**3GPP TSG-RAN WG4 Meeting # 102-e R4-22XXXXX**

**Electronic Meeting, 21 February – 03 March 2022**

**Agenda item:** 10.14

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

**Title:** Email discussion summary for [102-e][222] NR\_UE\_pow\_sav\_enh

**Document for:** Information

# Introduction

This document is the email discussion summary for UE Power Saving Enhancements (AI 10.14), including the following topics covered

\* Incoming LS from RAN2: R2-2201989 LS to RAN4 on RLM/BFD relaxation for ePowSav

* Topic 1: General (AI 10.14.1)
* Topic 2: RRM core requirements: UE measurements relaxation for RLM and/or BFD (AI 10.14.2)
* Topic 3: RRM performance requirements (AI 10.14.3)

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

* 1st round: Decide on the scope, priority, options and tentative agreement to be discussed in the 2nd round. Conclude issues with strict consensus, if any.
* 2nd round: Conclude the issues identified in the 1st round.

# Topic #1: General and work plan (AI 10.14.1)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2204531**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204531.zip) | CMCC | *Moderator: For UE feature* ***Proposal 1: Define one capability for the whole feature.******Proposal 2: For the UE capable of SSB-based RLM, and/or CSI-RS based RLM, and/or SSB-based BFD, and/or CSI-RS based BFD, the feature indicates the support of corresponding RLM and/or BFD relaxation measurement.******Proposal 3: The prerequisite feature groups are: SS block based RLM, CSI-RS based RLM and Beam failure recovery.******Proposal 4: The feature group can be supported by UE if any prerequisite feature group is supported by UE.******Proposal 5: gNB need to know whether the feature is supported or not.******Proposal 6: The UE feature is introduced per-UE granularity, no need to differentiate between FDD and TDD, and between FR1 and FR2.******Proposal 7: The UE feature is introduced as optional.******Proposal 8: Introduce the UE feature as follows in R17 feature table*** |
| [**R4-2205636**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205636.zip) | Ericsson, MediaTek Inc. | *DraftCR**Moderator: move to Topic 2 (2.3.2) to discuss.*  |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

#### **Issue 1-1: Feature for RLM/BFD relaxation in Rel-17 feature table**

* Background: Agreement in RAN4 #101-bis-e meeting (R4-2202640)

*RAN4 to introduce a UE capability to indicate the support of RLM/BFD relaxation in general in Rel-17 feature table.*

* Proposals
	+ Option 1: (CMCC)
		- ***Proposal 1: Define one capability for the whole feature.***
		- ***Proposal 2: For the UE capable of SSB-based RLM, and/or CSI-RS based RLM, and/or SSB-based BFD, and/or CSI-RS based BFD, the feature indicates the support of corresponding RLM and/or BFD relaxation measurement.***
		- ***Proposal 3: The prerequisite feature groups are: SS block based RLM, CSI-RS based RLM and Beam failure recovery.***
		- ***Proposal 4: The feature group can be supported by UE if any prerequisite feature group is supported by UE.***
		- ***Proposal 5: gNB need to know whether the feature is supported or not.***
		- ***Proposal 6: The UE feature is introduced per-UE granularity, no need to differentiate between FDD and TDD, and between FR1 and FR2.***
		- ***Proposal 7: The UE feature is introduced as optional.***
		- ***Proposal 8: Introduce the UE feature as follows in R17 feature table***

***Proposal 8: Introduce the UE feature as follows in R17 feature table***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Features*** | ***Index*** | ***Feature group*** | ***Components*** | ***Prerequisite feature groups*** | ***Need for the gNB to know if the feature is supported*** | ***Applicable to the capability signalling exchange between UEs (V2X WI only)”.*** | ***Consequence if the feature is not supported by the UE*** | ***Type******(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)*** | ***Need of FDD/TDD differentiation*** | ***Need of FR1/FR2 differentiation*** | ***Capability interpretation for mixture of FDD/TDD and/or FR1/FR2*** | ***Note*** | ***Mandatory/Optional*** |
| ***NR\_UE\_pow\_sav\_enh*** | ***TBD*** | ***Support of RLM/BFD relaxation*** | ***For the UE capable of SSB-based RLM, and/or CSI-RS based RLM, and/or SSB-based BFD, and/or CSI-RS based BFD, the feature indicates the support of corresponding RLM and/or BFD relaxation measurement.*** | ***1-3 SS block based RLM and/or*** ***1-7 CSI-RS based RLM and/or*** ***2-31 Beam failure recovery*** | ***Yes*** | ***No*** |  | ***Per UE*** | ***No*** | ***No*** | ***N/A*** | ***The feature group can be supported by UE if any prerequisite feature group is supported by UE.*** | ***Optional with capability signaling*** |

* Recommended WF: Any modification is needed for the Table provided by Option 1 (Proposal 8)? The stable version will be brought to feature list discussion in main section.

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| **Company** | **Comments** |
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# Topic #2: UE measurements relaxation for RLM and/or BFD (AI 10.14.2)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2203721](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203721.zip) | Qualcomm, Inc. | Observation 1: Without mandating good serving cell criterion to be configured for power saving, UE can be in OOS but still in relaxation mode.Proposal 1: Configuring good serving cell criterion is mandatory for power saving, i.e., only low mobility criterion configured but good serving cell criterion not configured is an invalid case for power saving.Proposal 2-1: For each CG, network configures the one specific SSB to be measured for the per-UE low mobility criterion evaluation.Proposal 2-2: The applicability of L3 filter on low mobility measurement is up to UE implementation.Proposal 3: Use Qin in RLM as the thresholds for RLM and BFD good serving cell entering conditions. Definition for Qin is Qin from RLM evaluation for thresholds of both RLM and BFD entering condition. The four values in the configured set are [2,4,6,8]dB.Proposal 4: Offset for entering condition is per-UE basis, and shared between RLM and BFD.Proposal 5: Set exit threshold as Qout, i.e., exit relaxation mode when OOS is detected.Observation 2: All the listed options for exit threshold is equal or higher than Qout. UE sending OOS indication during relaxation mode is impossible.Proposal 6: Do not send OOS indication in relaxation mode.Observation 3: When K=4 with T310 = 320ms and N310 = 1 and DRx = 40ms, the total relaxed RLF delay becomes almost 3 times of the original RLM delay.Proposal 7: Relaxation factor:* For FR1 RLM: (consider only DRx <= 80ms)
	+ K = 2 when DRx > 40ms \*or\* T310 <= 640ms;
	+ K = 4 when DRx <= 40ms \*and \* T310>640ms,
* For FR1 BFD: K = 2

Proposal 8: For relaxation in different RRM procedures:No need to discuss the following cases:* Pcell handover
* PSCell change

Allow relaxation for the following cases to keep consistency between RAN2 and RAN4 agreement* the set of RSs on which UE is required to perform RLM/BFD is changed
* the UE-specific CBW or the active BWP of the UE is changed
* the intra-band Scell on which UE is required to perform BFD becomes active

Proposal 9: Entering power saving mode when at least one of the configured resources are better than the entering threshold. Exiting power saving mode when all the configured resources are worse than the exiting threshold.Proposal 10: Do not consider PDCCH monitoring relaxation in RRM discussion for R17 power saving. |
| [R4-2203757](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203757.zip) | Apple | Proposal 1: It is up to UE’s implementation to evaluate mobility condition when mobility criterion is not configured by the network, and RLM/BFD is allowed by explicit signaling. Proposal 2: Cell quality criteria is configured per-UE basis. Proposal 3: Default entering serving cell criterion for RLM/BFD is Qin. X range in RRC configuration can be 2,4,6,8dB. Proposal 4: Exiting serving cell criterion for RLM/BFD is Qout. Proposal 5: The lower bound of relaxed evaluation period T is NOT relaxed. Proposal 6: Different scaling factor based on DRX cycle for FR1 and FR2 respectively. * FR1 K=4 for MAX(TDRX, TRS) ≤ 80 ms
* FR2 K=2 for MAX(TDRX, TRS) ≤ 80 ms

Proposal 7: * + - For entering condition: the radio link quality of at least one RS resource is better than Qin.
		- For exit condition: the radio link quality for all the RS resources is worse than Qout.
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| [R4-2203903](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203903.zip) | CATT | Proposal 1: If UE is configured by low speed criterion and fulfills + UE is configured by good serving cell quality criterion and fulfills, UE is allowed to apply relaxed requirement irrespective of the explicit signaling. If explicit signaling is true + UE is not configured by low speed criterion + UE is configured by good serving cell quality criterion and fulfills, UE is allowed to apply relaxed requirement. For other cases, UE is not allowed to apply relaxed requirement. Proposal 2: L3 CSI-RS can be used for low mobility criteria evaluation for UEs supports CSI-RS based L3 measurements as well. Proposal 3: Qx = Qin(Qin for RLM) for BFD is not good enough, it is close to Qout\_LR\_SSB. Therefore, we still propose to use Qx = [Qout\_LR\_SSB + Y] for BFD. Y is larger than 5dB at least. If the offset is not configured, the Pre-defined value can be 5 dB.Proposal 4: For RLM, Qx = Qin, Therefore, if the offset is not configured, the Pre-defined value X can be 0 dB. Proposal 5: For FR1, K= 4 and FR2, K= 2. Proposal 6: The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the threshold Qin for all RLM-RS resource. The UE shall exit the relaxed mode when the radio link quality is worse than the threshold Qin for any the RLM-RS resources.Proposal 7: Capture the relaxation criteria in the separate sub-section to be clearer. 8.1.1 and 8.5.1 are for applicability of RLM/BFD measurement relaxation. |
| [R4-2203904](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203904.zip) | CATT | draftCR |
| [R4-2204243](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204243.zip) | Xiaomi | Proposal 1: When the RLM/BFD relaxation feature is enabled by explicit signaling, UE is allowed to apply relaxed requirement provided that:* UE is configured with both low mobility criterion and good serving cell quality criterion and has fulfilled both criteria;
* UE is configured with good serving cell quality criterion and has fulfilled the criterion;

Proposal 2: RAN4 to use SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion.Proposal 3: For the link quality reference threshold for BFD, Qout\_LR is preferred, and Qin derived from RLM specific PDCCH transmission parameters can be accepted as compromise if the offset values of RLM and BFD are different.Proposal 4: The cell quality criteria configuration type could be per-UE basis.Proposal 5: UE to enter power saving mode when any of the configured resources are better than the entering threshold, and to exit power saving mode when all of the configured resources are worse than the exiting threshold.Proposal 6: Capture the configurations and criteria for RLM/BFD relaxation in the RAN2 spec. |
| [R4-2204280](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204280.zip) | OPPO | Proposal 1: Define enter thresholds of good serving cell quality criteria for RLM and BFD as follows,* + Qx + X for RLM, where Qx = Qin, X = 0dB as default.
	+ Qy + Y for BFD, where Qy = Qout\_LR, Y > 0dB as default.

Proposal 2: Define exit threshold of good serving cell quality criteria for RLM/BFD as Qout/Qout\_LR, i.e., exit relaxation mode when OOS is detected.Proposal 3: Define Relaxation criteria for multiple RLM-RS/BFD-RS, * For entering condition: the radio link quality of at least one RS resource is better than the entering threshold.
* For exit condition: the radio link quality for all the RS resources is worse than the exiting threshold.
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| [R4-2204337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204337.zip) | vivo | Observation 1 No measurement restriction is introduced in R16 regarding CSI-RS based L3 measurement.Proposal 1 CSI-RS based L3 measurement is not supported in the evaluation of low mobility criterion.Proposal 2 UE use the specific SSB indicated by gNB if the indicated SSB meets the corresponding side conditions, otherwise UE fall back to cell-level low mobility state evaluation based on all SSBs detected for the serving cell in L3 measurement.Observation 2 CSSF for intra-frequency measurement requirements is 1 only in NR PCell for the case of NR-SA, NE-DC and NR-DC, or in NR PSCell for the case of EN-DC.Proposal 3 UE needs only to identify low mobility state according to RRM measurements in the NR PCell for the case of NR single carrier, NR CA, NE-DC and NR-DC, and according to that in the NR PSCell for the case of EN-DC.Proposal 4 Low mobility criterion is preferred to be captured in RAN2 spec. Observation 3 According to RAN1/2 specs, it is highly possible that RLM-RSs and BFD-RSs are exactly the same set of RSs.Observation 4 The motivation for using Qin but not Qin\_LR for entering threshold of BFD relaxation is that, the SINR gap between Qin and Qout is re-used for the entering/exit relaxation, so as to avoid ping-pong effect.Proposal 5 Confirm to use Qin for entering threshold of BFD relaxation, and Qin here is the in-sync threshold for RLM.Proposal 6 The configurable values for X can be { -3dB, 3dB, 6dB, 9dB}.Proposal 7 Cell quality criterion is a per-CC configuration in dedicated signallingPropoal 8 Cell quality criterion is evaluated on a per-CC basis. UE can make RLM/BFD relaxation decisions separately for each configured CC/band according to the configured cell quality thresholds.Observation 5 Agreements in RAN4 98-bis-e are not clear on the required UE behaviour for exiting relaxation, since the wording ‘certain number’ and ‘observed link quality degradation’ need to be clarified before capturing them in the spec.Proposal 9 From the perspective of requirements impact, RAN4 to agree that only requirements to the first o-o-s indication or the first beam failure indication are relaxed in R17 RLM/BFD relaxation.Proposal 10 The UE behaviour on checking the exiting condition of cell quality criterion regarding multiple RLM-RSs/BFD-RSs is not specified.Proposal 11 UE enters RLM and BFD relaxation if the radio link quality of at least one RS resource is better than the entering thresholdProposal 12 RAN4 to discuss whether conclusions on relaxation criteria in intra-band CA achieved in RAN4 100-e need to be revisited or not.Proposal 13 Cell quality criterion is captured in RAN2 specs.Proposal 14 The applicability of requirements is not impacted by the enabling signalling for the feature.Observation 6 When network enables RLM/BFD relaxation feature without configuring low mobility criterion, it means network is able to ensure that, the UE, who is enabled with RLM/BFD relaxation feature, is in low mobility state. If network is not able to ensure this, it should configure the low mobility criterion to the UE.Observation 7 The agreement in 100e is revisited and reverted, since dedicated signalling is used to enable the RLM/BFD relaxation, and cell quality is agreed to be pre-defined while configurable X is optional. When neither serving cell quality criteria nor low mobility criteria is configured, the existing RLM/BFD requirements shall apply only if network has not enabled this feature by explicit signalling, or if the feature is enabled, but UE failed to meet the predefined cell quality criterion.Proposal 15 RAN4 further discuss the required UE behaviour if UE experiences some other important state change during the relaxed state, i.e. whether UE is allowed to start/continue relaxation for both RLM in spCell and BFD in SCell at the next slot after* PCell handover, or
* PSCell change, or
* the set of RSs on which UE is required to perform RLM/BFD is changed, or
* the UE-specific CBW is change
* the intra-band SCell on which UE is required to perform BFD becomes active

Proposal 16 In FR1 RLM/BFD relaxation, adopt relaxation factor as K1, FR1=2, and K2, FR1=3.Proposal 17 In FR2 SSB-based RLM/BFD relaxation, adopt relaxation factor as K1, FR2, SSB=1.5. |
| [R4-2204338](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204338.zip) | vivo | draftCR |
| [R4-2204398](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204398.zip) | Intel Corporation | Proposal 1: The existing agreement to use SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion is sufficient.Proposal 2: BFD is configured per serving cell and RLM relaxation is configured per-CG.Observation 1: SNR of Qout\_LR is 4 dB higher than SNR of Qout. Similarly, For Qin, it’s reasonable that SNR of BFD is higher than RLM.Proposal 3: Set the same entering threshold for both RLM and BFD relaxation, a SNR threshold higher than Qin will be used.* + - Qx = Qin for RLM and BFD
		- All the candidate value of X will be higher than 0dB, including the pre-defined value.

Proposal 4: Set the same exit criteria for both RLM and BFD, and Qout\_LR is used as the exist threshold.Proposal 5: Relaxation criteria for multiple RLM-RS/BFD-RS depends on conclusion of issue 3-1 and 4-1. |
| [R4-2204532](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204532.zip) | CMCC | *Proposal 1: The applicability conditions that UE is allowed to apply relaxed requirement are listed as below*1. *Network configure RLM/BFD enable signaling*
* *Network configure the offset of good serving cell quality criterion, and the criterion is fulfilled by UE*
* *Network configure the low mobility state criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network doesn’t configure the offset of good serving cell quality criterion, and the criterion with predefined offset ([0]dB) is fulfilled by UE*
* *Network configure the low mobility state criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network configure the offset of good serving cell quality criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network doesn’t configure the offset of good serving cell quality criterion, and the criterion with predefined offset ([0]dB) is fulfilled by UE*

*Proposal 2: The network can configure the RLM/BFD enable signaling without low mobility state criterion in case it determines the UE is in low mobility state. The determination method is up to network.**Proposal 3: L3 CSI-RS can be used for low mobility criteria evaluation for UEs supports CSI-RS based L3 measurements as well.**Proposal 4: The Qin used for BFD relaxation is the same SINR value used for RLM estimation.**Proposal 5: We prefer per-UE basis cell quality criterion configuration.**Proposal 6: Set exit threshold as entering threshold with a hysteresis value** *SINRexit = entering threshold – hysteresis of Z dB.*

*Proposal 7: The relaxation factor for FR1:** *K1, FR1 =2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
* *K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms*

*Proposal 8: The relaxation factor for FR2 SSB:** *K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.*
* *K=2 for MAX(TDRX, TSSB) ≤ 60 ms*

*Proposal 9:* * *The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the threshold (Qin + X) for all RLM/BFD-RS resource.*
* *The UE shall exit the relaxed mode when the radio link quality is worse than the threshold [Qout + X2] for any the RLM/BFD-RS resources.*
* *The value of X2 is depended on the agreement of exit criteria*
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| [R4-2204533](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204533.zip) | CMCC | draftCR |
| [R4-2204706](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204706.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: The good serving cell quality criterion is not mandatory to be configured. And the UE shall evaluate the good serving cell quality criterion only if it is configured. Proposal 2: The good serving cell quality criterion is configured via an “enable” signalling. The UE shall evaluate the good serving cell quality criterion when receiving the “enable” signaling.Proposal 3: Allow explicit relaxation command from the network to allow the UE to relax the RLM/BFD measurements. RRC signalling shall be used for the explicit relaxation command.Proposal 4: The explicit relaxation command can be used irrespective of the relaxation criteria configuration. It should override the evaluation result of the relaxation criteria if there is any inconsistence between them.Proposal 5: The UE-based relaxation can be left as UE implementation as long as the UE complies with the existing RLM/BFD measurement requirements and nothing needs to be specified in RAN4.Proposal 6: Do not use L3 CSI-RS for low mobility criteria evaluation. Observation 1: According to RAN2, the cell measurement result is the average of the intra-frequency L3 RSRP measurements over multiple SSBs if beam consolidation is configured, or the intra-frequency L3 RSRP measurement of the best beam.Proposal 7: L3 RSRP measurement of serving cell based on SSB to be used for low mobility criterion is derived as the intra-frequency SS-RSRP measured over a single SSB index.Proposal 8: The intra-frequency SS-RSRP measurement is derived from the SSB in the active TCI state. Proposal 9: L3 filtering shall not be applied when the intra-frequency L3 RSRP measurement of serving cell is used for low mobility relaxation evaluation for RLM/BFD.Proposal 10: RAN4 to agree on option 1, to additionally define a low mobility criterion based on the number of serving beam changes over time (e.g. TCI state change).Proposal 11: The good serving cell quality criterion for BFD is based on Qin. Proposal 12: The pre-defined value for good serving cell quality criteria is set to X = 0 dB. Proposal 13: UE shall exit from the relaxed RLM/BFD measurements at the 1st Qout occurrence, i.e. first L1 detection of Qout. Proposal 14: The exit criterion shall apply irrespective of how the RLM/BFD relaxation is triggered. Proposal 15: RAN4 to agree on option 1 to reduce the negative impact to the system performance. * Option 1: It is allowed for the network to configure different values of the RLF parameters, e.g. T310/N310/N311, for the relaxed operation to reduce the negative impact to the system performance.

Proposal 16: The scaling factor shall be set as below: * K = 1 for MAX(TDRX, TSSB) > 80 in both FR1 and FR2
* K = 4 for MAX(TDRX, TSSB) ≤ 80 ms in FR1
* K = 2 for MAX(TDRX, TSSB) ≤ 80 ms in FR2

Proposal 17: RAN4 should discuss whether the inconsistency across 80 ms and 160 ms DRX cycles caused by Option 1 in FR1 (i.e. K =4) is acceptable.Proposal 18: If a relaxation factor K=4 is deemed safe in FR1, option 1a should be adopted in FR1 to avoid inconsistency across different DRX cycles:* Option 1a:
	+ K=4 for MAX(TDRX, TSSB) ≤ 40 ms in FR1
	+ K=2 for 40ms < MAX(TDRX, TSSB) ≤ 80 ms in FR1

Proposal 19: When multiple RLM-RS/BFD-RS are configured,* The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the entering threshold i.e. Qin+ X for all RLM-RS resource.
* The UE shall exit the relaxed mode when the radio link quality is worse than the exit threshold for any of the RLM-RS resources.

Proposal 20: RAN4 to proceed with Option 1 (i.e. The interaction of Rel-17 RLM/BFD measurements relaxation with Rel-16 WUS (DCP) needs to be addressed).Proposal 21: The UE configured with Rel16 WUS can be allowed to relax RLM/BFD measurements only when UE is allowed to omit the L1-RSRP and CSI reports.Proposal 22: In FR1, P shall be set to one if the RLM/BFD measurement relaxation is enabled and neighboring cells measurements are allowed to be omitted (i.e. the UE fulfils the s-MeasureConfig based condition). |
| [R4-2204707](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204707.zip) | Nokia, Nokia Shanghai Bell | draftCR |
| [R4-2205331](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205331.zip) | Huawei, HiSilicon | *Proposal 1: The applicability conditions for relaxed RLM evaluation can be defined as follows:*

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| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for relaxed radio link monitoring as defined in clause 8.1.2.x and clause 8.1.3.x, provided that the following conditions are met:- UE is configured with *rlmRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected only to apply the minimum requirements for radio link monitoring as defined in clause 8.1.2.2 and clause 8.1.3.2. |

*Proposal 2: The applicability conditions for relaxed BFD evaluation can be defined as follows:*

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| --- |
| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.x and clause 8.5.3.x, provided that the following conditions are met:- UE is configured with *bfdRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.2 and clause 8.5.3.2. |

*Proposal 3: SSB based L3-RSRP measurement of the serving cell is sufficient to evaluate the low mobility criterion.**Proposal 4: For R17 low mobility criterion, the existing definition of L3 SS-RSRP is used and there is no need to indicate specific SSB for low mobility criterion.**Proposal 5: In FR1, the relaxation factor used for defining relaxed RLM/BFD evaluation period can be defined as K1, FR1 =4 for MAX(TDRX, TRS) ≤ 80 ms, i.e. option 1 is suggested.** *Option 1:*
	+ *K1, FR1 =4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
	+ *K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms*

*Proposal 6: In FR2, the relaxation factor used for defining relaxed RLM/BFD evaluation period can be defined as K1, FR2, SSB =2 for MAX(TDRX, TRS) ≤ 80 ms for MAX(TDRX, TRS) ≤ 80 ms, i.e. option 1 is suggested.** *Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms*

*Proposal 7: For RLM/BFD relaxation, when multiple RSs are configured for RLM/BFD, the followings are suggested for good serving cell quality criterion** *UE fulfills the good serving cell quality criterion when the radio link quality is better than the threshold (Qin + X dB) for any resource in the set of resources for RLM/BFD.*
* *UE does not fulfill the good serving cell quality criterion when the radio link quality is worse than the threshold (Qin + X dB) for all resource in the set of resources for RLM/BFD.*
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| [R4-2205332](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205332.zip) | Huawei, HiSilicon | draftCR |
| [R4-2205402](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205402.zip) | ZTE Corporation | Proposal 1: The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the threshold (Qout + X1) for all RLM-RS resource. The UE shall exit the relaxed mode when the radio link quality is worse than the threshold (Qout + X2) for any the RLM-RS resources. |
| [R4-2205637](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205637.zip) | Ericsson | Proposal 1: FFS on the applicability conditions for UE to apply the relaxed requirement shall be avoided as RAN4 has already reached concrete agreements on applicability conditions.Proposal 2: The existing agreement to use SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion is sufficient.Proposal 3: The predefined value of X for good serving cell quality for applying relaxed RLM is set to 0 dB.Proposal 4: Other configurable values for X for good serving cell quality for applying relaxed RLM comprises 2, 4, 6, and 8 dB.Proposal 5: Qx = Qin for BFD, where Qin is same value used in RLM in-synch. Network can configure different offset X for RLM and BFD, that is, RAN2 configures both XRLM and XBFD. Proposal 6: RAN4 to discuss whether QIn,LR can be used as Ox for applying relaxed BFD instead Qin.Proposal 7: The predefined value of Y for good serving cell quality for applying relaxed BFD is set to 5 dB.Proposal 8: Other configurable values for Y for good serving cell quality for applying relaxed BFD comprises 7, 9, 11, and 12 dB.Proposal 9: Good serving cell quality criterion is configured on per-UE basis for relaxed RLM/BFD.Proposal 10: For FR2, relaxation factor is 1 for for 80 ms < MAX(TDRX, TSSB) ≤ 160 ms.Proposal 11: For FR1, relaxation factors are defined as follows:* + K1, FR1 =4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
	+ K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms

Proposal 12: For FR2, relaxation factors are defined as follows:* + - K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
		- K=2 for MAX(TDRX, TSSB) ≤ 60 ms

Proposal 13: * + The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the threshold (Qout + X1) for all RLM-RS resource.
	+ The UE shall exit the relaxed mode when the radio link quality is worse than the threshold (Qout + X2) for any the RLM-RS resources.
	+ The values of X1, X2 can be same as those discussed for good serving cell quality.
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| [R4-2205660](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205660.zip) | MediaTek inc. | *Observation 1: The signaling design allows the scenario that the dedicated enabling signaling is configured but the low mobility criteria is not configured**Proposal 1: UE shall be allowed to apply the relaxed RLM/BFD requirement when the dedicated enabling signaling is configured but the low mobility criteria is not configured**Proposal 2: RAN4 only applies SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion**Proposal 3: RAN4 to conclude that an offset threshold value X to Qin can be configured to the UE by network to indicate the good serving cell quality criteria, where predefined offset is X=0dB, or network can select offset from a predefined set [2dB, 4dB, 8dB, 12dB]**Proposal 4: RAN4 to agree that configuration types of explicit signaling and offset value X are the same, i.e., RLM relaxation is enable/disable per-CG and BFD relaxation is enable/disable per serving cell* |
| [R4-2205661](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205661.zip) | MediaTek inc. | draftCR |
| [R4-2205850](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205850.zip) | Qualcomm communications-France | draftCR |

## Open issues summary

### Sub-topic 1 Relaxation applicability and criterion

Issue 1-1: Relaxation applicability and criterion

The following proposals are related to his issue

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| **T-doc number** | **Company** | **Proposals**  |
| [R4-2203721](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203721.zip) | Qualcomm, Inc. | Observation 1: Without mandating good serving cell criterion to be configured for power saving, UE can be in OOS but still in relaxation mode.Proposal 1: Configuring good serving cell criterion is mandatory for power saving, i.e., only low mobility criterion configured but good serving cell criterion not configured is an invalid case for power saving.Proposal 8: For relaxation in different RRM procedures:No need to discuss the following cases:* Pcell handover
* PSCell change

Allow relaxation for the following cases to keep consistency between RAN2 and RAN4 agreement* the set of RSs on which UE is required to perform RLM/BFD is changed
* the UE-specific CBW or the active BWP of the UE is changed
* the intra-band Scell on which UE is required to perform BFD becomes active
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| [R4-2203757](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203757.zip) | Apple | Proposal 1: It is up to UE’s implementation to evaluate mobility condition when mobility criterion is not configured by the network, and RLM/BFD is allowed by explicit signaling.  |
| [R4-2203903](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203903.zip) | CATT | Proposal 1: If UE is configured by low speed criterion and fulfills + UE is configured by good serving cell quality criterion and fulfills, UE is allowed to apply relaxed requirement irrespective of the explicit signaling. If explicit signaling is true + UE is not configured by low speed criterion + UE is configured by good serving cell quality criterion and fulfills, UE is allowed to apply relaxed requirement. For other cases, UE is not allowed to apply relaxed requirement.  |
| [R4-2204243](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204243.zip) | Xiaomi | Proposal 1: When the RLM/BFD relaxation feature is enabled by explicit signaling, UE is allowed to apply relaxed requirement provided that:* UE is configured with both low mobility criterion and good serving cell quality criterion and has fulfilled both criteria;
* UE is configured with good serving cell quality criterion and has fulfilled the criterion;
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| [R4-2204337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204337.zip) | vivo | Proposal 14 The applicability of requirements is not impacted by the enabling signalling for the feature.Proposal 15 RAN4 further discuss the required UE behaviour if UE experiences some other important state change during the relaxed state, i.e. whether UE is allowed to start/continue relaxation for both RLM in spCell and BFD in SCell at the next slot after* PCell handover, or
* PSCell change, or
* the set of RSs on which UE is required to perform RLM/BFD is changed, or
* the UE-specific CBW is change
* the intra-band SCell on which UE is required to perform BFD becomes active
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| [R4-2204532](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204532.zip) | CMCC | *Proposal 1: The applicability conditions that UE is allowed to apply relaxed requirement are listed as below*1. *Network configure RLM/BFD enable signaling*
* *Network configure the offset of good serving cell quality criterion, and the criterion is fulfilled by UE*
* *Network configure the low mobility state criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network doesn’t configure the offset of good serving cell quality criterion, and the criterion with predefined offset ([0]dB) is fulfilled by UE*
* *Network configure the low mobility state criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network configure the offset of good serving cell quality criterion, and the criterion is fulfilled by UE*
1. *Network configure RLM/BFD enable signaling*
* *Network doesn’t configure the offset of good serving cell quality criterion, and the criterion with predefined offset ([0]dB) is fulfilled by UE*

*Proposal 2: The network can configure the RLM/BFD enable signaling without low mobility state criterion in case it determines the UE is in low mobility state. The determination method is up to network.* |
| [R4-2204706](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204706.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: The good serving cell quality criterion is not mandatory to be configured. And the UE shall evaluate the good serving cell quality criterion only if it is configured. Proposal 2: The good serving cell quality criterion is configured via an “enable” signalling. The UE shall evaluate the good serving cell quality criterion when receiving the “enable” signaling.Proposal 3: Allow explicit relaxation command from the network to allow the UE to relax the RLM/BFD measurements. RRC signalling shall be used for the explicit relaxation command.Proposal 4: The explicit relaxation command can be used irrespective of the relaxation criteria configuration. It should override the evaluation result of the relaxation criteria if there is any inconsistence between them.Proposal 5: The UE-based relaxation can be left as UE implementation as long as the UE complies with the existing RLM/BFD measurement requirements and nothing needs to be specified in RAN4. |
| [R4-2205331](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205331.zip) | Huawei, HiSilicon | *Proposal 1: The applicability conditions for relaxed RLM evaluation can be defined as follows:*

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| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for relaxed radio link monitoring as defined in clause 8.1.2.x and clause 8.1.3.x, provided that the following conditions are met:- UE is configured with *rlmRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected only to apply the minimum requirements for radio link monitoring as defined in clause 8.1.2.2 and clause 8.1.3.2. |

*Proposal 2: The applicability conditions for relaxed BFD evaluation can be defined as follows:*

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| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.x and clause 8.5.3.x, provided that the following conditions are met:- UE is configured with *bfdRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.2 and clause 8.5.3.2. |

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| [R4-2205637](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205637.zip) | Ericsson | **Proposal 1:** FFS on the applicability conditions for UE to apply the relaxed requirement shall be avoided as RAN4 has already reached concrete agreements on applicability conditions. |
| [R4-2205660](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205660.zip) | MediaTek inc. | *Observation 1: The signaling design allows the scenario that the dedicated enabling signaling is configured but the low mobility criteria is not configured**Proposal 1: UE shall be allowed to apply the relaxed RLM/BFD requirement when the dedicated enabling signaling is configured but the low mobility criteria is not configured* |

#### **Issue 2-1-1: The cases that UE is allowed to apply the relaxed RLM/BFD requirement**

* Background:
	+ The agreed LS to RAN2 in RAN4#101-e-bis [R4-2202769]
		- *The RLM/BFD relaxation is enabled by explicit signaling. The signaling design is left for RAN2.*
		- *The low mobility criterion is NOT mandatory to be configured*
		- *Low mobility criterion is a per-UE configuration.*
		- *The good serving cell quality criteria for RLM/BFD is based on an offset X dB and Qx, while Qx is derived from PDCCH transmission parameters.*
			* *…*
		- *One pre-defined value is used for evaluation if the offset is not configured*
			* *…*
* Proposals
	+ Case 1: Provided UE is configured the “enabling” signalling and UE has fulfilled good serving cell criterion, if the low mobility criteria is NOT configured. (CMCC, Huawei, MTK, [Nokia], Apple, Xiaomi, CATT)
		- Note: if the offset of good serving cell quality criterion is not configured, then the criterion with predefined offset ([0]dB) is fulfilled by UE
	+ Case 2: Provided UE is configured the “enabling” signalling and UE has fulfilled both good serving cell criterion and low mobility criterion if low mobility criteria is configured. (CMCC, Huawei, MTK)
		- Note: if the offset of good serving cell quality criterion is not configured, then the criterion with predefined offset ([0]dB) is fulfilled by UE
		- Note: The network can configure the RLM/BFD enabling signaling without low mobility state criterion in case it determines the UE is in low mobility state. The determination method is up to network.
	+ Case 3: If UE is configured by low speed criterion and fulfills + UE is configured by good serving cell quality criterion and fulfills, UE is allowed to apply relaxed requirement irrespective of the explicit signalling. (CATT)
	+ Case 4: Configuring good serving cell criterion is mandatory for power saving, i.e., only low mobility criterion configured but good serving cell criterion not configured.
		- Option1: Case 4 is an invalid case for power saving. (Qualcomm)
* Recommended WF:
	+ Agree with both Case 1 and Case 2. Discuss if Case 3 is agreeable.
	+ On Case 4, since we already got the predefined offset so the good serving cell criteria will be evaluation if the “enabling” signalling is configured. It seems we don’t need to discuss case 4.

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| **Company** | **Comments** |
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#### **Issue 2-1-2: Text proposal for the applicability conditions for relaxed RLM evaluation**

* Proposals
	+ Option 1: (Huawei)
		- Proposal 1: The applicability conditions for relaxed RLM evaluation can be defined as follows:

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| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for relaxed radio link monitoring as defined in clause 8.1.2.x and clause 8.1.3.x, provided that the following conditions are met:- UE is configured with *rlmRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected only to apply the minimum requirements for radio link monitoring as defined in clause 8.1.2.2 and clause 8.1.3.2. |

* + - Proposal 2: The applicability conditions for relaxed BFD evaluation can be defined as follows:

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| When DRX is used and DRX cycle is no longer than 80ms, the UE is allowed to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.x and clause 8.5.3.x, provided that the following conditions are met:- UE is configured with *bfdRelaxation*; and- UE has fulfilled *goodCellQuality* criterion if *lowMobilityEvaluation* is not configured, or UE has fulfilled both *goodServingCellQuality* criterion and *lowMobilityEvaluation* criterion if *lowMobilityEvaluation* is configured.Otherwise, the UE is expected to apply the minimum requirements for beam failure detection as defined in clause 8.5.2.2 and clause 8.5.3.2. |

* Recommended WF: Suggest to be discussed in the corresponding CR.

#### **Issue 2-1-3: whether to introduce explicit relaxation command for network to allow UE to apply the relaxed RLM/BFD requirements, irrespective evaluation result of the relaxation criteria**

* Proposals
	+ Option 1: Yes (Nokia)
		- Allow explicit relaxation command from the network to allow the UE to relax the RLM/BFD measurements. RRC signalling shall be used for the explicit relaxation command.
		- The explicit relaxation command can be used irrespective of the relaxation criteria configuration. It should override the evaluation result of the relaxation criteria if there is any inconsistence between them.
	+ Option 2: No (vivo)
		- Option 2a: The applicability of requirements is not impacted by the enabling signalling for the feature. the RLM/BFD relaxation feature can be enabled by explicit signalling, but not relaxation (vivo)
* *Moderator’s understanding on Option 1 is that network can indicate directly that UE is allowed to apply relaxed requirement, even the evaluation results of relaxation criteria are not fulfilled.*
* Recommended WF: Discuss the proposal if the signalling is needed to be introduced. If no consensus, the signalling will not be introduced.

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| **Company** | **Comments** |
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#### **Issue 2-1-4: Relaxaion in transient**

* Proposals
	+ Option 1 (vivo): RAN4 further discuss the required UE behaviour if UE experiences some other important state change during the relaxed state, i.e. whether UE is allowed to start/continue relaxation for both RLM in spCell and BFD in SCell at the next slot after
		- PCell handover, or
		- PSCell change, or
		- the set of RSs on which UE is required to perform RLM/BFD is changed, or
		- the UE-specific CBW is change
		- the intra-band SCell on which UE is required to perform BFD becomes activeRecommended WF: Further discuss the proposal.
	+ Option 2 (Qualcomm):
		- No need to discuss the following cases:
			* Pcell handover
			* PSCell change
		- Allow relaxation for the following cases to keep consistency between RAN2 and RAN4 agreement
			* the set of RSs on which UE is required to perform RLM/BFD is changed
			* the UE-specific CBW or the active BWP of the UE is changed
			* the intra-band Scell on which UE is required to perform BFD becomes active
* Recommended WF: Discuss the proposal, if the clarification is needed in the spec for those cases.

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| **Company** | **Comments** |
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#### **Issue 2-1-5: UE based relaxaion**

* Proposals
	+ Option 1: (Nokia)
		- The UE-based relaxation can be left as UE implementation as long as the UE complies with the existing RLM/BFD measurement requirements and nothing needs to be specified in RAN4.
* Recommended WF: Discuss the proposal

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| **Company** | **Comments** |
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### Sub-topic 2 Low motility criteria

#### **Background**

* The agreement in RAN4 100-e meeting (R4-2115348):
	+ *Low mobility criteria*
		- *Reuse Rel-16 low mobility criterion based on L3 RSRP measurement variation.*
			* *FFS the RSs for L3 RSRP measurement*
* The agreement in RAN4 101-e meeting(R4-2120313):
* *For low mobility criterion, the threshold on RSRP variation and the time period over which the RSRP variation is evaluated for relaxed RLM/BFD measurement are configured by network.*
	+ *Thresholds for R16 low mobility criterion and R17 low mobility criterion can be configured separately.*
* *Intra-frequency L3 RSRP measurement of serving cell based on SSB is used for low mobility criteria evaluation.*
	+ *FFS: L3 CSI-RS*
	+ *FFS support beam-level low mobility criterion at least for UE configured with BFD*

#### **Issue 2-2-1: L3 CSI-RS to be used for Low mobility criteria**

* Proposals
	+ Option 1: The existing agreement to use SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion is sufficient. (vivo, Intel, Nokia, Ericsson, Huawei, MTK)
	+ Option 2: L3 CSI-RS can be used for low mobility criteria evaluation for UEs supports CSI-RS based L3 measurements as well. (CATT, Xiaomi, CMCC)
* *Moderator: Note that R16 low mobility criteria is not based L3 CSI-RS.*
* Recommended WF: Discuss the proposal if L3 CSI-RS is needed to be introduced for low mobility criteria. If no consensus, follow the existing agreement to use SSB based L3-RSRP for low mobility criteria.

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| **Company** | **Comments** |
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#### **Issue 2-2-2: the specific SSB to be measured for the low mobility criterion evaluation.**

* Proposals:
	+ Option 1: For R17 low mobility criterion, the existing definition of L3 SS-RSRP is used and there is no need to indicate specific SSB for low mobility criterion (Huawei)
	+ Option 2a: For each CG, network configures the one specific SSB to be measured for the per-UE low mobility criterion evaluation. (Qualcomm)
	+ Option 2b: UE use the specific SSB indicated by gNB if the indicated SSB meets the corresponding side conditions, otherwise UE fall back to cell-level low mobility state evaluation based on all SSBs detected for the serving cell in L3 measurement. (vivo)
	+ Option 3: L3 RSRP measurement of serving cell based on SSB to be used for low mobility criterion is derived as the intra-frequency SS-RSRP measured over a single SSB index. The intra-frequency SS-RSRP measurement is derived from the SSB in the active TCI state. (Nokia)
* Recommended WF: Discuss the proposals. If the clarification on the SSB for the R17 low mobility criteria is needed or it is up to UE implantation?

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| **Company** | **Comments** |
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#### **Issue 2-2-3: Additional Low mobility criteria**

* Proposals
	+ Option 1: RAN4 additionally to define a low mobility criterion based on the number of serving beam changes over time (e.g. TCI state change) (Nokia)
	+ Option 2: No additional low mobility criterion is needed besides R16 low mobility criterion.
* Recommended WF: Discuss the proposal. If no consensus, no additional low mobility criterion will be introduced besides R16 low mobility criterion.

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| **Company** | **Comments** |
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#### **Issue 2-2-4: Clarifications for Low mobility criteria evaluation**

* Proposals:
	+ Proposal 1: UE needs only to identify low mobility state according to RRM measurements in the NR PCell for the case of NR single carrier, NR CA, NE-DC and NR-DC, and according to that in the NR PSCell for the case of EN-DC. (Vivo)
* Recommended WF: Discuss the proposal. If this clarification is needed?

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| **Company** | **Comments** |
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#### **Issue 2-2-5: L3 filtering for intra-frequency L3 RSRP measurement of serving cell is used for low mobility criterion**

* Proposals
	+ Option 1: The applicability of L3 filter on low mobility measurement is up to UE implementation. (Qualcomm)
	+ Option 2: L3 filtering shall not be applied when the intra-frequency L3 RSRP measurement of serving cell is used for low mobility relaxation evaluation for RLM/BFD. (Nokia)
* Recommended WF: Discuss the proposal. If this clarification on L3 filtering is needed to be specified? If no consensus, Moderator’s understanding is that Option 2 will be the baseline, because the L3 filtering was not applied in R16 low mobility criteria, which is agreed to be used for R17 UE power saving.

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| **Company** | **Comments** |
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### Sub-topic 3 Good serving cell quality criteria

* Proposals related to this sub-topics

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| **T-doc number** | **Company** | **Proposals**  |
| [R4-2203721](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203721.zip) | Qualcomm, Inc. | Proposal 3: Use Qin in RLM as the thresholds for RLM and BFD good serving cell entering conditions. Definition for Qin is Qin from RLM evaluation for thresholds of both RLM and BFD entering condition. The four values in the configured set are [2,4,6,8]dB. |
| [R4-2203757](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203757.zip) | Apple | Proposal 3: Default entering serving cell criterion for RLM/BFD is Qin. X range in RRC configuration can be 2,4,6,8dB.  |
| [R4-2203903](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203903.zip) | CATT | Proposal 3: Qx = Qin(Qin for RLM) for BFD is not good enough, it is close to Qout\_LR\_SSB. Therefore, we still propose to use Qx = [Qout\_LR\_SSB + Y] for BFD. Y is larger than 5dB at least. If the offset is not configured, the Pre-defined value can be 5 dB.Proposal 4: For RLM, Qx = Qin, Therefore, if the offset is not configured, the Pre-defined value X can be 0 dB.  |
| [R4-2204243](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204243.zip) | Xiaomi | Proposal 3: For the link quality reference threshold for BFD, Qout\_LR is preferred, and Qin derived from RLM specific PDCCH transmission parameters can be accepted as compromise if the offset values of RLM and BFD are different. |
| [R4-2204280](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204280.zip) | OPPO | Proposal 1: Define enter thresholds of good serving cell quality criteria for RLM and BFD as follows,* + Qx + X for RLM, where Qx = Qin, X = 0dB as default.
	+ Qy + Y for BFD, where Qy = Qout\_LR, Y > 0dB as default.
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| [R4-2204337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204337.zip) | vivo | Observation 3 According to RAN1/2 specs, it is highly possible that RLM-RSs and BFD-RSs are exactly the same set of RSs.Observation 4 The motivation for using Qin but not Qin\_LR for entering threshold of BFD relaxation is that, the SINR gap between Qin and Qout is re-used for the entering/exit relaxation, so as to avoid ping-pong effect.Proposal 5 Confirm to use Qin for entering threshold of BFD relaxation, and Qin here is the in-sync threshold for RLM.Proposal 6 The configurable values for X can be { -3dB, 3dB, 6dB, 9dB}. |
| [R4-2204398](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204398.zip) | Intel Corporation | Observation 1: SNR of Qout\_LR is 4 dB higher than SNR of Qout. Similarly, For Qin, it’s reasonable that SNR of BFD is higher than RLM.Proposal 3: Set the same entering threshold for both RLM and BFD relaxation, a SNR threshold higher than Qin will be used.* + - Qx = Qin for RLM and BFD
		- All the candidate value of X will be higher than 0dB, including the pre-defined value.
 |
| [R4-2204532](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204532.zip) | CMCC | *Proposal 4: The Qin used for BFD relaxation is the same SINR value used for RLM estimation.* |
| [R4-2204706](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204706.zip) | Nokia, Nokia Shanghai Bell | Proposal 11: The good serving cell quality criterion for BFD is based on Qin. Proposal 12: The pre-defined value for good serving cell quality criteria is set to X = 0 dB.  |
| [R4-2205637](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205637.zip) | Ericsson | **Proposal 3:** The predefined value of X for good serving cell quality for applying relaxed RLM is set to 0 dB.**Proposal 4:** Other configurable values for X for good serving cell quality for applying relaxed RLM comprises 2, 4, 6, and 8 dB.**Proposal 5:** Qx = Qin for BFD, where Qin is same value used in RLM in-synch. Network can configure different offset X for RLM and BFD, that is, RAN2 configures both XRLM and XBFD. **Proposal 6:** RAN4 to discuss whether QIn,LR can be used as Ox for applying relaxed BFD instead Qin.**Proposal 7:** The predefined value of Y for good serving cell quality for applying relaxed BFD is set to 5 dB.**Proposal 8:** Other configurable values for Y for good serving cell quality for applying relaxed BFD comprises 7, 9, 11, and 12 dB. |
| [R4-2205660](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205660.zip) | MediaTek inc. | *Proposal 3: RAN4 to conclude that an offset threshold value X to Qin can be configured to the UE by network to indicate the good serving cell quality criteria, where predefined offset is X=0dB, or network can select offset from a predefined set [2dB, 4dB, 8dB, 12dB]* |

#### **Background of Issue 2-3-1 ~ 2-3-4**

* The agreement in RAN4 101-e-bis meeting:
* *The good serving cell quality criteria for RLM/BFD is based on an offset X dB and Qx, while Qx is derived from PDCCH transmission parameters.*
	+ *Qx = Qin for RLM*
	+ *Qx = [Qin] for BFD*
		- *Note: definition of Qin for BFD needs to be clarified*
	+ *The offset X can be configured from a set of 4 values*
		- *Exact values are FFS*
	+ *One pre-defined value is used for evaluation if the offset is not configured*
		- *Pre-defined value X = [0] dB*
	+ *Signalling details are up to RAN2*

#### **Issue 2-3-1: For RLM, the predefined offset X dB**

* Proposals
* Option 1: For RLM, confirm the predefined offset value X is 0 dB. (Oppo, CATT, Ericsson, MTK, Nokia)
* Option 2: the predefined offset value X is higher than 0 dB (Intel)
* Recommended WF: Agree with Option 1. Proponent of Option 2 could clarify the desired value and the reason.

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| **Company** | **Comments** |
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#### **Issue 2-3-2: For RLM, other configurable values of offset X dB**

* Background: The agreement in RAN4 101-e-bis meeting:
	+ *The offset X can be configured from a set of 4 values*
		- *Exact values are FFS*
* Proposals
	+ Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, Ericsson)
	+ Option 2: [-3, 3, 6, 9] dB. (vivo)
	+ Option 3: [2, 4, 8, 12] dB. (MTK)
* Recommended WF: The values are not too far among options. Suggest go with Option 1. LS will be assigned after 1st round to inform RAN2 the conclusion.

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| **Company** | **Comments** |
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#### **Issue 2-3-3: For BFD, the reference threshold Qx and the predefined offset X**

* Proposals
* Option 1: Qx = Qin is used as the reference threshold. (Qualcomm, Apple, Intel, Ericsson, vivo, CMCC, Nokia)
	+ Option 1a: and the predefined offset is 0 dB.
	+ Option 1b: and the predefined offset is 5 dB (Ericsson)
	+ Note: Qin corresponds to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1.
* Option 2: Qx = Qout\_LR\_SSB. (Xiaomi, OPPO, CATT)
	+ Option 2a: and the predefined offset is > 0 dB (OPPO).
	+ Option 2b: and the predefined offset is 5 dB (CATT).
* Option 4: RAN4 to discuss whether QIn,LR can be used as Qx for applying relaxed BFD instead Qin. (Ericsson)

*Moderator’s observation: From R15 RLM test case, it can be observed that Qin is 4.5 dB higher than Qout\_LR (-1.5 vs. -6 dB), and according to the simulation result of delta SINR submitted in RAN4#98-bis-e (*[SimResult\_98bise\_224\_v9\_Ericsson\_vivo2.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Inbox/Drafts/%5B98bis-e%5D%5B224%5D%20NR_UE_pow_sav_enh_RRM/Round%201/SimResult_98bise_224_v9_Ericsson_vivo2.xlsx)*), as excerpted below ( R4-2104757 CATT, R4-2106851 Ericsson, R4-2106581 Nokia), the delta SINR are within 3.6 dB for BFD with K<=4 in most cases.*



* Recommended WF:
	+ Comparing to Qout\_LR, take Qin as the reference threshold already raised the SINR level, company please also check the simulation results in RAN4#98-bis-e to see if the predefined value still need to be larger than 0dB.
	+ Suggest Option 1a, because according to the simulation result, the lower threshold (e.g. around 4.5dB vs. Qout\_LR) is applicable for some cases (e.g. K=2).

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| **Company** | **Comments** |
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#### **Issue 2-3-4: For BFD, other configurable values of offset X dB**

* Proposals
	+ Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple)
	+ Option 2: [-3, 3, 6, 9] dB. (vivo)
	+ Option 3: [2, 4, 8, 12] dB. (MTK)
	+ Option 4: [7,9,11,12] dB for BFD (Ericsson)
* Recommended WF: Discuss the Options. LS will be assigned after 1st round to inform RAN2 the conclusion.

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| **Company** | **Comments** |
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#### **Issue 2-3-5: Configuration type of offset for the cell quality criteria**

* Background:
	+ In last meeting, RAN2 already agreed the configuration type for the explicit signalling, in Report of 3GPP TSG RAN WG2 meeting #116bis-e, Jan., 2022.

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| * BFD relaxation is enable/disable per serving cell (i.e. separately between Pcell/PScell and Scell). FFS on stage-3 details.
* RLM relaxation is enable/disable per-CG (i.e. separately between Pcell and PScell). FFS on stage-3 details, FFS if enable/disable is by the UE or by the network.
 |

* Proposals
	+ Option 1: Offset for BFD is configured per serving cell and offset for RLM relaxation is configured per-CG. (Intel, MTK)
	+ Option 2: per-UE basis. (Qualcomm, Apple, Xiaomi, CMCC, Ericsson)
	+ Option 2a: per-UE basis, and the offset is shared for both RLM and BFD. (Qualcomm)
	+ Option 3: per-CG basis. (Nokia)
		- Option 3a (Nokia): Cell quality criterion is evaluated on a per-CC basis. UE can make RLM/BFD relaxation decisions separately for each configured CC/band according to the configured cell quality thresholds.
* Recommended WF: Discuss the proposal. Moderator’s understanding on the Option 1 is that the offset configuration type will follow the configuration type of the enabling signalling.

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| **Company** | **Comments** |
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### Sub-topic 4 Exiting Relaxation criteria

* Proposals related to this sub-topics

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| **T-doc number** | **Company** | **Proposals**  |
| [R4-2203721](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203721.zip) | Qualcomm, Inc. | Proposal 5: Set exit threshold as Qout, i.e., exit relaxation mode when OOS is detected. |
| [R4-2203757](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203757.zip) | Apple | Proposal 4: Exiting serving cell criterion for RLM/BFD is Qout.  |
| [R4-2204280](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204280.zip) | OPPO | Proposal 2: Define exit threshold of good serving cell quality criteria for RLM/BFD as Qout/Qout\_LR, i.e., exit relaxation mode when OOS is detected. |
| [R4-2204337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204337.zip) | vivo | Observation 5 Agreements in RAN4 98-bis-e are not clear on the required UE behaviour for exiting relaxation, since the wording ‘certain number’ and ‘observed link quality degradation’ need to be clarified before capturing them in the spec.Proposal 9 From the perspective of requirements impact, RAN4 to agree that only requirements to the first o-o-s indication or the first beam failure indication are relaxed in R17 RLM/BFD relaxation. |
| [R4-2204398](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204398.zip) | Intel Corporation | Proposal 4: Set the same exit criteria for both RLM and BFD, and Qout\_LR is used as the exist threshold. |
| [R4-2204532](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204532.zip) | CMCC | *Proposal 6: Set exit threshold as entering threshold with a hysteresis value** *SINRexit = entering threshold – hysteresis of Z dB.*
 |
| [R4-2204706](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204706.zip) | Nokia, Nokia Shanghai Bell | Proposal 13: UE shall exit from the relaxed RLM/BFD measurements at the 1st Qout occurrence, i.e. first L1 detection of Qout. Proposal 14: The exit criterion shall apply irrespective of how the RLM/BFD relaxation is triggered.  |

#### **Issue 2-4-1: Exiting relaxation criteria upon link quality**

* Background:
	+ Agreement in RAN4 98-e-Bis meeting:
		- *The UE while performing relaxed RLM upon detecting certain number of out-of-sync indications or upon triggering T310 or upon observed link quality degradation or mobility state change reverts to the normal RLM operation (i.e. without relaxation).*
	+ Agreement in RAN4 99-e-Bis meeting:
		- *If the UE fulfills any of serving cell quality exit condition or low mobility exit condition, or DRX cycle length is NOT allowed for relaxation, UE will exit relaxation mode.*
			* *Note1: Whether the exit condition for serving cell quality is explicitly specified or not is up to issue 2-3-2.*
			* *Note2: FFS the details of the exit condition of low mobility’*
	+ Agreement in RAN4 100-e meeting:
		- *No additional exit criterion for low mobility, i.e. UE exit low mobility state as long as the entering condition is not met.*
* Proposals
	+ Option 1: Set exit threshold as Qout, i.e., exit relaxation mode when OOS is detected (Qualcomm, Apple, OPPO, Intel)
	+ Option 1a: UE shall exit from the relaxed RLM/BFD measurements at the 1st Qout occurrence, i.e. first L1 detection of Qout. (vivo, Nokia)
	+ Option 2: Set exit threshold as entering threshold with a hysteresis value. (CMCC)
		- *SINRexit =* entering threshold – hysteresis of Z dB
* *Moderator’s observation:*
	+ *No additional exit criterion for low mobility was agreed in the last meeting, and companies would like to clarify the exit criterion upon serving cell quality.*
	+ *According to sub-topic 3, the good serving cell quality criterion is either based on Qin + X dB or Qout\_LR + 10 dB, thus Option 1, based on Qout, does provide a hysteresis value as described in Option 2.*
* Recommended WF: Based on Option 1/1a, please start from the following
	+ UE is not allowed to apply the relaxed RLM requirement when UE sends OOS.
	+ UE is not allowed to apply the relaxed BFD requirement when UE sends beam failure indication.

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| **Company** | **Comments** |
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### Sub-topic 5 During Relaxation mode

* Background:
	+ Agreement in RAN4#100e:
		- *RAN4 does not specify UE RLM/BFD relaxation behaviour in the spec but to specify the evaluation period during for relaxation*
		- *RAN4 specify the new evaluation period based on Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS))*
			* *where Y is K \* current Rel-15 samples, and K is the predefined relaxation factor.*
			* *where T is the lower bound of relaxed evaluation period. FFS whether the relaxation factor K to be applied on T.*
			* *Scaling factor K is defining the relaxed RLM/BFD evaluation period is defined based on max(TDRX, TSSB).*
			* *Note: 1.5 scaling factor is considered in current Rel-15 samples.*
	+ Regarding the lower bound, as agreement in RAN4#101e-bis:
		- *The lower bound of relaxed evaluation period is NOT relaxed by K, if K > 2 is applying.*
		- *The lower bound of relaxed evaluation period is relaxed by K, if K <=2 and K>1 is applying.*

#### **Issue 2-5-1: relaxation factors**

* Background:

*Agreement in RAN4#100e:*

* + *The relaxation factor for FR1:*
		- *TRS is the periodicity of SSB for the case of SSB based, and the periodicity of CSI-RS for the case of CSI-RS based.*
		- *K0, FR1 =1 for 80 ms < MAX(TDRX,* *TRS) ≤ 160 ms.*
		- *K1, FR1=[2, 3 or 4] for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
		- *K2, FR1=[2, 3, or 4] for MAX(TDRX, TRS) ≤ 40 ms*
		- *FFS select between [2,3,4]*
	+ *The relaxation factor for FR2 SSB:*
		- *K0, FR2, SSB = 1 for [80] ms < MAX(TDRX, TSSB) ≤ 160 ms*
		- *K1, FR2, SSB= [1.5 or 2] for MAX(TDRX, TSSB) ≤ [80] ms for SSB based relaxation.*
	+ *The relaxation factor for FR2 CSI-RS:*
		- *K0, FR2, CSI-RS =1 for 80 ms < MAX(TDRX, TCSI-RS) ≤ 160 ms*
		- *K1, FR2, CSI-RS = 2 for MAX(TDRX, TCSI-RS) ≤ 80 ms for CSI-RS based relaxation.*

*Agreement in RAN4#101e-bis:*

* + *The relaxation factor for FR1:*
* *Option 1:*
	+ *K1, FR1 =4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
	+ *K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms*
* *Option 2*
	+ *For FR1 RLM: (consider only DRx <= 80ms)*
		- *K = 2 when DRx > 40ms \*or\* T310 <= 640ms;*
		- *K = 4 when DRx <= 40ms \*and \* T310>640ms,*
	+ *For FR1 BFD: K = 2*
	+ *The relaxation factor for FR2 SSB:*
		- Confirm K0, FR2, SSB = 1 for 80 ms < MAX(TDRX, TSSB) ≤ 160 ms.
		- Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms
		- Option 2:
			* K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
			* K=2 for MAX(TDRX, TSSB) ≤ 60 ms
* Proposals related to this issue

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| **T-doc number** | **Company** | **Proposals**  |
| [R4-2203721](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203721.zip) | Qualcomm, Inc. | Proposal 7: Relaxation factor:* For FR1 RLM: (consider only DRx <= 80ms)
	+ K = 2 when DRx > 40ms \*or\* T310 <= 640ms;
	+ K = 4 when DRx <= 40ms \*and \* T310>640ms,
* For FR1 BFD: K = 2
 |
| [R4-2203757](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203757.zip) | Apple | Proposal 5: The lower bound of relaxed evaluation period T is NOT relaxed. Proposal 6: Different scaling factor based on DRX cycle for FR1 and FR2 respectively. * FR1 K=4 for MAX(TDRX, TRS) ≤ 80 ms
* FR2 K=2 for MAX(TDRX, TRS) ≤ 80 ms
 |
| [R4-2203903](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203903.zip) | CATT | Proposal 5: For FR1, K= 4 and FR2, K= 2.  |
| [R4-2204337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204337.zip) | vivo | Proposal 16 In FR1 RLM/BFD relaxation, adopt relaxation factor as K1, FR1=2, and K2, FR1=3.Proposal 17 In FR2 SSB-based RLM/BFD relaxation, adopt relaxation factor as K1, FR2, SSB=1.5. |
| [R4-2204532](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204532.zip) | CMCC | *Proposal 7: The relaxation factor for FR1:** *K1, FR1 =2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
* *K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms*

*Proposal 8: The relaxation factor for FR2 SSB:** *K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.*
* *K=2 for MAX(TDRX, TSSB) ≤ 60 ms*
 |
| [R4-2204706](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204706.zip) | Nokia, Nokia Shanghai Bell | Proposal 16: The scaling factor shall be set as below: * K = 1 for MAX(TDRX, TSSB) > 80 in both FR1 and FR2
* K = 4 for MAX(TDRX, TSSB) ≤ 80 ms in FR1
* K = 2 for MAX(TDRX, TSSB) ≤ 80 ms in FR2

Proposal 17: RAN4 should discuss whether the inconsistency across 80 ms and 160 ms DRX cycles caused by Option 1 in FR1 (i.e. K =4) is acceptable.Proposal 18: If a relaxation factor K=4 is deemed safe in FR1, option 1a should be adopted in FR1 to avoid inconsistency across different DRX cycles:* Option 1a:
	+ K=4 for MAX(TDRX, TSSB) ≤ 40 ms in FR1
	+ K=2 for 40ms < MAX(TDRX, TSSB) ≤ 80 ms in FR1
 |
| [R4-2205331](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205331.zip) | Huawei, HiSilicon | *Proposal 5: In FR1, the relaxation factor used for defining relaxed RLM/BFD evaluation period can be defined as K1, FR1 =4 for MAX(TDRX, TRS) ≤ 80 ms, i.e. option 1 is suggested.** *Option 1:*
	+ *K1, FR1 =4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms*
	+ *K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms*

*Proposal 6: In FR2, the relaxation factor used for defining relaxed RLM/BFD evaluation period can be defined as K1, FR2, SSB =2 for MAX(TDRX, TRS) ≤ 80 ms for MAX(TDRX, TRS) ≤ 80 ms, i.e. option 1 is suggested.** *Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms*
 |
| [R4-2205637](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205637.zip) | Ericsson | Proposal 10: For FR2, relaxation factor is 1 for for 80 ms < MAX(TDRX, TSSB) ≤ 160 ms.Proposal 11: For FR1, relaxation factors are defined as follows:* K1, FR1 =4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
* K2, FR1 =4 for MAX(TDRX, TRS) ≤ 40 ms

Proposal 12: For FR2, relaxation factors are defined as follows:* K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
* K=2 for MAX(TDRX, TSSB) ≤ 60 ms
 |

*Moderator’s observation:*

* No need to discuss MAX(TDRX, TSSB) > 80 ms, which has been conclude as K=1 in RAN4#101e-bis.
* No need to discuss the lower bound, which has been conclude as K=1 in RAN4#101e-bis.

Proposals summary:

* The relaxation factor for FR1:
* Option 1a: (Apple, CATT, Huawei, Ericsson)
	+ K1, FR1 = 4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
	+ K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms
* Option 1b: (CMCC, Nokia)
	+ K1, FR1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
	+ K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms
	+ Note: to consider the inconsistency across 80 ms and 160 ms DRX cycles caused by K=4 in FR1.
* Option 1c: (vivo)
	+ K1, FR1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
	+ K2, FR1 = 3 for MAX(TDRX, TRS) ≤ 40 ms
* Option 2: (Qualcomm)
	+ For FR1 RLM: (consider only DRx <= 80ms)
		- K = 2 when DRx > 40ms \*or\* T310 <= 640ms;
		- K = 4 when DRx <= 40ms \*and \* T310>640ms,
	+ For FR1 BFD: K = 2
* The relaxation factor for FR2 SSB:
* Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms. (Apple, CATT, Huawei, Nokia)
* Option 2: (CMCC, Ericsson)
	+ K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
	+ K=2 for MAX(TDRX, TSSB) ≤ 60 ms
* Option 2a: K1, FR2, SSB= 1.5 for MAX(TDRX, TSSB) ≤ 80 ms. (vivo)
* Recommended WF:
	+ For FR1, consider Option 1b as compromise, because it also addresses the inconsistency across 80 ms and 160 ms DRX cycles caused by K=4 in FR1.
	+ For FR2, please consider Option 2 as compromise, because it is the middle ground between Option 1 and Option 2a.

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| **Company** | **Comments** |
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#### **Issue 2-5-2: Clarification on OOS indication during relaxation mode**

* Proposals:
	+ Option 1: Do not send OOS indication in relaxation mode (Qualcomm)
* Recommended WF: It may depend on Issue 2-4-1. If it concludes UE is not allowed to apply the relaxed requirement when UE sends OOS, not sure this clarification is still needed.

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| **Company** | **Comments** |
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#### **Issue 2-5-3: Additional N310/N311 values for relaxation mode**

* Proposals
	+ Option 1: To reduce the negative impact to the system performance, it is allowed for the network to configure different values of the RLF parameters, e.g. T310/N310/N311, for the relaxed operation to reduce the negative impact to the system performance. (Nokia)
* Recommended WF: Discuss if the additional values are needed. If no consensus, no additional values of N310/N311 will be introduced.

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| **Company** | **Comments** |
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### Sub-topic 6 Other Aspects

#### **Issue 2-6-1: Specification for relaxation criteria**

* Proposals
	+ Option 1: Capture the relaxation criteria in the separate sub-section of RAN4 specification. Clause 8.1.1 and 8.5.1 are for applicability of RLM/BFD measurement relaxation. (CATT)
	+ Option 2: Capture the relaxation criterion for RLM/BFD relaxation in the RAN2 spec. (Xiaomi)
	+ Option 2a: Low mobility criterion is preferred to be captured in RAN2 spec. (Nokia)
	+ Option 2b: Cell quality criterion is captured in RAN2 specs. (vivo)
* Recommended WF:
	+ According to incoming LS from RAN2 (R2-2201989), the spec separation was assumed as the following in RAN2:

*Regarding the spec separation for RLM/BFD relaxation:*

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| * *RAN2 assumes the configurations for RLM/BFD relaxation should be captured in RAN2 specification, while the relaxation requirements/approaches should be captured in RAN4 specification.*
* *RAN2 assumes that the criteria for RLM/BFD relaxation will be captured in RAN2 TS, can ask R4*
 |

* + Therefore, suggest to capture the relaxation criteria for RLM/BFD relaxation in the RAN2 specifications to align with RAN2 assumption.

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| **Company** | **Comments** |
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#### **Issue 2-6-2: Clarification on multiple RLM-RS/BFD-RS**

Proposals

* For entering condition,
	+ Option 1: the radio link quality of at least one RLM-RS is better than the entering threshold. (Huawei, Qualcomm, Xiaomi, Apple, vivo. OPPO)
	+ Option 2: The UE is allowed to operate RLM/BFD in relaxed mode for a certain cell (SpCell or SCell) when the radio link quality is better than the threshold (e.g. Qout + X1) for all RLM-RS resource. (CMCC, Ericsson, CATT, Nokia, ZTE)
	+ Option 3: pending by other issues (Intel)
* For exiting condition,
	+ Option 1: the radio link quality for all the RLM-RS resources are worse than the exiting threshold. (Huawei, Qualcomm, Xiaomi, Apple, OPPO)
	+ Option 2: The UE shall exit the relaxed mode when the radio link quality is worse than the threshold (e.g. Qout + X2) for any the RLM-RS resources. (CMCC, Ericsson, CATT, Nokia, ZTE)
	+ Option 3: The UE behaviour on checking the exiting condition of cell quality criterion regarding multiple RLM-RSs/BFD-RSs is not specified. (vivo)
	+ Option 4: pending by other issues (Intel)

Recommended WF: Moderator’s understanding is that RAN4 requirement is specified based on per-RS. Thus, if no consensus, there will be no clarification on for the multiple RLM-RS/BFD-RS and it implies the relaxed requirement would apply for some RSs but would not apply for other RSs.

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| **Company** | **Comments** |
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#### **Issue 2-6-3: Clarification with Rel-16 WUS (DCP)**

* Proposals
	+ Option 1: The UE configured with Rel16 WUS can be allowed to relax RLM/BFD measurements only when UE is allowed to omit the L1-RSRP and CSI reports. (Nokia)
	+ Option 2: Do not discuss the PDCCH monitoring relaxation in RRM for R17 power saving (Qualcomm)
* Recommended WF: Discuss if the clarification with R16 WUS is needed.

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| **Company** | **Comments** |
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#### **Issue 2-6-4: Set P values to one**

* Proposals
	+ Option 1: In FR1, P shall be set to one if the RLM/BFD measurement relaxation is enabled and neighboring cells measurements are allowed to be omitted (i.e. the UE fulfils the s-MeasureConfig based condition) (Nokia)
* Recommended WF: Discuss the proposals.

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| **Company** | **Comments** |
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#### **Issue 2-6-5: Whether to revisit agreement in relaxation criteria in intra-band CA achieved in RAN4 100-e**

* Background:

Agreements in RAN4 100-e

**Issue 6-2-1: Relaxation criteria in intra-band CA**

* When BFD measurements are configured on SCell
	+ For intra-band CA with CSI-RS based RLM on SpCell and CSI-RS based BFD in SCell, the UE is allowed the operate in relaxed mode for RLM and/or BFD if UE has fulfilled the relaxation criteria for both RLM and BFD.
	+ For intra-band CA with CSI-RS based RLM on SpCell and CSI-RS based BFD in SCell, if UE has failed to fulfil the relaxation criteria for any of RLM and BFD, then the UE is not allowed to operate in relaxed mode in RLM and BFD in any of the cells.
	+ Note: This can be revisited upon clarification on the SCell BFD requirements in R16 eMIMO maintenance.
* When BFD measurements are configured on SpCell
	+ For intra-band CA, whether to allow RLM/BFD relaxation depends upon whether both RLM and BFD measurements on SpCell fulfil the relaxation criterion.

Company propose to discuss whether conclusions on relaxation criteria in intra-band CA achieved in RAN4 100-e need to be revisited or not, as mentioned in R4-2004337, as cited below:

*In RAN4 101-e, some discussion on the CR [4] is triggered in R16 eMIMO WI. Based on discussion it is agreed that for intra-band CA case, RLM in SpCell and BFD in SCell is a valid scenario. After the clarification is done, it is worth for RAN4 to decide whether the conclusions above need to be re-visited.*

* Proposals
	+ Option 1: RAN4 to discuss whether conclusions on relaxation criteria in intra-band CA achieved in RAN4 100-e need to be revisited or not. (Vivo)
* Recommended WF: Moderator see no need to discuss this, because it seems no contradiction to R16 eMIMO discussion as “*RLM in SpCell and BFD in SCell is a valid scenario*”. No consensus means the previous agreement applies.

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| **Company** | **Comments** |
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## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

***No need to repeat the comments if you have already provided comments to the related open issues.***

***Comments on the exact wording can be provided here, if any.***

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| **CR/TP number** | **Comments collection** |
| R4-2205661 (MTK, Ericsson) | Moderator: General of RLM, applicability of RLM measurement relaxation (8.1.1.1) |
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| R4-2205332 (Huawei) | Moderator: SSB RLM (8.1.2.X) |
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| R4-2204338 (vivo) | Moderator: CSI-RS RLM (8.1.3.X) |
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| R4-2204707 (Nokia) | Moderator: Criteria for RLM (8.1.Y1), related to Issue 2-6-1 |
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| R4-2205636 (Ericsson, MTK) | Moderator: General of BFD, applicability of measurement relaxation (8.5.1.1) |
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| R4-2204533 (CMCC) | Moderator: SSB BFD (8.5.2.X) |
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| R4-2203904 (CATT) | Moderator: Criteria for BFD (8.5.Y1), related to Issue 2-6-1 |
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| R4-2205850 (Qualcomm) | Moderator: BigCR title |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

## Discussion on 2nd round (if applicable)

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

# Topic #3: RRM performance requirements (AI 10.14.3)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2203722](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203722.zip) | Qualcomm, Inc. | **Proposal 1: Introduce the following tests for verifying UE RLM/BFD relaxation behavior**1. **RLM Out-of-sync SSB based non-DRx in FR1 in EN-DC**
2. **BFD CSI-RS based DRx in FR2 in NR-SA**

**Proposal 2: Design the two tests in proposal 1 by reusing the corresponding legacy test with the following modifications:**1. **RLM Out-of-sync SSB based non-DRx in FR1 in EN-DC**

**Configure offset to Qin for entering condition = 0dB to keep the SINR variation setting in the legacy test****Change D1 as****KSSB, FR1 \* 20 (T\_SSB) \* 2 (P) \* 10 + 20 (T\_SSB) \* 2 (P) = 400 KSSB, FR1 + 40 (ms)****(2) BFD CSI-RS based DRx in FR2 in NR-SA****(a) Configure offset to Qin for entering condition = 0dB and set SNR1>Qin****(b) Extend T3 by the additional delay allowed for BFD evaluation** |
| [R4-2203758](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203758.zip) | Apple | **Proposal 1: No RRM requirement for R17 idle mode UE power saving enhancement.** **Proposal 2: No additional accuracy requirement for serving cell quality criterion.** **Proposal 3: No need to define radio link monitoring out-of-sync or in-sync test cased for RLM/BFD measurement relaxation.**  |
| [R4-2203905](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203905.zip) | CATT | **Proposal 1: Design all test cases when both low mobility criterion and good serving cell quality criterion are configured and fulfils. Do not design the test cases for other cases such as low mobility criterion is not configured.** **Proposal 2: The following list of test cases in Table 1 are specified for UE power saving enhancement****Table 1. Test case list for power saving enhancement**

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|  | **No.** | **Test case** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=40ms |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=40ms |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX=40ms |
| 4 | Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX=40ms |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX=40ms |
| 6 | Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX=40ms |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX=40ms |
| 8 | Radio Link Monitoring In-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX=40ms |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in DRX=40ms |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in DRX=40ms |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with SSB-based BFD and LR in DRX=40ms |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX=40ms |

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| [R4-2204534](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204534.zip) | CMCC | ***Proposal 1: at least 8 test cases should be defined for RLM/BFD relaxation requirement, which include**** ***Relaxed RLM Test for FR1/FR2 PCell configured with SSB/CSI-RS-based RLM RS in DRX mode***
* ***Relaxed BFD Test for FR1/FR2 PCell configured with SSB/CSI-RS-based BFD RS in DRX mode***

***Proposal 2: Different DRX period can be configured for FR1 and FR2 test cases.******Proposal 3: The number of time duration depends on exit threshold.*** * ***If exit threshold is Qout+ZdB, then at least 4 time durations should be set up.***
	+ ***For T1, the SINR is higher than Qin; For T2, the SINR is higher than Qout+ZdB and lower than Qin; for T3, the SINR is higher than Qout and lower than Qout+ZdB; For T4, the SINR is lower than Qout.***
* ***If exit threshold is Qout, then at least 3 time durations should be set up.***
	+ ***For T1, the SINR is higher than Qin; For T2, the SINR is higher than Qout and lower than Qin; for T3, the SINR is lower than Qout.***

***Proposal 4: The length of duration of D1 depends on exit threshold**** ***If exit threshold is Qout+ZdB, the current D1 value can be reused.***
* ***If exit threshold is Qout, the D1 value should be relaxed.***
 |

## Open issues summary

## Companies views’ collection for 1st round

### Open issues

#### **Issue 3-1: Performance requirements**

* Proposals
	+ Proposal 1: No RRM requirement for R17 idle mode UE power saving enhancement. (Apple)
	+ Proposal 2: No additional accuracy requirement for serving cell quality criterion. (Apple)
	+ Proposal 3: No need to define radio link monitoring out-of-sync or in-sync test cased for RLM/BFD measurement relaxation. (Apple)
* Recommended WF: Discuss if the above proposals are agreeable?

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| **Company** | **Comments** |
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#### **Issue 3-2: General test configuration**

* Proposals
	+ Proposal 1: Design all test cases when both low mobility criterion and good serving cell quality criterion are configured and fulfils. Do not design the test cases for other cases such as low mobility criterion is not configured. (CATT)
	+ Proposal 2: Introduce the following tests for verifying UE RLM/BFD relaxation behavior (Qualcomm)
* RLM Out-of-sync SSB based non-DRx in FR1 in EN-DC
* BFD CSI-RS based DRx in FR2 in NR-SA
* Recommended WF: Discuss if the above proposals are agreeable?

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| **Company** | **Comments** |
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#### **Issue 3-3: DRX period setting**

* Proposals
	+ Option 1: Different DRX period can be configured for FR1 and FR2 test cases. (CMCC)
	+ Option 2: DRX period are the same for FR1 and FR2 test cases. (CATT)
		- DRX period is 40 ms.
* Recommended WF: Discuss the proposals. Encourage companies provide example DRX values for discussion.

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| **Company** | **Comments** |
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#### **Issue 3-4: Test case list**

* Proposals

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| --- | --- | --- | --- | --- |
|  | **No.** | **Test case** | **Needed** | **Not Needed** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms |  |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms |  |  |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms |  |  |
| 4 | Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms |  |  |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms |  |  |
| 6 | Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms |  |  |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms |  |  |
| 8 | Radio Link Monitoring In-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms |  |  |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in DRX= TBDms |  |  |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms |  |  |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with SSB-based BFD and LR in DRX= TBDms |  |  |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms |  |  |

* Recommended WF: DRX cycle length can be discussed later. Please comment if those test cases is “Needed” or “Not needed” in the above table. CR spilt would be discussed in the 2nd round if the tests are stable.

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| **Company** | **Comments** |
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#### **Issue 3-5: Detailed test configuration**

* Proposals
	+ Proposal 1: reusing the corresponding legacy test with the following modifications: (Qualcomm)
1. RLM Out-of-sync SSB based non-DRx in FR1 in EN-DC
	1. Configure offset to Qin for entering condition = 0dB to keep the SINR variation setting in the legacy test
	2. Change D1 as

KSSB, FR1 \* 20 (T\_SSB) \* 2 (P) \* 10 + 20 (T\_SSB) \* 2 (P) = 400 KSSB, FR1 + 40 (ms)

1. BFD CSI-RS based DRx in FR2 in NR-SA
	1. Configure offset to Qin for entering condition = 0dB and set SNR1>Qin
	2. Extend T3 by the additional delay allowed for BFD evaluation
	* Proposal 2: The number of time duration depends on exit threshold. (CMCC)
		+ If exit threshold is Qout+ZdB, then at least 4 time durations should be set up.
			- For T1, the SINR is higher than Qin; For T2, the SINR is higher than Qout+ZdB and lower than Qin; for T3, the SINR is higher than Qout and lower than Qout+ZdB; For T4, the SINR is lower than Qout.
		+ If exit threshold is Qout, then at least 3 time durations should be set up.
			- For T1, the SINR is higher than Qin; For T2, the SINR is higher than Qout and lower than Qin; for T3, the SINR is lower than Qout.
	* Proposal 3: The length of duration of D1 depends on exit threshold (CMCC)
		+ If exit threshold is Qout+ZdB, the current D1 value can be reused.
		+ If exit threshold is Qout, the D1 value should be relaxed.
* Recommended WF: Discuss if the above proposals are agreeable?

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| **Company** | **Comments** |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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| **Title** | **Source** | **Comments** |
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**Existing tdocs**

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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

**New tdocs**

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**Existing tdocs**

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| **New****Tdoc number** | **Title** | **Source** | **Recommendation** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

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| --- | --- | --- |
| **Company** | **Name** | **Email address** |
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Note:

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