**3GPP TSG RAN #103 RP-240714**

**Maastricht, Netherlands, March 18 – 21, 2024**

**Title: Moderator's summary for discussion on RRM enhancements**

**Source: Moderator (vivo)**

# Introduction

This document summarizes the proposals on Release 19 WID on RRM performance requirements enhancements under agenda 9.1.4.4 in RAN #103 meeting.

Submitted contributions in RAN #103 for agenda 9.1.4.4 are listed as below:

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| Tdoc | Title | Source |
| RP-240058 | Motivation on Scell with uplink only transmission | KDDI Corporation, ZTE, Sanechips |
| RP-240059 | New WID: Scell with uplink only transmission | KDDI Corporation, ZTE, Sanechips |
| RP-240068 | Proposals on RRM topics for Rel-19 | NTT DOCOMO, INC. |
| RP-240110 | Views on R19 candidate RRM topics | Spreadtrum Communications |
| RP-240132 | Views on Rel-19 RAN4 RRM scope | vivo |
| RP-240153 | CMCC views on Rel-19 RAN4 RRM topics | CMCC |
| RP-240260 | RRM topics for Rel-19 | Nokia |
| RP-240313 | R19 UE RRM enhancement | OPPO |
| RP-240328 | Proposals on Rel-19 RAN4-led RRM | LG Electronics Deutschland |
| RP-240333 | Views on RRM topics for Rel-19 | Qualcomm Incorporated |
| RP-240350 | Views on candidate RRM topics for RAN4 Rel-19 | China Telecom |
| RP-240378 | Views on the scope of R19 RRM topics | Samsung |
| RP-240396 | Views on Rel-19 RRM topics | CATT |
| RP-240432 | Views on RRM topics for Rel-19 | Huawei, HiSilicon |
| RP-240454 | MediaTek Views on RAN4 Rel-19: RRM | MediaTek Inc. |
| RP-240472 | Views on Rel-19 RRM enhancement | ZTE, Sanechips |
| RP-240491 | Apple’s view on RAN4 led RRM enhancement for Rel-19 | Apple |
| RP-240505 | Views on Rel-19 RAN4 RRM package | Ericsson Inc. |
| RP-240545 | Views on Rel-19 RAN4 RRM topics | Intel Corporation |

To be noted, two papers submitted un 9.1.4.4 are moved to NTN thread for further discussion

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| RP-240079 | Motivation to support mobile VSAT in NGSO deployment scenarios | Eutelsat Group, Fraunhofer IIS, Fraunhofer HHI, Airbus, ESA, Novamint, MediaTek, Sharp, Thales, SyncTechno Inc., Continental Automotive, TTP, Lockheed Martin, Robert Bosch GmbH |
| RP-240080 | Regulatory status of NTN in bands above 10 GHz post WRC-23 | Eutelsat Group |

In RP-240019, baseline objectives for RRM requirements is provided as below:



# Summary of contributions on Demodulation topics

In the below table, companies view on candidate objectives are summarized.

Also, these are several papers indicate the additional topics/objectives, i.e., objectives #4, #5 and #6. Based on the baseline objectives provided by RAN and RAN4 chair, moderator suggest not to consider these objectives in this summary.

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|  | ***Candidate objectives for Rel-19 and supporting companies*** | ***Details of objectives*** |
| **1**  | **FR2 L3/L1 measurement delay reduction**  | ***Proposed objectives:**** FR2-1 SSB based L3 and L1 measurement delay reduction for connected mode
	+ For UE in multiple-Rx simultaneous reception mode on single carrier [and CA]:

*Supporting: LG* * + - Study and, if feasible, enhance to reduce FR2-1 L3/[L1] measurement delay by optimizing following factor:
			* Rx beam sweeping factor
			* [Reducing RX beam sweeping factor based on AI/ML based beam prediction]

*Supporting: CMCC** + - * [Taking Rel-18 FR2 SCell activation delay reduction as baseline]

*Supporting: CMCC, LG** + - * [Study suitable scenarios and conditions to decrease the measurement delay in FR2 with reduced beam scaling factor]

*Supporting: Samsung* * + For UE not in multiple-Rx simultaneous reception mode:
		- Study and, if feasible, enhance to reduce FR2-1 L3/L1 measurement delay by optimizing following factor(s):
			* CSSF
			* [FFS on assumption on number of searchers, e.g., 3 and relative scenarios, e.g., in FR1+FR2，UE supporting Per-FR gap]

*Supporting: Huawei, OPPO* * + - * [FFS on applied enhanced CSSF in FR1]

*Supporting: China Telecom* * + - Note 1: the above enhancement by reducing CSSF focuses on CA/DC scenario
		- Note 2: Whether and how CSSF enhancement can be applied to UE in multiple-Rx simultaneous reception mode in CA/DC scenario can be discussed after concluding the above enhancement.
	+ [Note: The scope of above FR2-1 L3 measurement reduction focuses on the RRM measurement delay.]

*Other L3 operation can be considered: MTK** + [Note: The scope of above FR2-1 L1 measurement reduction includes the following L1 operations:
		- L1-RSRP/L1-SINR measurement
		- BFD evaluations
		- CBD evaluations
		- RLM evaluations]

*Supporting: Apple* |
| **2** | **Fast Scell activation with EMR** | ***Proposed objectives:**** Fast SCell/[PScell] activation with EMR *supporting: OPPO*
	+ Study and, if feasible, enhance to reduce the SCell activation delay with valid EMR reporting upon UE entering RRC\_Connected mode
	+ [FFS UE continue performing idle/inactive measurement after entering connected mode]

*Supporting: Nokia, OPPO**Not supporting: CMCC, CATT, vivo* * + [FFS enhanced measurement accuracy requirements]

*Supporting: Nokia* *Not supporting: CMCC, CATT, vivo* * + [FFS apply in FR1]

*Supporting: LG,* * + Note: RAN4 to start this work from Q3’2024 and aim for completion in Dec’2024. Workplan for this bullet can be discussed in May’2024
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| 3 | **Other objectives** | Extend the R17 RLM/BFD relaxation requirements to RedCap UEs*Supporting: Spreadtrum, QC, MTK, Ericsson*Scell with uplink only transmission*Supporting: KDDI, ZTE, Intel* HO with PScell *Supporting: QC, MTK* FR2 unknown SCell activation based on Temporary RS*Supporting: Huawei*Interruptions enhancement at NR SRS antenna port switching*Supporting: Huawei*L1/L2 mobility inter-frequency measurement enhancement*Supporting: Huawei*Inter-frequency measurement based on NCSG*Supporting: MTK*Dynamic RTD/TTD status update (operation with RTD > CP)*Supporting: Intel*Parallel measurement with NCSG*Supporting: Intel*Pre-configured NCSG*Supporting: Intel*Moderator Note: Based on RAN/RAN4 chair guideline, these objectives are not to be discussed |

# Moderator recommendation on detailed objectives

In RAN #103 meeting, moderator suggest to focus on the recommended detailed objectives during the offline session. Meanwhile, moderator proposed draft WID RP-240725 with justifications and other aspects of WID. Companies are suggested to discuss the wording of justification and other aspects in the draft WID. Based on the discussion outcome from this summary, moderator will update the objectives accordingly.

For recommended objectives, these are several bullets and sub-bullets with square brackets which are proposed by companies. In moderator understanding, these bullets require further discussions in RAN #103 meeting to finalize the detailed objectives.

Moderator’s recommendation before the meeting (To be revised during the offline sessions)

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| * FR2-1 SSB based L3 measurement delay reduction for connected mode
	+ For UEsupporting multiple-Rx simultaneous reception on single carrier:
		- Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 measurement delay by optimizing:
			* Rx beam sweeping factor
	+ For UE not in multiple-Rx simultaneous reception mode::
		- Study suitable scenarios and conditions and, if feasible, introduce methods to reduce FR2-1 L3 [] measurement delay by optimizing:
			* CSSF outside gap in CA/DC scenarios
			* ~~[Beam sweeping factor]~~
				+ Baseline assumption on number of searcher is 2
* Fast SCell activation for UE supporting Rel-18 EMR
	+ Study and, if feasible, to reduce the SCell activation delay with valid EMR reporting
	+ Apply fast scell activation in FR1 and FR2-1

Note: RAN4 to start this work from Q3’2024 and aim for completion in Dec’2024. Workplan for this bullet can be discussed in May’2024 |
|  |

Based on offline discussion, besides the agreed objectives above, the below aspects are also regarded as common understanding:

* + On the interpretation of “UE not in multiple-Rx simultaneous reception mode”, technically it means: (1)UE is not capable of multiple-Rx simultaneous reception, or (2)UE is capable of multiple-Rx simultaneous reception but the UE is not configured with multi-Rx operation.
	+ RAN4 will consider to apply CSSF enhancements in FR1 once the work for FR2-1 is done
	+ RAN4 will consider to apply fast scell activation to PScell once the work for Scell is done

Also, moderator also capture the view collected from offline e-mail discussions before 2nd offline session (20th March, Wednesday)

|  |  |
| --- | --- |
| **Scope bullets** | **Comments** |
| **FR2-1 SSB based L3 [and L1] measurement delay reduction for connected mode** | [Apple]: discussed in AdHoc session. Whether [L1] is removed or not is subject to the sub-bullets discussion. [E///]: As discussed offline, we prefer to remove [L1] and only focus on the L3 in this Rel-19 objective. The scope of this objective is already wide, e.g. we have two cases, UEs supporting and not-supporting multi-Rx simultaneous reception mode. If we on the top that also include parallel measurements, it will extend the scope further. We prefer to specify the objective in a short and concise way so that the expected work is very clear in the WG and workload is controllable.[Nokia]: Whether L1 is included or not here should of course be aligned on what is agreed for other sub-bullets. However, as commented online, we can agree working only L3 measurement delay reduction.[vivo]: We should focus on L3 measurement delay reduction as there is no enhancement on L3/L1 sharing mechanism at least at initial stage based on what we discussed this noon. [Huawei]: We prefer to focus on L3 measurement delay reduction to avoid overly broad scope.[Intel] We are ok to focus on L3.[ZTE]: okay to focus on L3 measurement.[xiaomi]: fine to focus on L3.[LGE] OK to focus on L3[CATT] We prefer to keep L1 measurement, as we explained online, anyway we need to consider the impact on L1 measurement, it is better to consider the enhancement together. On the other hand, including L1 measurement doesn’t mean parallel L3/L1 measurement, we still need to consider scaling factor. Since the enhancement for L3 and L1 measurement is usually similar, we just propose to also apply the reduced Rx beam sweeping factor to L1 measurement. |
| - For UE not in multiple-Rx simultaneous reception mode: | [Apple]: the wording shall be aligned with first main bullet, i.e., “For UE not supporting multiple-Rx simultaneous reception mode:” [Nokia] We agree that the bullets should be aligned to avoid confusion during the WI. We suggest following, to try to address the two different scenarios:-         For UE not supporting/capable of multiple-Rx simultaneous reception, or-         For UE supporting/capable of multiple-Rx simultaneous reception] on a single carrier, when scenarios or conditions above do not apply:[Intel] Agree with Nokia propos[Huawei] we support to consider both cases: UE supporting and not supporting multi-Rx. They are scenarios the enhanced solutions are different. Agree with the wording from Apple. [LGE] Agree with Apple’s suggested wording and support to consider both cases |
| - - Study [suitable scenarios and conditions] and, if feasible, enhance to reduce FR2-1 L3/[L1] measurement delay by optimizing following factor(s): | [Apple]: if parallel L3 and L1 is not in the scope, then the L1 shall be removed.[E///]: For the reasons explained above, we prefer to focus on the L3 measurements only in this objective and thus support removal of [L1]. [Nokia]: Not fully clear what ‘parallel’ means – as mentioned by Apple. But to keep clear focus we can agree to working on L3 measurement delays only. We suggest following wording (same wording can be used in the other similar bullet):o    Study [suitable scenarios and conditions] for, introducing reduced FR2-1 L3 measurement delay by optimizing following factor:[Huawei]: prefer to remove L1[Intel] We suggest the following modification (same wording can be used in the other similar bullet):* Study and ,if feasible, specify scenarios/conditions and enhancements to reduce FR2-1 L3 measurement delay by optimizing following factor:

[Xiaomi] if companies agreed to don’t touch L1 in this WI, remove L1 is fine. But we are not sure the target of “study suitable and conditions” are only “parallel L3 and L1”.[CATT] as commented above, we understand applying the enhancement to L1 measurement doesn’t mean parallel measurement, we still need to consider scaling factor.  |
| - - - CSSF [outside gap] | [Apple]: support this bullet[E///]: We have a preference to remove CSSF and only focus on reducing beam sweeping part when possible. But, we are open to hear views from other companies on this issue.  [Nokia]: We think the understanding of ‘CSSF’ need to be clarified and more clearly scoped. Hence, we suggest following two bullets (instead of this bullet):  CSSF for CA/DC scenarios   Consider both scenarios where UE is configured with and without gaps[vivo]: Though it would dependent on how CSSF can be enhanced, we are fine to focus on outside gap CSSF enhancement. [Huawei]: Support to remove the bracket[]. We can mainly focus on CSSFoutsidegap.[Intel] We prefer to keep it generic and just mention CSSF. Details can be discussed in RAN4.[ZTE]:more clarirication on the CSSF enhancement,  e.g. reusing the measurements among serving cells or based on increasing Ue cell searchers in the baseband. [Xiaomi] fine to remove bracket. For ZTE’s comments, maybe the exact to handle CCSF formulating can be left to WG.[CATT] support this bullet. |
| - - - [Beam sweeping factor] | [Apple]: neutral on this bullet. [Nokia]: As this bullet is when assuming single Rx operations on UE side, we understand that this was discussed a lot during Rel-15. When discussing reducing the beam sweep factor for L3 measurements it need to be ensured that such reduction will not have negative impact on the deployments.[vivo]: Clarification on how beam sweeping factor can be reduced for single Rx UE is needed if this is to be considered.[Huawei]:Negative on this bullet. Without muliti-RX reception, the reduction of beam sweeping factor for L3 measurement may decrease the cell detection range from UE side.[Intel] Ok to remove it to limit the scope.[CATT] support this bullet, it is beneficial to enable general approach to reduce Rx beam sweep factor. |
| - - - [FFS on assumption on number of searchers, e.g., 3 and relative scenarios, e.g., in FR1+FR2，UE supporting Per-FR gap] | [Apple]: we prefer to study the L3 enhancement based on 2 searcher assumption since increasing searcher number will change the fundamental architecture of UE baseband.[E///]: We prefer to use the legacy searcher assumptions for this objective. RAN4 has discussed the assumptions on number of searchers for different cases in the past and this this Rel-19 further work should be based on that instead of reopening the past discussions. Doing so may consume many meeting time without any productive outcome. Therefore we propose to remove this bullet. [Nokia]: Introducing additional searchers at this stage is likely not going to be something that can give large benefits in the field. We are fine continuing the work with the current searcher assumption. If the requirements using existing searcher assumption can be enhanced may give benefits but likely only if supported by the majority of UEs. [vivo]: We understood that assumption on searcher is 2 since Rel-15. However, for UE supporting per-FR gap, the UE needs to be equipped with 3 searchers, 2 for intra-frequency measurement outside gap and at least 1 for gap based measurement. Otherwise, UE cannot meet the requirements. If UE has already equipped with 3 searchers, then it is worthy of enhancing the requirements so that UE capability can be fully used.So, this bullet should be kept, at least study in RAN4 is preferred.In addition, the enhancement of CSSF based on 3 searchers should also be applicable for FR1, which seems not listed in table for input.[Huawei]: We support this bullet. We share the same view as vivo. For a per-FR capable UE, UE is required to have 3 searchers from R15, otherwise UE can not satisfy the current requirements.[Intel] Prefer to keep this up to RAN4 decision.[ZTE]: we are open for further discussion.  even though we tend to agree 2 cell searcher in the baseband as common assumption, if any chipset is enable to increase cell searcher in  baseband in FR1+FR2 scenario,  we are open for further enhancement. [Xiaomi] can be ffs in RAN4 WG discussion. [LGE] OK to assume 3 searchers in Rel-19 [CATT] we understand this is one possible approach to enhance CSSF, so it can be the sub-bullet of CSSF. And we are fine to consider this bullet. |
| - - [Note 1: the above enhancement by reducing CSSF focuses on CA/DC scenario] | [Apple]: support this bullet[Nokia]: Support this bullet as also reflected in our proposed wording above.[vivo]: The note is not clear enough. If it implies CSSF outside gap, it might be okay.[Huawei]: We support this bullet.[Intel] Support the bullet[ZTE]: it's fine for us and we could prioritize CA scenarios if necessary. [Xiaomi] CA can be prioritized. [LGE] support this bullet. OK to prioritize CA.[CATT] support this bullet |
| - - Note 2: Whether and how CSSF enhancement can be applied to UE in multiple-Rx simultaneous reception mode in CA/DC scenario can be discussed after concluding the above enhancement. | [Apple]: support this bullet [Nokia]: We are fine removing this bullet. If RAN4 has additional time during Rel-19 this can be proposed as another WI like the rest of the Wis not within the current Rel-19 package.[vivo]: It is not clear how the two aspects can be combined. Prefer to remove.[Huawei]: combination of CSSF and multi-RX is complicated and needs more clarification and discussion. We are not favor of it.[Intel] Support the bullet[ZTE]: this should be out of scope of RAN chair package propsal. [Xiaomi] support.[CATT] support this bullet |
| - [Note: The scope of above FR2-1 L3 measurement reduction focuses on the RRM measurement delay.] | [Apple]: since the suitable scenario and conditions will be studied anyway for this WI, perhaps we can remove this note. For instance, whether L3 enhancement is considered in SCell activation or HO or other operations, can be discussed as scenarios to apply such enhancement. [E///]: we support this note and it is aligned with the topbullet, which clearly says the motivation is to recue the measurement delay. [Nokia]: We are fine focusing the work on L3 measurements. However, this should be clearly reflected by the Objectives and bullets and therefore an additional note may not be necessary?[vivo]: It is aligned with our understanding. Further clarification is needed that enhancement is only for measurement delay reduction.[Huawei]: We support this note. For example, L3 measurement delay reduction has no relation with SCell activation delay. [Intel] We agree with the note, but it seems redundant as the main objective already aims to reduce L3 measurement delay[ZTE]: the note is fine for us.[Xiaomi] neutral on this since in the main bullet the reduction for L3 measurement delay was mentioned.[CATT]we support to remove this bullet. It is not clear what is the intention of this bullet, is it to exclude HO or SCell? If so, we tend to agree with Apple that this can be discussed in the WI. |
| - [Note: The scope of above FR2-1 L1 measurement reduction includes the following L1 operations: - - L1-RSRP/L1-SINR measurement - - BFD evaluations - - CBD evaluations - - RLM evaluations] | [Apple]: If L1 enhancement is removed from the whole WI, then we are also fine to remove this note. Otherwise, we support to clarify the L1 operations in the WID to avoid ambiguity. [E///]: For the reasonable explained above, we prefer to remove the L1 related measurements in this objective.  [Nokia]: Based on above discussion we are fine to remove these bullets.[vivo]: Remove this whole bullet.[Huawei]: As we proposed to focus on L3 measurement, this note is not needed at all.[Intel] Ok to remove.[ZTE]: fine for us to remove and focus on L2 measurement. [Xiaomi] fine to remove this.[CATT] support this bullet. |
| **Fast SCell/[PScell] activation with EMR** | [Apple]: if PSCell is really needed here, we think both PSCell activation and PSCell addition shall be considered, i.e., Fast SCell/[PScell] activation and fast PScell addition with EMR [E///]: We prefer to focus on the SCell in this objective.  [Nokia]: We are fine also considering PSCell. Whether it is adding an SCell or PSCell based on early measurements should not make a big difference. However, it seems some of the endorsed wording in RP-240019 has been excluded.  [vivo]: Focus on SCell activation with EMR. If PSCell is considered, it should be for PSCell addition rather than PSCell activation. But it seems to be upscoping if PSCell addition is considered.In addition, we think direct SCell activation should be included.[Huawei]: We prefer to mainly focus on SCell. In addition, we share the similar view as vivo, one sub-bullet can be added: both normal and direct SCell activation with EMR are included.[Intel] Prefer SCell only.ZTE： focus on Scell only and not touch Pscell at the current stage. [xiaomi]: can focus on SCell activation since this objective would be started later. [CATT] we are open to include PSCell. |
| - Study and, if feasible, enhance to reduce the SCell activation delay with valid EMR reporting upon UE entering RRC\_Connected mode | [Apple]: wording to be aligned with 1st main bullet for multi-Rx case; i.e., “Study and, if feasible, ~~enhance to~~ reduce the SCell activation delay with valid EMR reporting upon UE entering RRC\_Connected mode” [Nokia]: We are fine to work on this aspect. We think the wording can be as follows:         Study [suitable scenarios and conditions] for introducing reduced SCell activation delay.[vivo]: Wording from Apple is fine for us.[Huawei]: Either the current wording or updated word by Apple is fine.[Intel] Apple wording is fine.[ZTE]:  fine with Apple's wording. [xiaomi] fine with apple’s wording[CATT] support this bullet. |
| - [FFS UE continue performing idle/inactive measurement after entering connected mode] | [Apple]: prefer to remove this FFS, since this will just repeat the same discussion as we did in R18 mobility enhancement. Based on the current time plan recommended by RAN chair, we don’t think this one shall be included. [Nokia]: We think it may not be needed to discuss whether UE continue the measurements during RRC Connection setup, RRC Connection Resume or after UE has entered Connected. What is more important is that the RAN4 specifications do not restrict UE performing any such measurements by defining unnecessary restrictions. RAN4 requirements should allow different UE implementations and optimizations and should not restrict such implementations as long as these do not have negative impact on the system performance.[Intel] Prefer to remove.[ZTE]: this was discussed in Rel-18 and this is also somehow not listed in RAN chair's package. [Xiaomi] prefer to remove this bullet. At least it shall be FFS. [CATT]support to remove this bullet. |
| - [FFS enhanced measurement accuracy requirements] | [Apple]: prefer to remove this FFS. We didn’t see justification to enhance the accuracy requirement. [Nokia]: For measurements which are reported to the network there need to be defined UE measurement accuracy requirements. For Rel-16 EMR this was not the case when T331 had expired. For Rel-18 Measurement report for fast CA/DC setup measurement accuracy requirements are missing for the case when UE does not support Rel-16 EMR. We believe such measurement accuracy requirements shall be defined as otherwise Rel-18 feature is nor useful for networks and UEs which do not support Rel-16 solution.[Intel] Prefer to remove. We can be ok to keep it subject to further RAN4 decision whether to support enhanced measurement accuracy requirements.[Xiaomi] Not clear the accuracy requirements is for measurement before activation command? Or the the measurements can be continued after SCell activation? For the later case, it is not preferable for us due to the complicated procedure and requirements needed.[CATT]support to remove this bullet. We understand the scope is to enhance the activation delay with EMR rather than to introduce new measurement or to complete the Rel-18 leftover. |
| - [FFS apply fast scell activation in FR1] | [Apple]: prefer to remove this FFS, and we think this fast SCell activation enhancement with EMR is for both FR1 and FR2. [Nokia]: As Rel-18 solution for Measurement report for fast CA/DC setup is not limited to FR2-1 we don’t see this would be necessary now.[vivo]: This should be applicable to both FR1 and FR2.[Huawei]: Technically, the solution can be applied to FR1 as well.[Intel] Ok with both FR1 and FR2.[ZTE]: okay with both FR1 and FR2.[Xiaomi] fine for both FR1 and FR2[LGE] support this objective[CATT] OK to apply the approach to both FR1 and FR2. |