecture and UE performance perspectives. |
| Xiaomi | Option 2, as this topic related to both RF and RRM scope, Rel-17 FeRRM WI may be not the appropriate place. |
| MTK | We have no strong view on which WI to handle it, if RAN4 still has the margin for this objective. Please note that we need TUs for RF, RRM and Demod.  Also, we need to explicitly clarify this non-colocated deployment is for NCCA only |
| LG Uplus | Option1 |
| CATT | Need to decide the scope first, e.g. whether RF part is included. |
| LGE | Prefer option 1. |
| Huawei | Option 1 seems ok, subject to RF interrelations clarification. |
| ZTE | If it does not require much non-RRM effort, fine with Option 1. |
| Nokia | Should not be included, as the RF session TUs are negative and this objective has RF impact. |
| vivo | If the objective is agreeable to the group, it would better to be treated in a RF WI or a new WI as there are RF, RRM and demodulation requirements. |

**Issue 1-3-2 Whether requirements shall be introduced in a release independent manner**

* Option 1: Yes
* Option 2: No
* Option 3: Decide during WI stage

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1 or option 3 |
| SoftBank | We prefer Option 1 but Option 3 is also fine with us. |
| Apple | It should be discussed after the related work is completed. We need to understand the impact on legacy implementation before being able to agree on the release independent. |
| Xiaomi | Option 3, the impact on implementation should be considered during the WI stage. |
| MTK | Option 3 |
| LG Uplus | Option1 or option 3 |
| CATT | Need further discussion after the requirements are defined. |
| LGE | It should be discussed during WI stage. |
| ZTE | Option 3. |
| Nokia | Option 2 |

**Issue 1-3-3 Candidate objectives**

*Moderator: Many companies commented that the WI has relation to the RF/Demod requirements. Further discussion on how to handle the specific requirements is required.*

Issue 1-3-3-1 RRM requirements scope

* Option 1: MRTD and MTTD requirements

Issue 1-3-3-2 RF scope

*Moderator: Given RF room capacity constraints companies are encouraged to comment on possible RF work scope (whether it should be added) and possible suggestions to minimize the work efforts*

* Option 1: Yes
  + Option 1A: Power imbalance between 2 CCs in the same band
* Option 2: No

Issue 1-3-3-3 Demodulation scope

*Moderator: Demod Tus are included in RD budget and there may be possibility to include limited scope of requirements*

* Option 1: Yes
  + Option 1A: PDSCH demodulation performance requirement based on the applicable MRTD and power imbalance values.
* Option 2: No

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Issue 1-3-3-1: Option 1  Issue 1-3-3-2: Option 1  Issue 1-3-3-3: Option 1 |
| SoftBank | Issue 1-3-3-1: Support Option 1.  Issue 1-3-3-2: Support Option 1.  Issue 1-3-3-3: Support Option 1. |
| Apple | Subject to the outcome of the study, we are OK with option 1 for all three issues. |
| Xiaomi | Issue 1-3-3-1: Option 1  Issue 1-3-3-2: Option 1  Issue 1-3-3-3: Option 1 |
| MTK | Issue 1-3-3-1: OK with MRTD. Regarding MTTD, we need RF session’s confirmation on whether Tx are needed for both (or all) carriers.  Issue 1-3-3-2:   * Power imbalance (FFS whether the highest QAM-level needs to be considered together) * Confirmation on number of UL CCs are needed in this non-colocated NCCA scenario * FFS whether to explicitly list the band combination (and # of carriers) that needs to support this non-colocated deployment   Issue 1-3-3-3: OK with Option 1 |
| Qualcomm | Issue 1-3-3-1: we should only do MRTD. MTTD brings even more complications.  Issue 1-3-3-2: Power imbalance should be limited to 6dB as is the case for LTE NC intra-band CA. Studying the impact of larger power imbalance in the RF session will take a long time and depend on many factors. We prefer Option 2 and keep the imbalance to 6dB.  Issue 1-3-3-1: we can agree to Option 1 with a 6dB imbalance. Characterizing performance with different levels of power imbalance will require a lot of simulations. |
| LG Uplus | Issue 1-3-3-1: Support Option 1.  Issue 1-3-3-2: Support Option 1.  Issue 1-3-3-3: Support Option 1.  Where we open to discuss considering Qualcomm’s suggestion about 6dB as one of the practical alternative due to the time limitation but anyway we can have this feature in Rel-17. |
| CATT | Issue 1-3-3-1: Fine with option 1.  Issue 1-3-3-2: Fine with option 1.  Issue 1-3-3-3: Fine with option 1. |
| LGE | Issue 1-3-3-1: option 1  Issue 1-3-3-2: option 1  Issue 1-3-3-3: option 1 |
| Huawei | Issue 1-3-3-1: option 1  Issue 1-3-3-2: option 1  Issue 1-3-3-3: option 1 |
| ZTE | Issue 1-3-3-1: Option 1  Issue 1-3-3-2: Option 1  Issue 1-3-3-3: Option 1 |
| Nokia | Issue 1-3-3-2: Would need input from the RF session, but available TUs are negative in the RF session. |
| vivo | Issue 1-3-3-1: Fine with option 1.  Issue 1-3-3-2: Fine with option 1.  Issue 1-3-3-3: Fine with option 1.  We also agree it is necessary to define requirements based on limited level of power imbalance, e.g., 6dB. |

#### **Sub-topic 1-4. Objective #2: RRM requirements for UE capability ‘NeedForGap’**

**Issue 1-4-1. In which WI the objective shall be included**

*Moderator: Companies are encouraged to suggest in which WI the new objectives shall be included*

* Option 1: Include in Rel-17 FeRRM WI
* Option 2: Include in Rel-17 NR MG Enh WI
* Option 3: TEI16
* Option 3: Other

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 3. But we are also fine with option 2 if release independent from Rel-16 |
| Apple | If this one can be agreed, we are OK with option 1 or2. Firstly, this is not very urgent, e.g. system is not broken without this. We don’t see why it has to be treated as TEI16. The release independency can be further decided once the related work is done. |
| CMCC | OK with either option 1 and option2. And release independent should be applied from Rel-16. |
| Xiaomi | Fine with option 1 or option 2 |
| MTK | Option 2, if agreed to be introduced |
| China Telecom | OK with Option 1 or Option 2 with a release independent manner. |
| CATT | Fine with option 1 and option 2. |
| Huawei | Option 3 as first priority. Option 1 as second priority. |
| ZTE | Option 3. |
| vivo | All options are fine on the condition that it is better to be a Rel-16 feature. |

**Issue 1-4-2 Whether requirements shall be introduced in a release independent manner if objective is included in Rel-17 WI**

* Option 1: Yes
* Option 2: No
* Option 3: Decide during WI stage

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1 (from release 16 in which RAN2 signaling was introduced). |
| Apple | Decide after the related work is agreed and finished. |
| CMCC | Option 1. |
| Xiaomi | Option 3 |
| MTK | Option 3, although we see no problem for this one to be release independent. |
| China Telecom | Option 1. |
| CATT | Need further discussion after the requirements are defined. |
| Nokia | Should not be included. |
| vivo | Option 1. |

**Issue 1-4-3 Candidate objectives**

*Moderator: Based on the initial round most of the companies confirmed that R4-2108039 can be used as baseline. Further comments on possible objectives refinement are welcome.*

* Option 1 (R4-2108039)
  + Define RRM requirements ‘NeedForGap’ feature
    - Limited to SSB based measurements configured via measurement objects
    - Study whether the additional interruption is allowed when UE reporting ‘no gap’
      * Further define the interruption length, occasion and ratio, if the interruption is allowed
    - Study the related requirements, such as CSSF, measurement period, scheduling restriction etc.
    - RAN4 to further consider the relation with other UE capabilities, such as NCSG etc.
    - Analyse other WG impact although impact is not expected.
    - Decide if it is feasible that the UE requirements are defined in R16 or release independent from Rel-16.

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Ericsson | Option 1 |
| CMCC | Option 1 |
| Xiaomi | Fine with option 1 |
| MTK | OK with Option 1. |
| China Telecom | Option 1 |
| Huawei | Option 1 |
| Nokia | Should not be included. |
| vivo | In general option 1 is fine.  For the bullet RAN4 to further consider the relation with other UE capabilities, such as NCSG etc., we think it would better to be an objective for NCSG. If NeedForGap starts from Rel-16, we don’t think we need to consider relation with a Rel-17 feature. |

### Summary

## Final Round

### Open issues and companies views’ collection

### Summary

# Topic #2: Clarification of FeRRM WI objectives

In RAN4 #99e there was no common understanding whether NR-U scenario is in the scope of in the scope of HO with PSCell objective in FeRRM WI.

For Topic #2 moderator recommends the following plan of the discussion:

1. Initial round
   1. Collect views on whether further clarification on NR-U scope are needed
   2. Collect views whether NR-U shall be treated as a separate objective.
2. Intermediate round
   1. Decide on updated WID (if agreeable) or move discussion to Topic #1 if companies prefer to handle it as a separate objective

## Initial Round

### Open issues and companies views’ collection

*Moderator: In RAN4 #99e there was no common understanding whether NR-U scenario is in the scope of in the scope of HO with PSCell objective in FeRRM WI. Moderator recommend to further collect companies views on this issue.*

**Issue 2-1. Whether NR-U is in the scope of HO with PSCell objective in FeRRM WI**

* Option 1: Yes (NR-U is in the scope of HO with PSCell in FeRRM WI)
* Option 2: No (NR-U is NOT in the scope of HO with PSCell in FeRRM WI)

|  |  |
| --- | --- |
| Company | Comments collection |
| Ericsson | Option 1. RAN2 procedures/signaling on HO with PSCell covers NR as well as NR-U. The RAN2 procedures are the same for two cases. FeRRM WID does not explicitly excludes HO with PSCell for NR-U. So we see no reason to exclude NR-U. Also EN-DC with NR-U is an important deployment scenario. |
| Apple | Option 2. Unless NR-U is explicitly specified, we otherwise should assume only licensed based operation. Otherwise, NR-U can be interpreted as being included in all other ongoing WI, e.g. HST, RedCap, etc. |
| Intel | Option 2. From RRM perspective, requirements are defined separately between NR and NR-U. in our understanding if not explicitly displayed, NR-U is not considered as a target scenario in terms of RRM requirements applicability. |
| CMCC | Option2. Agree with Apple’s comments. Unlicensed operation is not within the scope. |
| OPPO | Option 2 is preferred. |
| MTK | Option 2. |
| LGE | Option 2 |
| Huawei | Technical discussion to be continued in RAN4 – if there is no consensus, the option 2 seems to be the baseline. |
| vivo | In our understanding, there would be additional work needed if NR-U is supported. Parallel processing may need further discussion under LBT case. We understand current discussion on HO with PSCell are not taking LBT into consideration.  Though the WID may not preclude NR-U explicitly, we think NR-U is not in the scope of the WID.  From HO with PSCell procedure wise, it would also be applicable to NR-U in our understanding. |
| ZTE | Option 2 in our understanding. |
| Nokia | Option 2. This work could be done, but should be in the WI where NR-U work is addressed. |
| CATT | Option 2. |

Issue 2-2. Whether NR-U scope for HO with PSCell shall be added as a separate objective and handled in Topic #1

|  |  |
| --- | --- |
| Company | Comments collection |
| Ericsson | Related to issue 2-1. We do not see any need to add it as separate objective. |
| Apple | It is not suggested to include NR-U at this stage. If needed, it can be considered in the future release. |
| Intel | We prefer not to, at least before Rel-18. Let’s further discuss it in Rel-18. |
| CMCC | NO |
| MTK | No |
| ZTE | No |
| Nokia | As mentioned in Issue 2-1, we believe this work should be handled in an NR-U related WI. |
| CATT | No. |

### Summary

**Issue 2-1. Whether NR-U is in the scope of HO with PSCell objective in FeRRM WI**

Candidate options

* Option 1: Yes (NR-U is in the scope of HO with PSCell in FeRRM WI)
* Option 2: No (NR-U is NOT in the scope of HO with PSCell in FeRRM WI)

Summary of comments

* Option 1: E///,
* Option 2: Apple, Intel, CMCC, OPPO, MTK, LGE, Huawei, vivo, ZTE, Nokia, CATT
* Continue discussion in RAN4: Huawei

**Issue 2-2. Whether NR-U scope for HO with PSCell shall be added as a separate objective and handled in Topic #1**

Summary of comments

* NR-U scope for HO with PSCell shall NOT be added as a separate objective: E///, Apple, Intel, CMCC, MTK, ZTE, Nokia, CATT

**Moderator’s views/proposal**

* 11 companies think that NR-U is out of scope of HO with PSCell requirements objective. One company thinks NR-U shall be discussed in FeRRM WI scope.
* **Proposal 2-1: NR-U is out of scope of HO with PSCell requirements objective. Add a corresponding note to the FeRRM WID.**
* **Rel-17 FeRRM WI rapporteur company is asked to provide a WID revision with corresponding change and share in Drafts folder for review in the intermediate round**

## Intermediate Round

### Open issues and companies views’ collection

**Proposal 2-1: NR-U is out of scope of HO with PSCell requirements objective. Add a corresponding note to the FeRRM WID.**

*Moderator: Please comment if you have a strong objection to the objective.*

*Moderator: FeRRM WI rapporteur company is asked to provide a WID revision with corresponding change and share in Drafts folder for review*

|  |  |
| --- | --- |
| **Company** | **Comments collection** |
| Apple | OK with the proposal |
| CMCC | Support the proposal |
| MTK | OK with Proposal 2-1. |
| Qualcomm | We objecto Proposal 2-1. Question to the chairman and the group: is the expectation now that for any feature it should be explicitly decided apriori whether NR-U is in scope or is the default that NR-U is in scope? |
| CATT | OK with the proposal |
| ZTE | Fine with Moderator’s proposals. |
| Nokia | OK |
| vivo | No matter whether NR-U is in the scope or not, clarification in the WID is needed. It would also be fine if there is general guidance from RAN plenary on how NR-U is assumed by default. |

### Summary

## Final Round

### Open issues and companies views’ collection

### Summary

## Summary

# Conclusions

Tentative conclusions (To be confirmed in intermediate and final rounds)

* **Proposal 1: Down-select the following objectives for approval**
  + **Objective #1: RRM requirements for FR1+FR1 NR-DC**
  + **Objective #4: Support of non-co-located deployment for FR1 intra-band NR-CA/EN-DC**
  + **FFS: Objective #2: RRM requirements for UE capability ‘NeedForGap’**
* **Proposal 2: NR-U is out of scope of HO with PSCell requirements objective. Add a corresponding note to the FeRRM WID.**

# Annex: Contacts

Please provide a company contact that the email discussion moderator can contact if required.

|  |  |
| --- | --- |
| **Company** | **Contact name and email** |
| Nokia | Matthew Baker <matthew.baker@nokia.com> |
| E/// | Muhammad Kazmi (Muhammad.Kazmi@ericsson.com) |
| CMCC | Zhangxiaoran@chinamobile.com |
| Qualcomm | Valentin Gheorghiu <vgheorgh@qti.qualcomm.com> |
| LG Uplus | Jaehyun Chang <jaehyunchang@lguplus.co.kr> |
| CATT | [songyuexia@catt.cn](mailto:songyuexia@catt.cn); guoqiuge@catt.cn |
| Huawei | michal.szydelko@huawei.com |
| ZTE | [Cao.aijun@zte.com.cn](mailto:Cao.aijun@zte.com.cn) |
| Nokia | Matthew Baker <matthew.baker@nokia.com> |
| vivo | qian9.yang@vivo.com |