**3GPP TSG-RAN WG4 Meeting # 102-e R4-2207063**

**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

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

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

***Option 1a (Moderator)***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***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 relaxation*** | ***For the UE capable of SSB-based RLM, and/or CSI-RS based RLM, the feature indicates the support of corresponding RLM relaxation measurement.*** | ***1-3 SS block based RLM and/or***  ***1-7 CSI-RS based RLM and/or*** | ***Yes*** | ***No*** |  | ***Per UE*** | ***No*** | ***Yes*** | ***N/A*** | ***The feature group can be supported by UE if any prerequisite feature group is supported by UE.*** | ***Optional with capability signaling*** |
| ***NR\_UE\_pow\_sav\_enh*** | ***TBD*** | ***Support of BFD relaxation*** | ***For the UE capable of SSB-based BFD, and/or CSI-RS based BFD, the feature indicates the support of corresponding BFD relaxation measurement.*** | ***2-31 Beam failure recovery*** | ***Yes*** | ***No*** |  | ***Per UE*** | ***No*** | ***Yes*** | ***N/A*** |  | ***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.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Option 1 is agreeable. |
| **vivo** | **OK to the proposal** |
| CMCC | We support the table in Option 1. |
| Moderator | o In this RAN2#117-e meeting (Feb., 2022), RAN2 agreed the following for the UE capability  • Introduce 2 separate capability bits for RLM relaxation feature and for BFD relaxation feature  • The capability bit(s) for RLM and BFD relaxation shall be per UE with FR differentiation  Thus, the option 1 is suggested to be updated as Option 1a, to update with RAN2 agreement accordingly, please check if any questions on Option 1a. |
| Intel | Fine with option 1a. |
| Nokia | Fine with Option 1a.  On Prerequisite feature groups for “Support of BFD relaxation”, should SSB-based BFD and/or CSI-RS based BFD also be listed as they are present in the definition of the feature? |
| Moderator | @Nokia, according to 38.822, 2-31 covers both SSB-BFD and CSI-RS BFD. Thus 2-31 is sufficient. |
| Vivo2 | Fine with option 1a |

## 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.*

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

*Summary of the status:*

* Proposals
  + Option 1: (MTK, vivo, CMCC)
  + Option 1a: further update based on Option 1 and RAN2 agreement. (Moderator, Intel, Nokia, MTK, vivo)

*Recommendations for 2nd round:*

* If no further comment on Option 1a, it will be brought to feature list discussion in main section by 25th Feb.

## 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”.*

No open issue

# 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

|  |  |  |
| --- | --- | --- |
| **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. |
| [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. |
| [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 signalling  Propoal 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 threshold  Proposal 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* |
| [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:*   |  | | --- | | 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:*   |  | | --- | | 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.* |
| [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. |
| [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

|  |  |  |
| --- | --- | --- |
| **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 |
| [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; |
| [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 |
| [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:*   |  | | --- | | 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:*   |  | | --- | | 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. | |
| [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** |
| **MTK** | Agree with both case 1 and case 2. For case 3, our understanding is that it is not aligned with the previous agreement “*The RLM/BFD relaxation is enabled by explicit signaling.*” |
| QC | We agree with moderator’s comment on case 4, no need to discuss. Case 3 contradicts to RAN2 conclusion. Agree with case 1 and 2. |
| **vivo** | **Agree with recommended WF on Case 1 and Case 2.**  **For Case 3, we do not understand what is the motivation for saying ‘irrespective of the explicit signalling’ here. In our understanding, it is clear from WF in 101-be meeting:** **Issue 1-2-1&Issue 1-2-2: Enable the RLM/BFD relaxation feature**  * RLM/BFD relaxation is enabled by explicit signaling.   **Therefore, RAN4 has only agreed to introduce signaling for the corresponding feature. Whether to further introduce signaling for entering relaxation mode without checking criteria can be discussed in issue 2-1-3.**  **If the signaling in case 3 refers to the signaling for entering relxation, we do not think case 3 needs to be discussed before we can conclude 2-1-3.**  **If the signaling in case 3 refers to the signaling for enabling the feature, we think Case 3 is not needed since UE would not need to check the criteria if the feature is not enabled.**  **For Case 4, we agree with Qualcomm. It is already agreed in RAN4 #98b meetings that**  **Issue 2-3-1: Criteria of RLM/BFD relaxation – General**  **whether relaxed RLM/BFD requirements can be applied depends on both the serving cell quality and UE mobility state**  **That means the case UE only in low mobility state or only in good cell quality state is already precluded from entering condition of relaxation mode in R17. Therefore, we do not want to revert the agreements. It is not allowed in R17 that UE does NOT check cell quality state before entering relaxation.** |
| **Apple** | **Agree with case 1 and 2.**  **For Case 3, is the proposal related to whether the explicit signaling is mandatory or optional for the network? If the signaling is optional, when not signaled, but mobility criterion is signaled and fulfilled, and serving cell criterion is fulfilled, then UE should be able to relax.** |
| CMCC | We think Option 3 comes from Issue 2-1-3. We prefer not to introduce such explicit relaxation signaling, since good serving cell quality is mandatory to be configured (or predefined). |
| Ericsson | Case 2 is agreeable.  For option 1, we have different understanding. In our understanding, there is no RAN4 agreement that states that the UE can enter relaxation mode only if good serving cell criterion is met. For example, in the LS [R4-2115349] that was sent to RAN2, it is stated as follows:   * “*Whether relaxed RLM/BFD requirements can be applied depends on both the serving cell quality and UE mobility state. (in RAN4 #98e-bis) “*   In RAN4 WF [R4-2105797], following was captured:  *“Issue 2-3-1: Criteria of RLM/BFD relaxation – General*  *whether relaxed RLM/BFD requirements can be applied depends on both the serving cell quality and UE mobility state*   * *FFS the precise and robust metric for serving cell quality and UE mobility state”*   *Therefore we don’t support option 1 since it is not aligned with previous RAN4 agreement. However, we can compromise if it is clarified that the signaling indicates that the low mobility state of the UE. Then it is aligned with previous agreement.*  We don’t support case 3 because in this option the feature is not enabled by the NW. Relaxation can be applied on if NW has enabled the feature. For similar reason case 4 is also invalid. |
| CATT | There are 3 factors: 1) explicit signaling; 2) UE is configured by low speed criterion and fulfills; 3) UE is configured by good serving cell quality criterion and fulfills;  Before this meeting, there is no clear agreement about the priorities of those three factors. For example: explicit signaling is mandatory or optional and on the top of low speed criterion and good serving cell quality criterion.  For Case 1 and Case 2, we want to confirm whether the “enabling” signalling is the same explicit signalling for the feature.  For case 1, we agree it because the explicit signaling can be used by NW to ensure the low speed status.  We think for Case 2, there is no ambiguity. We can support UE can be allowed to relax in Case 2.  For case 3, we think it can be two separate cases in Case 3:  Case 3A: explicit signaling is true + UE is configured by low speed criterion and fulfills + UE is configured by good serving cell quality criterion and fulfills  Case 3B: explicit signaling is false + UE is configured by low speed criterion and fulfills + UE is configured by good serving cell quality criterion and fulfills  Case 3A is the same as case 2 which we agree. But for the second Note under Case 2, it should be removed.  So the question is if explicit signalling is false or if this signalling is not mandatory, but two other criteria are configured and fulfilled, whether UE can be allowed to relax. If companies agree the explicit signalling is mandatory to relax, we are fine to remove Case 3B.  For Case 4: if good serving criterion is not configured, we support not to allow UE to relax. |
| Xiaomi | Agree with Case 1 and Case 2. |
| Huawei | Agree with case 1 and case 2.  For case 3, whether to fulfill the specified low mobility criterion for RLM/BFD relaxation depends on whether the parameters for specified low mobility criterion are configured.  For case 4, if the UE is configured with the “enabling” signaling but not configured with good serving cell criterion, RAN4 has achieved the agreement that the offset for good serving cell criterion is pre-defined as 0dB. |
| Intel | Agree with case 1 and case 2. For Case 3, in last meeting, we already agree to introduce explicit signaling to enable the feature. |
| Nokia | We’d like to first understand what “enabling” signaling mean? Does it indicate the UE shall evaluate both of the relaxation criteria if present? Some clarification is needed.  With Case 1 and Case 2, the good serving cell quality criteria is mandatory condition for relaxation. This now makes it more difficult for UEs to enter relaxation. If this is what UE prefers, we are fine with Case 1 and Case 2.  Case 3, we understood this “explicit signaling” is not “enabling signaling”, but a signaling to push the UE to relaxation immediately. If this is correct understanding, we rather think the explicit signaling should override the evaluation results of the relaxation criteria. This can be discussed in Issue 2-1-3. |
| Moderator | @Nokia, my understanding is the “explicit signaling” is corresponding to the previous agreement “*The RLM/BFD relaxation is enabled by explicit signaling.”*,while we don't have the formal term yet. It is used for enabling/disabling the RLM/BFD relaxation feature, while UE needs to fulfill the criteria to apply the relaxed requirement.  It could be clarified as “ Provided UE is configured the *explicit* signalling and UE has fulfilled….” |

#### **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 directly 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** |
| **MTK** | Disagree with option 1. It is risky to perform RLM/BFD relaxation when criteria are not fulfilled. |
| QC | Option 1 is obscure, if we say that relaxation command can override evaluation results, we don’t believe that UE will slow down the measurement when it knows that SINR is bad or in high mobility. Moreover, even if UE doesn’t slow down the measurement when receiving the indication, its behavior is still spec compliant. Therefore, we don’t think further discussion on this issue is needed. |
| **Vivo** | **Support option 2.**  **We think there are various method for NW forcing UE to exit from relaxation mode, e.g. by disabling the feature.**  **Regarding entering relaxation, we think based on agreements in last meeting, UE would at least ensure the radio link quality to be above Qin before entering relaxation. There is no harm to the NW by checking this if NW would like to enable relaxation. Therefore, we do not think it is needed to further introduce another signaling.** |
| **Apple** | **Option 2.** |
| CMCC | Option 2.  We don’t prefer to introduce such explicit relaxation signaling, since good serving cell quality is mandatory to be configured (or predefined). |
| CATT | It is another case of applicability of the relaxation. We support option 2. |
| Xiaomi | Support Option 2. |
| Huawei | Support option 2.  Whether the UE is allowed to apply relaxed RLM/BFD requirements depends on whether the UE satisfies the applicability conditions for RLM/BFD relaxation. |
| Intel | Support option 2. Explicit signaling is only used to enable the feature. Whether relaxation can apply depends on whether the criteria is satisfied. |
| Nokia | Option 1. we still see some scenarios where the network can command the UE to start or stop relaxation. This may help network to give certain control on the relaxation status.  This may also relate to the discussion in Issue 2-1-4. In some cases e.g. PCell handover, if the network commands the UE to change a cell, the relaxation criterial may still be fulfilled but the UE shall exit from the relaxation. The network explicit signaling can be used to stop the relaxation. |
| Moderator | *@* *Nokia, we have agreed “The RLM/BFD relaxation is enabled by explicit signaling.” in the last meeting. And it mean if the explicit signaling is not configured, this feature is disabled. I.e. it does exist explicit signaling to stop the relaxation.* |

#### **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** |
| **MTK** | Disagree with both options. Clarification is not needed. Too many transient stages exist, it would be hard for RAN4 to list all of them in the spec. |
| **QC** | We are fine with no clarification. Our intention to propose option 2 is not contradicting to RAN2 agreements. |
| **vivo** | **For the PCell handover and/or PSCell change, we think UE needs to exit relaxation since the serving cell has changed. It is worth for such clarification since the NW may also add/release serving cells besides changing serving cells.**  **For rest 3 of above, we also think it is good to keep consistency with RAN2 agreements.** |
| **Apple** | **Agree with MTK’s comments.** |
| **CMCC** | We think UE is not allowed to continue relaxation for both RLM in spCell and BFD in SCell at the next slot after the set of RSs on which UE is required to perform RLM/BFD is changed.  We are also fine with MTK’s suggestion. |
| Ericsson | We disagree with both options. The relaxation feature is enabled by the NW, and the relaxation criteria are configured by the NW. Therefore it should be possible for the NW to move the UE out of relaxation before these actions are performed. No clarification is needed. |
| Huawei | Same view as MTK’s comments. |
| Nokia | We understood there are some cases e.g. PCell handover, PSCell change where the UE needs to exit from the relaxation mode. Either some clarification is needed, or as E/// commented the network need to find ways to move the UE out of relaxation, then an explicit command from network is expected as discussed in Issue 1-2-3. In any case, it would be good to clarify the UE behaviour. |
| vivo2 | Thanks for all the comments. Our motivation is to clarify the required UE behavior when above situations happen. However, as commented by Ericsson, if would also be ensured by NW signaling in some of the cases. If so, we are fine to compromise to not specifying the clarification in the spec. In this case, our understanding is that whether UE is allowed to enter relaxation or not when above operation is done without explicit signaling is not specified, i.e. up to UE implementation. |
| Moderator | *@* *Nokia, we have agreed “The RLM/BFD relaxation is enabled by explicit signaling.” in the last meeting. And it mean if the explicit signaling is not configured, this feature is disabled. I.e. it does exist explicit signaling to stop the relaxation.* |

#### **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** |
| MTK | Our understanding is option 1 is the common understanding and it has no spec impact in RAN4. |
| QC | It’s not obvious to us how this proposal can be reflected in spec and signaling. |
| **Vivo** | **No need to discuss this. We should focus on the spec impacts.** |
| **CMCC** | **We don’t fully understand the Option 1. Do the existing RLM/BFD measurement requirements mean current requirements or relaxed requirements? If it is the previous one, then we don’t agree with Option 1. If it is the latter case, then we think at least relaxed requirements should be specified.** |
| Ericsson | This option does not have any specification impact. |
| CATT | **In general, option 1 is fine. But no spec impact.** |
| Xiaomi | Agree with the proposal, but no spec impact. |
| Huawei | We share the same understanding as option 1. |
| Intel | Fine with option 1. |
| Nokia | Option 1. The intention is exactly to avoid any spec impact. |

### 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*
* The agreement in RAN4 101-e meeting(R4-2202640):
  + *Low mobility criterion is configured on per-UE basis.*

#### **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** |
| MTK | Support option 1. RAN4 has never evaluated the performance of CSI-RS based low mobility criteria, so there is no evaluation result to support the feasibility of CSI-RS based low mobility criteria. |
| QC | Support option 1, do not see benefit from mobility evaluation perspective by replace SSB by CSI-RS |
| **vivo** | **Option 1 is preferred.**  **After double check, we think the measurement restrictions would be quite important for enabling the feature of CSI-RS based L3 measurements. However, that part is missing in R16 specs. Therefore, we think it is not mature to use CSI-RS based L3 measurements to judge the low mobility state.** |
| **Apple** | **Option 1** |
| **CMCC** | **First, we think there is no technical issues if CSI-RS is used for low mobility criteria evaluation. And then, for some UEs which is using CSI-RS for L3-RSRP measurement, reuse CSI-RS L3-RSRP measurement results is beneficial for power saving.**  **For the sake of progress, we can compromise to Option 1.** |
| Ericsson | We also support option 1. At this stage of WI, we don’t see any need to introducing new requirements. |
| CATT | **We think option 2 CSI-RS can be used as well. But since this is the last meeting of core part, we can compromise to option 1 as option 1 can also work.** |
| Xiaomi | Our position is Option 1. |
| Huawei | Support option 1. |
| Intel | We support option 1. |
| Nokia | Option 1. |

#### **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** |
| MTK | Prefer option 1. Option 3 is also acceptable if it is based on SpCell. |
| QC | Question to option 1: Without indication, is the selection of SSB up to UE implementation?  What’s the side condition in option 2b? The legacy side conditions are all below 0dB SINR or very low RSRP, in that case UE fails good serving cell condition already, and the side condition becomes useless. |
| **Vivo** | **Option 1 or option 2a/2b.**  **For option 3, we are wondering how to deal with the case if the source RS of active TCI is not in a QCL-chain that contains SSB. This case is not precluded from RAN4 requirements in our understanding.** |
| **Apple** | **Option 1** |
| **CMCC** | **Option 1 is fine for us** |
| Ericsson | We also support option 1 which is the simplest approach, i.e. to reuse the existing definition of L3 SS-RSRP. |
| CATT | **Option 1.** |
| Xiaomi | Prefer Option 1. |
| Huawei | Support option 1.  For single beam, SS-RSRP is measured over a single SSB index. However, how to derive a cell level quality from multiple beams is left to UE implementation. |
| Intel | Fine with option 1. |
| Nokia | Option 3.  Option 2a/2b, this may introduce additional signaling to configure the specific SSB. Option 3 is more clean approach without any signaling impact.  For Option 1, we had same question with QC. Also @Huawei, we agree there is no problem for single beam. The concern is when multiple beams are configured. If the selection of beams is left for UE implementation, the SS-RSRP may not fulfill the accuracy requirements. So we prefer defining the single SSB clearly to ensure the performance of measured RSRP. |

#### **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** |
| MTK | Support option 2. Same concern as issue 2-2-1, RAN4 has never evaluated the performance, so there is no evaluation result to support the feasibility of option 2. |
| QC | Option 2 |
| **vivo** | **Option 2.**  **For option 1, we think NW may disable the RLM/BFD feature if TCI change due to UE mobility is observed, and no spec impact is needed.** |
| **Apple** | **Option 2** |
| **CMCC** | **We support Option 2** |
| Ericsson | We support a modified version of option 1: “The UE shall not operate RLM/BFD in relaxed mode if any Rx beam changes have occurred during the last evaluation period. “. |
| CATT | **Support option 2.** |
| Xiaomi | **Support option 2.** |
| Huawei | Support option 2. |
| Intel | Support option 2 |
| Nokia | Option 1, but we can compromise to Ericsson’s proposal (with minor change) to avoid any signaling impact: “The UE shall not operate RLM/BFD in relaxed mode if any TCI state change have occurred during the last evaluation period. “.  Especially in case of BFD, the TCI state change may imply the radio link problem hence the potential BFD. The UE shall be able to exit from relaxation to monitor the radio link more closely. |

#### **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** |
| MTK | Agree this proposal. This clarification is needed. |
| QC | Based on our proposal in 2-2-2, Pcell and PSCell low mobility evaluations are done separately in NR-DC. |
| **Vivo** | **Support the proposal.**  **This is to answer the question from RAN2 LS**   * *Postpone the discussion on how to enable/disable RLM relaxation per-CG, and how to enable/disable BFD relaxation per-serving cell to wait for RAN4 conclusions on the configuration of criteria.* * *Postpone the discussion on how to provide the criteria configuration for RLM relaxation and BFD relaxation for low mobility criterion to wait for progress from RAN4.* * *Postpone the discussion on how to evaluate the low mobility criterion for RLM/BFD relaxation to wait for progress from RAN4.*   **In our understanding, the cell with CSSF always equals to 1 should be prioritized in the low mobility state evaluation. In this case the low mobility can be evaluated with the best accuracy.**  **As we have argued in many meetings, it is not preferred for UE to check low mobility state in each of the serving cell. This is quite complex and not necessary.** |
| **Apple** | **OK with the clarification.** |
| **CMCC** | **we are fine with this clarification.** |
| Ericsson | We disagree to proposal 1. It is obvious that RLM is on sPCell and there is no need to clarify that. Therefore we don’t see any need to agree on proposal 1. We don’t support the proposal for relaxed BFD since BFD can also be performed on the SCell. Therefore UE needs to evaluate the relaxation criteria on each serving cell. |
| Xiaomi | Fine with the clarification. |
| Huawei | It depends on how to configure the low mobility criterion. |
| Nokia | We agree with Ericsson and Huawei. It is understood the low mobility criteria is evaluated on the cells where RLM-RS/BFD-RS is present. We may need discuss if low mobility criteria is configured per cell, per-CG before reaching any conclusion. |
| Moderator | Please discuss based on the current agreement, the *Low mobility criterion is configured on per-UE basis.* |
| vivo2 | To Ericsson and Nokia, the low mobility state should be describing the low mobility state of the UE, but not the radio link quality or other for as specific link between one gNB and a UE. It is wasting power if UE would need to evaluate low mobility state on more than one serving cell.  Moreover, there is no limitation on the number of SCells, and the L3 evaluation period will be enlarged by the number of SCell configured with BFD relaxation. Do you think it is good for the low mobility evaluation? |
| Moderator | The current status is summarized below:  *Background:*  The agreement in RAN4 101-e meeting (R4-2202640):   * + *Low mobility criterion is configured on per-UE basis.*   *Summary of the status:*   * Proposal 1: the low mobility criteria is evaluated on the NR PCell for the case of NR single carrier, NR CA, NE-DC, and evaluated on the NR PSCell for the case of EN-DC. (Vivo, MTK, Apple, CMCC, Xiaomi)   + Proposal 1a: (Vivo, MTK, Apple, CMCC, Xiaomi)     - the low mobility criteria is evaluated on Pcell in NR-DC.   + Proposal 1b: (Qaulcomm)     - the low mobility criteria is evaluated separately on Pcell and PSCell in NR-DC. * Proposal 2: the low mobility criteria is evaluated on the cells where RLM-RS/BFD-RS is present. (Ericsson, Nokia)   *Moderator’s note:*   * *Proposal 1 is split as 1a/1b for NR-DC case. This issue is suggested for GTW because the clarification has impact on RAN2 regarding how to evaluate the low mobility criterion.*   *Recommendations for 2nd round:*   * Suggest agree on Proposal 1a as it is the majority view. |

#### **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** |
| MTK | Prefer option 1. Option 2 is also acceptable. |
| QC | Could moderator explain how does option 2 as baseline reflect in spec? Is L3 filtering configured in idle mode? If it is not configured, connected mode can’t follow idle mode since L3 filtering might be configured. |
| **Vivo** | **Fine to option 2 and the recommended WF.** |
| Moderator | @Qualcomm:  In RAN4 # 100-e meeting agreement (R4-2115348).   * *Reuse Rel-16 low mobility criterion based on L3 RSRP measurement variation.*   In R16, L3 filtering is not configured nor applied, which is aligned with Option 2. But it is good to clarify the understanding with the group |
| Ericsson | We disagree to both options. L3 filtering is typically used in the NW. If L3 measurements are not filtered, then this may cause issues for the exiting procedures and events that are using those L3 measurements (serving cell measurements). Therefore we don’t think anything need to be modified with respect to the legacy requirements on this aspect. |
| CATT | According to our understanding, in R16, it is for Idle mode, no L3 filtering. But for connected mode, all RRM measurement including L3 RSRP are involved L3 filtering. So we prefer to enable L3 filtering for ssb-RSRP |
| Huawei | We support option 1. |
| QC | We suggest to continue the discussion based on the spec impact. For option 1, we expect no specific description/requirement captured related to L3 filtering. R16 spec doesn’t mention L3 filtering.  Could proponent of option 2 explain what’s the spec impact and how to capture option 2 if it is agreed?  Same question for moderator: when you say “Option 2 will be the baseline”, how do we capture it in spec?  If both option 1 and 2 have no spec impact related to L3 filtering, we are fine for both. |
| Intel | Generally fine with option 1 considering that the low mobility criteria has its own evaluation window TSearchDeltaP. |
| Nokia | Option 2.  The reason to remove L3 filtering is that L3 filtering will add additional delay as cited below. This may further impact the evaluation of RSRP variation.  TS 38.133 section 9.2.4:  *The event triggered measurement reporting delay, measured without L3 filtering shall be less than Tidentify intra with index or T identify intra without index defined in clause 9.2.5.1 or clause 9.2.6.2.When L3 filtering is used an additional delay can be expected.*  And according to RAN2 spec, L3 filtering is always applied in connected mode “2> if in RRC\_CONNECTED, apply layer 3 cell filtering as described in 5.5.3.2; |

### 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. |
| [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** |
| MTK | Agree with option 1. |
| QC | Option 1 |
| **vivo** | **Agree with option 1.**  **For option 2, in our understanding, even if BFD relaxation is enabled and explicit threshold for cell quality criterion is not configured, the gap between Qin and Qout\_LR is already enough to avoid ping-pong effect, based on the evaluation results submitted in previous meetings. In case NW observed higher fluctuation of SINR in a cell, higher threshold can be configured and there is no need to define 3Db.** |
| **Apple** | **Agree with option 1** |
| **CMCC** | **Option 1 is ok for us.** |
| Ericsson | We are fine with the recommended WF. |
| CATT | **Support option 1** |
| Xiaomi | Fine with Option 1. |
| Huawei | Agree with option 1. |
| Intel | The issue is related to issue 2-3-3.  If the requirement can be defined separately for BFD and RLM, we are fine that 0Db can be used as pre-defined value.  If the same requirement is defined for both RLM and BFD, offset will be higher than 0Db considering that Qin condition of BFD is higher than RLM. |
| OPPO | Fine with Option 1. |
| Nokia | Option 1. |

#### **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** |
| MTK | Support option 3. Based on our SLS results, the offset value in FR2 should be much higher than that in FR1. [8 12]Db are values for RF2 scenarios. We can also compromise to option 1. |
| QC | Option 1. |
| **Vivo** | **Open to discuss.**  **We think minus value, i.e. -3Db, is needed, e.g. for the case BFD relaxation is not enabled, especially for the case BFD is not configured in a serving cell. In FR2 such scenario is possible.**  **For other values, we think 3Db step would be benefit to cover the potential range than can be considered for relaxation.** |
| **Apple** | **Option 1** |
| **CMCC** | **Option 1 and Option 3 are fine for us, we can go with majority views.** |
| Ericsson | We support the recommended WF, i.e. option 1. |
| CATT | **For option 1 and option 3, no strong view. Do not support option 2 for minus value.** |
| Huawei | Either option 1 or option 3 is acceptable for us. |
| Intel | Fine with option 1. |
| OPPO | Fine with option 1. |
| Nokia | Fine with Option 1. |
| Moderator | The current status is summarized below:  *Summary of the status:*   * + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, Ericsson, MTK, CMCC, CATT, Huawei, Intel, Oppo, Nokia)   + Option 2: [-3, 3, 6, 9] dB. (vivo)     - Not support the negative value: CATT   + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC, CATT, Huawei)   Tentative Agreement   * For RLM, the offset X dB can be configured from a set of [2, 4, 6, 8] dB.   *Recommendations for 2nd round:* to be confirmed in GTW |

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

* Background: 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*
* 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. (Xiaomi, OPPO, CATT)
  + Option 2a: and the predefined offset is > 0 Db (OPPO).
  + Option 2b: the offset should be larger than 5Db. If the offset is not configured, 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 Qin + 0Db threshold (e.g. Qin is about Qout\_LR + 4.5Db) is applicable for most cases.
  + Since it will impact on RAN2 signalling design, on how to configure offsets, this issue will be suggested for GTW.

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| **Company** | **Comments** |
| MTK | Suppotion 1a. |
| QC | Option 1 and 1a. |
| **vivo** | **Support option 1 and 1a.** |
| **Apple** | **Option 1 and 1a** |
| **CMCC** | We are ok with Option 1a. However, we would also like to mention that there are some differences between The PDCCH transmission parameters for beam failure instance and that for RLM in-sync evaluation. For example, Aggregation level and bandwidth.  As the note states, if Qin corresponds to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1. Then the value of Qin for RLM and BFD may be different. |
| Ericsson | Support Option 1. We are fine to use RLM Qin + X.  X=0Db (Option 1a) means the condition to trigger the power save mode for BFD evaluation is same as RLM. However it seems we can configure different X between RLM and BFD like XRLM and XBFD, we are ok to Option 1a. See Issue 2-3-4 also for our preferred X. |
| CATT | We cannot support option 1a.  Qin for RLM is for PDCCH agg level = 4 and 4Db boosting. Qout\_LR is for PDCCH agg level = 8 and 0Db boosting. We don’t agree the relationship should be 4.5Db from the test cases. During the R15 discussion, R4-1805501 (in RAN4#86-bis meeting), it is the simulation results summary. It can be observed from 24PRB for DCI 1\_0. BLER. The gap between 2% for AL4 and 10% for AL8 is around 3~4Db from all companies. And that gap cannot cover SINR accuracy. Then 4Db boosting is introduced for RLM. For option 1a, we think Qin+0Db is about Qout\_LR+ 3Db which cannot cover SINR accuracy. It is not good enough. So Qin with margin such as option 1b or Qout\_LR with margin should be used. A margin should be introduced for Qin or Qout\_LR anyhow. Why just use BFD threshold? From implementation/programming view, it is not straightforward to introduce another RLM threshold to BFD module design. So we prefer to use Qout\_LR + margin to ensure UE is good enough to relax. And margin is larger than SINR accuracy at least. |
| Xiaomi | As mentioned by companies, the PDCCH transmission parameters for RLM in-sync evaluation and BFD are different. We would like to ask for clarification about the reference threshold in Option 1.  The reference threshold refers to the SINR value mapping the BLER=2%(BLERin) of the hypothetical PDCCH parameters for RLM in-sync evaluation, or the SINR value mapping the BLER=2% of the hypothetical PDCCH parameters for BFD beam failure instance? |
| Huawei | Support option 1 and option 1a. |
| Moderator | @ CATT: Thank you for check the R15 simulation results and I agree 4.5 Db is just an example and some extra margin would be needed. In this observation “we think Qin+0Db is about Qout\_LR+ 3Db”, according to the simulation result of delta SINR submitted in RAN4#98-bis-e, although there are few cases beyond 3Db, could these case be handled by configuring a higher offset?  @ Xiaomi: my understanding, as companies clarified, Qin is as for RLM in-synch. There is no Qin\_LR BLER is defined, thus it should be clear. |
| Intel | Fine with option 1. We also want to clarify that even if Qin is used as reference, the PDCCH parameter in Qin for BFD may be same or different from that used for RLM. For example, Aggregation level can change for BFD.  If the same PDCCH parameter of Qin is used, the predefine value will be larger than 0Db for BFD.  If the PDCCH parameter of Qin is different, it’s possible that the predefine value can be 0Db. |
| OPPO | We are confused why Qout\_LR BLER cannot be used as the reference threshold since we have the same understanding that the Qin + 0Db threshold (e.g. Qin is about Qout\_LR + 4.5Db) is applicable for most cases. It seems strange that Qin for RLF used for BFD, as the PDCCH parameters of them may be quite different. Whatever, there will exist impact on RAN2 signalling design.  Thus, we prefer option 2 and Qout\_LR + offset could be more straightforward. However, considering this is the last meeting, we can also compromise to the majority view. |
| Nokia | Agree with the recommended WF. |
| Moderator | @ Intel/CMCC, I understand the idea is to use the Qin (defined for RLM) to standard for certain cell quality and ensure the signal quality is sufficiently higher than Qou\_LR to cover the variations due to relaxation around 3 Db, according to the simulation results.  For Qin, the PDCCH parameter shall follow RLM Qin’s parameter, since there is no Qin parameters for BFD. Agree the Qout\_LR PDCCH parameters are different from Qin’s, thus when it applies the Qout\_LR PDCCH parameter at the signal quality of Qin it will get BLER < 2%, so the predefined value = 0Db should be fine. Besides, we have configurable method to protect it if higher threshold is needed.  @ OPPO, agree using Qin (defined for RLM) as the signal quality for BFD to ensure the SINR margin apart from Qout\_LR is a bit confusion, but the majority seems fine with it and we can work on the clear wording to avoid the confusion. Thank you for the willing to compromise to the majority view.  The current status is summarized below:  *Summary of the status:*   * Option 1: Qx = Qin is used as the reference threshold. (Qualcomm, Apple, Intel, Ericsson, vivo, CMCC, Nokia, Huawei)   + Option 1a: and the predefined offset is 0 Db. (MTK, Qualcomm, vivo, Apple, CMCC, Nokia)     - Ericsson can comprise to Option 1a if the offset X can be configured from [3,6,9,12] Db   + Note: Qin corresponds to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1. * Option 2: Qx = Qout\_LR. (CATT, Oppo, [Xiaomi])   + Option 2b: the offset should be larger than 5Db. If the offset is not configured, the predefined offset is 5 Db (CATT).   *Moderator’s note:*   * *Option 1/1a got majority support, while some companies think Option 2 is more straightforward for BFD to avoid confusion. Hope the above clarification make it clearer.*   *Recommendations for 2nd round:* to be discussed in GTW. Suggested WF:   * For BFD, confirm Qx = Qin and the predefined offset value X is 0 dB*.* |

#### **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** |
| MTK | Support option 3. We have concern on option 4. Based on our SLS results, there is no big difference of SINR variation between RLM and BFD, so the lowest offset value in option 4 might be too high. We can also compromise to option 1. |
| QC | Option 1 |
| **vivo** | **Support option 2. Open to discuss.**  **In our view, it would be better if we can agree on Qx before we discuss the threshold configuration** |
| **Apple** | **Option 1. Same as RLM** |
| **CMCC** | **Either Option 1 or Option 3 is fine for us, we can go with the majority view between Option 1 and Option 3.** |
| Ericsson | We propose to discuss issues 2-3-2, 2-3-3, 2-3-4 as a package. This is our compromised proposal  For RLM: Qin + XRLM, XRLM = {0 (default)}, 2, 4, 6, 8}  For BFD: Qin + XBFD, XBFD = {0 (default)}, 3, 6, 9, 12} |
| CATT | **Depends on the outcome of Issue 2-3-3.** |
| Huawei | Same as RLM |
| Intel | Depends on issue 2-3-3. |
| Nokia | Option 1, and also fine with E///’s compromised proposal. |
| Moderator | The current status is summarized below:  *Summary of the status:*  *Summary of the status:*   * + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, MTK, Huawei, CMCC)   + Option 2: [-3, 3, 6, 9] dB. (vivo)   + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC)   + Option 4: [7,9,11,12] dB for BFD (Ericsson)   + Option 4a: [3,6,9,12] dB for BFD (Ericsson, Nokia)   *Moderator’s note:*   * *Option 1 is the majority view. Option 4a is the compromise suggested from Ericsson to set higher threshold for BFD. Option 4a covers the lowest value close to Option 1 and the highest value as Option 3 and 4.*   *Recommendations for 2nd round:* Suggest to consider Option 4a as a compromise.  Suggested WF:   * For BFD, the offset X dB can be configured from a set of [3, 6, 9, 12] dB. |

#### **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. |

* + In this RAN2#117-e meeting (Feb., 2022), RAN2 agreed the following for the UE capability

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| * **Introduce 2 separate capability bits for RLM relaxation feature and for BFD relaxation feature** * **The capability bit(s) for RLM and BFD relaxation shall be per UE with FR differentiation** |

* Proposals
  + Option 1: Offset for RLM/BFD relaxation is configured either per serving cell or per-CG. (Intel, MTK, vivo)
    - Option 1a: (Intel, MTK)
      * Offset for RLM relaxation is configured per serving cell and offset for BFD is configured per-CG.
    - Option 1b: (vivo)
      * If the offset X is shared for both RLM and BFD, the offset configuration is on a per-serving cell basis, because BFD is configured on a per-serving cell basis.
      * 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.
  + 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: The offset X for the cell quality criteria is per UE with FR differentiation (Moderator)
* Recommended WF: Moderator’s understanding on the Option 1a is that the offset configuration type will follow the configuration type of the enabling signalling agreed in RAN2. Since it will impact on RAN2 signalling design, this issue will be suggested for GTW. Companies please provide views on these questions:
  + Q1: Regarding the offset for the cell quality criteria, which option can be supported? Or any middle ground can be considered.
  + Q2: whether the offset is configured separately for RLM and BFD or not?
    - Option 1: the offset are configured separately for RLM and BFD. (….)
    - Option 2: the offset X is shared for both RLM and BFD (Qualcomm)

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| **Company** | **Comments** |
| MTK | Support option 1-a. Our understanding is that offset values can be separately configured for RLM and BFD, because it will be more aligned with current RAN2 design that the explicit ignaling to enable the RLM and BFD relaxation will be separately configured. |
| QC | Option 2 and 2a are both good for us. Since applying relaxation on only one from RLM and BFD can’t bring power saving gain, using the same offset to align entering condition is beneficial from implementation perspective.  Our understanding is that the enabling signal is different than criterion configuration, and threshold configuration depends on whether different thresholds are needed, not following enabling signal. |
| **Vivo** | **Option 1 and 1b. 1a is also acceptable if RAN4 agrees that X is not shared for RLM and BFD.**  **We are also fine to further discuss in RAN2. However, even for option 2 we do not think UE will only evaluate cell quality criteria on a per-UE basis. At least we think how to evaluate the criteria would be agreeable for cell quality criteria. We also think RAN2 need this information, as the following question is asked in the LS.**   * *Postpone the discussion on how to enable/disable RLM relaxation per-CG, and how to enable/disable BFD relaxation per-serving cell to wait for RAN4 conclusions on the configuration of criteria.* * *Postpone the discussion on how to provide the criteria configuration for RLM relaxation and BFD relaxation for serving cell quality criterion to wait for progress from RAN4.*   *Postpone the discussion on how to evaluate the serving cell quality criterion for RLM/BFD relaxation to wait for progress from RAN4.* |
| **Apple** | **Option 2.** |
| Moderator | This issue has impact on RAN2 signaling design, so this issue will be suggested for GTW. And we need to also discuss whether the offset is configured separately for RLM and BFD or not. Please provide views on Q1 and Q2. |
| **CMCC** | **We prefer Option 2 per-UE basis.**  **Per-UE basis offset configuration is not conflict with per serving cell/per CG RLM/BFD relaxation enabling/disabling**  For the Q2  We slightly prefer Option 1 |
| Ericsson | We support option 2. Given that RLM/BFD relaxation are performed in CONNECTED mode, having the criteria configured per UE is preferred as NW can adapt those based on individual UE conditions. |
| MTK | For Q1: (reply to QC)  Based on previous evaluation results, the appropriate entering condition (SINR threshold) in FR1 is much lower than that in FR2. If RAN4 agree on “configuration type of offset is per-UE basis,” it means that Network can only configure 1 offset value for all cells. To ensure this offset value is high enough on FR2 cell, Network might always choose a very high offset value, then it will also limit the relaxation on the FR1 cell and make the overall relaxation conditions very hard to be fulfilled. It seems to us that it is kind of violate the RAN2 design that relaxation of RLM/BFD need to be considered per serving cell. As a compromise, we would like to suggest that the offset value X can be configured per FR, as shown below  Option 3: The offset X for the cell quality criteria is configured separately for FR1 and FR2.  At least this per-FR basis configuration can solve the mismatch issue between FR1 and FR2 cells.  For Q2:  We support option 1. This option can provide more Network implementation flexibility. Based on previous evaluation results, the appropriate entering conditions (SINR thresholds) for RLM/BFD relaxation are not the same. |
| Xiaomi | For Q1: For the offset configuration, we prefer per-UE basis  For Q2: Support Option 1. |
| Huawei | For Q2, according to RAN2’s agreement that criteria configuration for RLM relaxation and BFD relaxation are configured separately, the offset can be configured separately for RLM and BFD. |
| Moderator | Update RAN2 progress and add the corresponding “Option 3 per UE with FR differentiation” |
| Intel | Q1:  From the agreement in RAN4 101, RAN4 agree to define different threshold for each serving cell. Therefore, we prefer that the threshold will be configured per serving cell.   |  | | --- | | **Issue 6-2: Relaxation criteria in NR-DC and inter-band CA** Agreement  *For the case of NR-DC and inter-band CA, UE can make the relaxation decisions separately for each serving cell configured for either RLM and/or BFD evaluation.* |   For Option 3, per UE with FR differentiation, we are also fine with that.  Q2: Whether the offset is configured separately for RLM and BFD or not?  We prefer that the offset is the same for RLM and BFD. |
| OPPO | For Q1: We prefer per-UE basis  For Q2: Whether the offset is configured separately for RLM and BFD or not can be further discussed. If Qin was used as threshold for both RLM and BFD, we see no problem to use the same offsets for both RLM and BFD as well. |
| Nokia | Q1: Option 2.  Q2: Option 1. |
| Moderator | The current status is summarized below:  *Summary of the status:*   * Q1: Regarding the offset for the cell quality criteria, which option can be supported? Or any middle ground can be considered.   + Option 1: Offset for RLM/BFD relaxation is configured either per serving cell or per-CG. (Intel, MTK, vivo)   + Option 2: per-UE basis. (Qualcomm, Apple, CMCC, Ericsson, Xiaomi, Oppo, Nokia)     - Option 2a: per-UE basis, and the offset is shared for both RLM and BFD. (Qualcomm)   + Option 3: The offset X for the cell quality criteria is per UE with FR differentiation (Moderator, Intel) * Q2: whether the offset is configured separately for RLM and BFD or not?   + Option 1: the offset are configured separately for RLM and BFD. (Huawei, MTK, Nokia, Ericsson)   + Option 2: the offset X is shared for both RLM and BFD (Qualcomm, Intel)   *Moderator’s note:*   * *Option 2 is the majority view. Option 3 is suggested as a compromise between Option 1 and Option 2, and to address the concern on the threshold for FR1 and FR2 could be very different. Question 2 is related to issue 2-3-3/4/5, i.e. if different configurable offset for RLM/BFD are agreed, then Option 1 (separate configured) is needed.*   *Recommendations for 2nd round:*  Suggested WF:   * The offset X dB can be configured separately for RLM and BFD, if different configurable offset for RLM/BFD are agreed. * The offset X dB for the cell quality criteria is per UE with FR differentiation. |
| vivo | For Q1, we still support option 1. But we can compromise to option 3.  Same view as MTK. It is important to have FR1/FR2 differentiation, according the evaluation results submitted in previous meetings.  For Q2, we support option 2 but can compromise to option 1.  Moreover, we think it is important to answer RAN2’s question on how to evaluate the cell quality criterion. We have provided our proposal in the previous post. It is copied below again.  **At least we think how to evaluate the criteria would be agreeable for cell quality criteria, i.e. on a per-CC basis. We also think RAN2 need this information, as the following question is asked in the LS.**   * *Postpone the discussion on how to enable/disable RLM relaxation per-CG, and how to enable/disable BFD relaxation per-serving cell to wait for RAN4 conclusions on the configuration of criteria.* * *Postpone the discussion on how to provide the criteria configuration for RLM relaxation and BFD relaxation for serving cell quality criterion to wait for progress from RAN4.* * *Postpone the discussion on how to evaluate the serving cell quality criterion for RLM/BFD relaxation to wait for progress from RAN4.* |
| Moderator | @vivo, On the good serving cell quality criterion evaluation, we already sent RAN2 LS in RAN4 meeting#101-e, as   * *Reuse the existing method to evaluate “downlink radio link quality” for RLM/BFD*   + *hypothetical BLER with corresponding PDCCH parameters is used to evaluate good serving cell quality criterion* * *The good serving cell quality criteria for RLM is based on an offset X dB and Qx, while Qx is derived from PDCCH transmission parameters.*   My understanding is the evaluation is clearly per cell as the legacy. And also, it should be clear in the agreement in RAN4#101-e   * For the case of NR-DC and inter-band CA, UE can make the relaxation decisions separately for each serving cell configured for either RLM and/or BFD evaluation.   Do you think it is necessary to send another LS to RAN2 for the above requirement? If yes, we can check with companies in the 2nd round for sending LS. Or the previous LS would be sufficient. |

### 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)
  + Option 1a: UE shall exit from the relaxed RLM/BFD measurements at the 1st Qout occurrence, i.e. first L1 detection of Qout. (Nokia)
  + Option 1b: UE shall exit from the relaxed RLM measurements at the 1st Qout occurrence, i.e. first o-o-s indication from lower layers, and shall exit from the relaxed BFD measurements at the 1st beam failure occurrence, i.e. first beam failure indication from lower layers. (vivo)
  + Option 2: Set exit threshold as entering threshold with a hysteresis value. (CMCC)
    - *SINRexit =* entering threshold – hysteresis of Z dB
  + Option 3: Set the same exit criteria for both RLM and BFD, and Qout\_LR is used as the exist threshold.(Intel)
* *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 + 5 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** |
| MTK | Support recommended WF. |
| QC | Support recommended WF |
| **vivo** | **We are fine to work from the recommended WF, but we think it is a bit unclear on how may OOS or beam failure is used. As we proposed, we think the 1st OOS should be used as fallback condition for UE with only RLM relaxation, or 1st beam failure indication should be used as that for also BFD relaxation. However, we are also fine to consider the starting T310, i.e. N310 OOS as a compromise for the fall back condition..** |
| **Apple** | **Support the WF** |
| **CMCC** | **Option 2.**  **We would like to clarify the purpose of Option 2. The hysteresis value is used to guarantee that the exit threshold is higher than Qout/Qout\_LR. We think the relaxation should not be happened when Radio link/beam is about to failure.**  **In order to address the ambiguity, may be clarification that** *SINRexit* >**Qout for RLM and** *SINRexit* **>Qout\_LR for BFD can be added.** |
| Ericsson | We don’t support recommended WF and the intention of this recommended WF is not clear to us. As pointed out by the moderator the previous agreements, exiting criteria already covers most of the opitons presented here. See the agreements cited by the moderator from RAN4 98-e-Bis. Why is there a need to discuss those again? |
| Xiaomi | Fine with the recommended WF. |
| Huawei | Generally we can agree with the recommended WF.  When the serving cell quality is worse than Qin but still better than Qout/Qout\_LR, the good cell quality is not satisfied. Then UE is not allowed to apply relaxed RLM/BFD requirements and fall back to legacy RLM/BFD requirements. Based on legacy RLM/BFD measurements, the UE shall further evaluate whether the serving cell quality is worse than Qout/Qout\_LR. |
| Intel | We are fine with the recommended WF. |
| OPPO | Support recommended WF. |
| Nokia | Fine with the recommended WF in principle. Just wonder why the wording says “UE is not allowed to apply the relaxed RLM requirement” instead of “UE is not allowed to relax the RLM measurements”? We think the latter formulation is more clear? |
| Moderator | @Niokia, we can further work on the wording in the CRs. One consideration is that UE still needs to meet certain relaxed requirement even it is allowed to relax the RLM measurement. E.g. The UE is not allowed to relax the RLM measurements and apply the relaxed requirements… , maybe also ok. |

### 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** |
| MTK | Support recommended WF. For FR1, support option 1b. For FR2, support option 2. |
| QC | FR1:  We don’t see why relaxation factor should depend on DRx. Our preference is option 2, but between option 1 abc, we support option 1a. The misalignment should be addressed by scaling the DRx > 80ms cases, otherwise the inconsistency still exists in certain values, e.g., with   * + K1, FR1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms   DRx 80ms: 80\*2\*1.5 = 240ms  DRx 120ms: 120\*1.5 = 180ms  DRx 160ms: 160\*1.5 = 240ms  However, when we replace the 1.5 by 2 for DRx > 80ms, we have  DRx 80ms: 80\*2\*1.5 = 240ms  DRx 120ms: 120\*2 = 240ms  DRx 160ms: 160\*2 = 320ms  Hence we suggest to **allow relaxation for 80ms < DRx <= 320ms via replacing 1.5 by 2**.  FR2:  1.5 relaxation factor is not ideal for UE implementation. Could proponents of option 2, 2a explain why we want to use 1.5 instead of 2? |
| **Vivo** | **We are fine to the recommended WF.** |
| **Apple** | **For FR1, OK with the proposed WF. For FR2, still prefer option 1.** |
| **CMCC** | **Support the recommended WF.** |
| Ericsson | We can compromise to recommended WF. |
| CATT | **For FR1, we support Recommended WF.**  **For FR2, we support option 1 because we don’t understand how 1.5 comes from.**  **e.g. current requirement** Max(200, Ceil(15 × P × N) × Max(TDRX,TSSB))  **15 samples are used. How to relax 1.5 times? How to do the UE implementation for 22.5 samples for each beam?** |
| Xiaomi | Fine with the recommended WF. |
| Huawei | For FR1, we can compromise to option 1b.  For FR2, we support option 1. |
| OPPO | Fine with the recommended WF. |
| Nokia | FR1, fine with the recommended WF  FR2, is there any reason to use K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms? |

#### **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** |
| QC | Agree with moderator, if UE is not allowed to apply the relaxed requirement when UE sends OOS, no need to discuss this issue |
| **vivo** | **Support the recommended WF.** |
| **Apple** | **Support the WF.** |
| **CMCC** | **We still think the legacy framework can work well, no need of further clarification.** |
| Ericsson | No need to discuss it now as it depends on issue 2-4-1. |
| Xiaomi | Support the recommended WF. |
| Huawei | Agree with the recommended WF. |
| Intel | Fine with the recommended WF. |
| OPPO | Support the recommended WF. |
| Nokia | Fine with the recommended WF. |

#### **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** |
| MTK | Our understanding is UE will be not allowed to apply the relaxed requirement when T310/N310/N311 is triggered, so there is no need to configure different values for RLM/BFD relaxation. |
| QC | No additional values are needed. |
| **Vivo** | **As we commended in last meeting, we do no think this is needed. It is up to NW to change N310/N311 if NW can know UE has entered relaxed mode. NW may also configure N310/N311 when NW enables this feature.** |
| **Apple** | **Do not see the need** |
| Huawei | Since the threshold for good cell quality is defined as Qin or higher, the UE shall apply legacy RLM/BFD requirements when UE indicates OOS or BFI.  Hence, there is no need to different values for RLF parameters. |
| Nokia | The intention is to compensate the negative impact i.e. delay due to relaxation. Considering the R17 timeline, we can compromise not to introduce this optimization. |

### 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. (vivo)
  + 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** |
| MTK | Support recommended WF. To capture the relaxation criteria for RLM/BFD relaxation in the RAN2 specifications. |
| QC | Support the recommended WF based on RAN2 LS. |
| **vivo** | **Support option 2/2a/2b. We think the legacy rule should be followed, and criteria should be captured in RAN2.** |
| **CATT** | **The good serving cell quality criterion is more suitable in RAN4 spec because the downlink radio link quality and meaning of threshold is all in RAN4 spec.** |
| **Xiaomi** | Support the recommended WF |
| Huawei | Agree with the recommended WF. |
| Nokia | We also think good serving cell quality criterion needs to be defined in RAN4, as the downlink radio link quality is not visible in RAN2. But we are fine to follow RAN2 decision. |

#### **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** |
| **ZTE** | Support Option 2. The exit condition shall be triggered by any of the threshold, since any monitoring criterion indicates anomaly, and in this case the relaxation mode should be exited. If not, then the power saving gain might be destroyed since the UE may experience RLF or beam failure or any of the failure that require re-establishment. |
| **QC** | Questions to proponents of option 2 for entering condition:  Why UE is allowed to declare IS when \*ANY\* RS satisfies Qin, but to enter power saving mode, \*ALL\* RSs satisfying entering condition is needed? |
| **Vivo** | **We support option 1 for entering and option 3 for exiting.**  **For option 2, we think it is not reasonable to consider all RSs for entering. If at least one of them has large enough gap to the OOS, then there is enough gap to the threshold that should trigger OOS.**  **For exiting, we think if the same logic that UE triggers OOS is re-used, no need to consider this issue. For OOS triggering, all RSs are considered.** |
| **CMCC** | **We support Option 2, which is stricter than Option 1.**  **The relaxation will be applied to every configured RS, it is important to guarantee that the quality of these RSs fulfill the relaxation criteria, or else, the measurement accuracy can’t be guaranteed.**  **In our point of view, declaring IS is not equal to entering power saving mode, they are separate behaviors, which can have different conditions. Power saving is an enhanced feature for UE in good radio link, the entering conditions can be stricter.** |
| Ericsson | We support option 2 for both entering and exiting criteria. The entering criteria should be much stricter then exiting criteria. |
| CATT | **As the same as last meeting, we support option 2 to be stricter than option 1 .** |
| Xiaomi | **We share the view with Vivo, support option 1 for entering and option 3 for exiting.** |
| Huawei | Support option 1 for both entering condition and exiting condition.  The principles used for defining out-of-sync (worse than the threshold for any one RS resource) and in-sync (better than the threshold for any one RS resource) are suggested for good cell quality criterion. |
| Intel | Depends on issue 2-3-1 and 2-3-3. |
| Nokia | We support Option 2 for both enter and exit conditions. |

#### **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** |
| **QC** | **Option 2** |
| **vivo** | **We support option 2.** |
| **Apple** | **Support opion 2** |
| **CMCC** | **Option 2 is slightly preferred** |
| **CATT** | **Option 2.** |
| Huawei | Option 2. |
| Nokia | We wonder if the UE can still benefit from relaxation if it shall still monitor L1-RSRP and CSI reports when configured with WUS. Probably some applicability condition can be defined for simplicity. |

#### **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** |
| **QC** | Overlapping RSs still can happen even when relaxed measurement requirements are applied. We don’t agree with option 1. |
| **Vivo** | **No need for option 1. P factor should be kept so as to simplify UE implementation.** |
| Huawei | We support to keep the same definition of factor P when relaxed RLM/BFD requirements are applied.  RAN4 has agreed that there is no impacts on the existing RRM measurement requirements due to RLM/BFD relaxation. |
| Nokia | Considering R17 timeline, we can compromise not to update P. |

#### **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 does not see 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** |
| MTK | Prefer to follow the previous RAN4 agreement. |
| QC | Agree with moderator. |
| **Vivo** | **We would like to provide some further clarification to the proposal.**  **In RAN4 100e, the key issue that was discussing on this issue is whether RLM in SpCell and BFD in Scell is a valid scenario. No discussion on the details that similar to issue 2-6-2.**  **Therefore, we suggest to check whether discussion on the details are needed. If companies are fine, then we are also fine to confirm this.** |
| Ericsson | We don’t see any need to discuss this issue again and previous agreement shall be maintained. |
| CATT | Support Recommend WF. no need to discuss. |
| Nokia | Support the recommended WF. |

## 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.***

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205661 (MTK, Ericsson) | Moderator: General of RLM, applicability of RLM measurement relaxation (8.1.1.1) |
| Vivo:  1. ‘The UE sends out-of sync indications to the higher layers,’ is not clear enough. It can be further updated or removed based on conclusion of issue 2-4-1 |
|  |
| R4-2205332 (Huawei) | Moderator: SSB RLM (8.1.2.X) |
| vivo: Up to conclusion of 2-5-1. |
| Ericsson: changes (if) compared to endorsed version should be highlighted. |
|  |
| R4-2204338 (vivo) | Moderator: CSI-RS RLM (8.1.3.X) |
| vivo: Up to conclusion of 2-5-1. |
| Ericsson: changes (if) compared to endorsed version should be highlighted. |
|  |
| R4-2204707 (Nokia) | Moderator: Criteria for RLM (8.1.Y1), related to Issue 2-6-1 |
| QC: This is procedure related, should be captured in RAN 1/2 spec as R16 power saving |
| vivo: suggest to not pursue this CR, since criteria as assumed to be captured in RAN2. |
| Ericsson: it depends on the ongoing discussion on the related issue. Also is there any difference compared to the original version which was endorsed? |
|  | To Ericsson: This CR was postponed in last meeting. If this CR is needed depends on the issue 2-6-1. |
| R4-2205636 (Ericsson, MTK) | Moderator: General of BFD, applicability of measurement relaxation (8.5.1.1) |
| QC: 1. This is pending RRM discussion on which criterion to be configured, what indicator to be signaled, and the corresponding relaxation action, suggest to come back after agreements are reached  2. Description should be aligned to R4-2205661 for consistency |
| vivo: suggest to align wording including title with R4-2205661(MTK) |
| R4-2204533 (CMCC) | Moderator: SSB BFD (8.5.2.X) |
| QC: What are the changes w.r.t. the endorsed version? |
| Vivo: Up to conclusion of 2-5-1. |
| CMCC: @QC: We think the changes should be according to the agreements in this meeting, such as Issue 2-5-1 as vivo mentioned, we intend to revisit the CR based on the discussion in the first round. |
| Ericsson: We are fine to revisit the CR based on the outcome of first round discussions. |
| R4-2203904 (CATT) | Moderator: Criteria for BFD (8.5.Y1), related to Issue 2-6-1 |
| QC: Could you specify what has been changed compared to the endorsed version? We can’t review the change without authors marking them. |
| Vivo: suggest to not pursue this CR, since criteria as assumed to be captured in RAN2. |
| Ericsson: changes (if) compared to endorsed version should be highlighted. |
| R4-2205850 (Qualcomm) | Moderator: BigCR title |
|  |
|  |

## 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.*

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

*Summary of the status:*

* + Case 1:
    - Support: MTK, QC, vivo, Apple, Xiaomi, Huawei, CATT, Intel, [Nokia]
    - Not support: Ericsson, but can compromise if it is clarified that the signalling indicates that the low mobility state of the UE.
  + Case 2: not objection
  + Case 3:
    - Not support: MTK, QC. CMCC, Ericsson…
  + Case 4:
    - Not need to discuss: QC, vivo…

*Moderator’s note:*

* *Ericsson provides suggestion on Case1 to clarify that the signalling indicates that the low mobility state of the UE.*

*Recommendations for 2nd round:* The WF is suggested as

UE is allowed to apply the relaxed RLM/BFD requirement,

* provided UE is configured the explicit signalling and UE has fulfilled both good serving cell criterion and low mobility criterion, if low mobility criteria is NOT configured, or
* provided UE is configured the explicit signalling and UE has fulfilled both good serving cell criterion and low mobility criterion if low mobility criteria is configured
* Note: the explicit signalling indicates that the low mobility state of the UE, if low mobility criteria is configured

#### **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**

*Summary of the status:*

* Option 1: Yes (Nokia)
* Option 2: No (MTK, vivo, Apple, CMCC, CATT, Xiaomi, Huawei, Huawei, Intel)

*Moderator’s note:*

* Majority have no interest to introduce the command in R17.

Tentative Agreement

* In R17 UE power saving, not to introduce explicit relaxation command for network to allow UE to apply the relaxed RLM/BFD requirements, irrespective evaluation result of the relaxation criteria

*Moderator’s note:*

* *@* *Nokia, we have agreed “The RLM/BFD relaxation is enabled by explicit signaling.” in the last meeting. And it mean if the explicit signaling is not configured, this feature is disabled. I.e. it does exist explicit signaling to stop the relaxation.*

*Recommendations for 2nd round:* suggest no further discussion

#### **Issue 2-1-4: Relaxaion in transient**

*Summary of the status:*

* Fine with no clarification: MTK, QC, Apple, Ericsson, Huawei, CMCC, Ericsson, Huwaei
* Good to clarify: Nokia, vivo

*Moderator’s note:*

* *@* *Nokia, we have agreed “The RLM/BFD relaxation is enabled by explicit signaling.” in the last meeting. And it mean if the explicit signaling is not configured, this feature is disabled. I.e. it does exist explicit signaling to stop the relaxation.*

*Recommendations for 2nd round:* suggest no further discussion

#### **Issue 2-1-5: UE based relaxation**

*Summary of the status:*

* Companies see no spec impact: MTK, QC, vivo, CMCC, Ericsson, CATT, Xiaomi, Huawei, Intel, Nokia

*Moderator’s note:*

* *Majority see on spec impact.*

*Recommendations for 2nd round:* suggest no further discussion

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

*Summary of the status:*

* Companies are fine with Option 1.

Tentative Agreement

* The existing agreement to use SSB based L3-RSRP measurement of the serving cell to evaluate the low mobility criterion is sufficient

*Recommendations for 2nd round:* suggest no further discussion

#### **Issue 2-2-2: Clarification on the specific SSB to be measured for the low mobility criterion evaluation.**

*Summary of the status:*

* 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
* Support: MTK, vivo, apple, CMCC, Ericsson, CATT, Xiaomi, Huawei, Intel, Qualcomm
* need clarification: Nokia
* 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)

*Moderator’s note:*

* *Majority is fine with Option 1. If no censuses, then no additional clarification will be introduced.*

*Recommendations for 2nd round:* Continue discuss. The WF is suggested as the majority view

* 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.

#### **Issue 2-2-3: Additional Low mobility criteria**

*Summary of the status:*

* Option 1a: The UE shall not operate RLM/BFD in relaxed mode if any Rx beam changes have occurred during the last evaluation period. (Ericson, Nokia)
* Option 2: No additional low mobility criterion is needed besides R16 low mobility criterion. (MTK, QC, vivo, Apple, CMCC, CATT, Xiaomi, Huawei, Intel)

*Moderator’s note:*

* *Majority is fine with Option 2. If no censuses, then no additional rule will be introduced.*

*Recommendations for 2nd round:* Continue discuss. The WF is suggested as the majority view

* In R17 UE power saving, no additional low mobility criterion is needed besides R16 low mobility criterion.

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

*Background:*

The agreement in RAN4 101-e meeting (R4-2202640):

* + *Low mobility criterion is configured on per-UE basis.*

*Summary of the status:*

* Proposal 1: the low mobility criteria is evaluated on the NR PCell for the case of NR single carrier, NR CA, NE-DC, and evaluated on the NR PSCell for the case of EN-DC. (Vivo, MTK, Apple, CMCC, Xiaomi)
  + Proposal 1a: (Vivo, MTK, Apple, CMCC, Xiaomi)
    - the low mobility criteria is evaluated on Pcell in NR-DC.
  + Proposal 1b: (Qaulcomm)
    - the low mobility criteria is evaluated separately on SpCell(s) in NR-DC.
* Proposal 2: the low mobility criteria is evaluated on the cells where RLM-RS/BFD-RS is present. (Ericsson, Nokia)

*Moderator’s note:*

* *Proposal 1 is split as 1a/1b for NR-DC case. This issue is suggested for GTW because the clarification has impact on RAN2 regarding how to evaluate the low mobility criterion.*

*Recommendations for 2nd round:*

* Continue discuss in 2nd round. Suggest agree on Proposal 1a as it is the majority view.

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

*Summary of the status:*

* + Option 1: MTK, QC, Huawei, Intel
  + Option 2: MTK, vivo, Nokia
  + Option 3: shall apply L3 filtering (CATT)
  + No spec impact: Ericsson

*Recommendations for 2nd round:* Discuss if spec impact is expected. To moderator’s understanding, there is no spec impact needed. WF is suggested:

* No RRM requirement impact with respect to the L3 filtering for intra-frequency L3 RSRP measurement of serving cell is used for low mobility criterion.

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

*Summary of the status:*

* + Option 1: no objection

Tentative Agreement

* For RLM, confirm the predefined offset value X is 0 dB

*Recommendations for 2nd round:* no need to discuss

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

*Summary of the status:*

* + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, Ericsson, MTK, CMCC, CATT, Huawei, Intel, Oppo, Nokia)
  + Option 2: [-3, 3, 6, 9] dB. (vivo)
    - Not support the negative value: CATT
  + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC, CATT, Huawei)

Tentative Agreement

* For RLM, the offset X dB can be configured from a set of [2, 4, 6, 8] dB.

*Recommendations for 2nd round:* to be confirmed in GTW

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

*Background:* 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*

*Summary of the status:*

* Option 1: Qx = Qin is used as the reference threshold. (Qualcomm, Apple, Intel, Ericsson, vivo, CMCC, Nokia, Huawei)
  + Option 1a: and the predefined offset is 0 dB. (MTK, Qualcomm, vivo, Apple, CMCC, Nokia)
    - Ericsson can comprise to Option 1a if the offset X can be configured from [3,6,9,12] dB
  + Note: Qin corresponds to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1.
* Option 2: Qx = Qout\_LR. (CATT, Oppo, [Xiaomi])
  + Option 2b: the offset should be larger than 5dB. If the offset is not configured, the predefined offset is 5 dB (CATT).

*Moderator’s note:*

* *Option 1/1a got majority support, while some companies think Option 2 is more straightforward for BFD to avoid confusion. Hope the above clarification make it clearer.*
* *@ CATT: Thank you for check the R15 simulation results and I agree 4.5 dB is just an example and some extra margin would be needed. In this observation “we think Qin+0dB is about Qout\_LR+ 3dB”, according to the simulation result of delta SINR submitted in RAN4#98-bis-e, although there are few cases beyond 3dB, could these case be handled by configuring a higher offset?*
* *@ Xiaomi: my understanding, as companies clarified, Qin is as for RLM in-synch. There is no Qin\_LR BLER is defined, thus it should be clear.*
* *@ Intel/CMCC, I understand the idea is to use the Qin (defined for RLM) to standard for certain cell quality and ensure the signal quality is sufficiently higher than Qou\_LR to cover the variations due to relaxation around 3 dB, according to the simulation results.*
* *For Qin, the PDCCH parameter shall follow RLM Qin’s parameter, since there is no Qin parameters for BFD. Agree the Qout\_LR PDCCH parameters are different from Qin’s, thus when it applies the Qout\_LR PDCCH parameter at the signal quality of Qin it will get BLER < 2%, so the predefined value = 0dB should be fine. Besides, we have configurable method to protect it if higher threshold is needed.*
* *@ OPPO, agree using Qin (defined for RLM) as the signal quality for BFD to ensure the SINR margin apart from Qout\_LR is a bit confusion, but the majority seems fine with it and we can work on the clear wording to avoid the confusion. Thank you for the willing to compromise to the majority view.*

*Recommendations for 2nd round:* to be discussed in GTW. Suggested WF:

* For BFD, confirm Qx = Qin and the predefined offset value X is 0 dB*.*

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

*Summary of the status:*

* + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, MTK, Huawei, CMCC)
  + Option 2: [-3, 3, 6, 9] dB. (vivo)
  + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC)
  + Option 4: [7,9,11,12] dB for BFD (Ericsson)
  + Option 4a: [3,6,9,12] dB for BFD (Ericsson, Nokia)

*Moderator’s note:*

* *Option 1 is the majority view. Option 4a is the compromise suggested from Ericsson to set higher threshold for BFD. Option 4a covers the lowest value close to Option 1 and the highest value as Option 3 and 4.*

*Recommendations for 2nd round:* Suggest to consider Option 4a as a compromise.

Suggested WF:

* For BFD, the offset X dB can be configured from a set of [3, 6, 9, 12] dB.

#### **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.

|  |
| --- |
| * 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. |

* + In this RAN2#117-e meeting (Feb., 2022), RAN2 agreed the following for the UE capability

|  |
| --- |
| * **Introduce 2 separate capability bits for RLM relaxation feature and for BFD relaxation feature** * **The capability bit(s) for RLM and BFD relaxation shall be per UE with FR differentiation** |

*Summary of the status:*

* Q1: Regarding the offset for the cell quality criteria, which option can be supported? Or any middle ground can be considered.
  + Option 1: Offset for RLM/BFD relaxation is configured either per serving cell or per-CG. (Intel, MTK, vivo)
    - Option 1a: (Intel, MTK, [vivo])
      * Offset for RLM relaxation is configured per serving cell and offset for BFD is configured per-CG.
    - Option 1b: (vivo)
      * If the offset X is shared for both RLM and BFD, the offset configuration is on a per-serving cell basis, because BFD is configured on a per-serving cell basis.
      * 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.
  + Option 2: per-UE basis. (Qualcomm, Apple, CMCC, Ericsson, Xiaomi, Oppo, Nokia)
    - Option 2a: per-UE basis, and the offset is shared for both RLM and BFD. (Qualcomm)
  + Option 3: The offset X for the cell quality criteria is per UE with FR differentiation (Moderator, Intel, vivo)
* Q2: whether the offset is configured separately for RLM and BFD or not?
  + Option 1: the offset are configured separately for RLM and BFD. (Huawei, MTK, Nokia, Ericsson, vivo)
  + Option 2: the offset X is shared for both RLM and BFD (Qualcomm, Intel, vivo)

*Moderator’s note:*

* *Option 2 is the majority view. Option 3 is suggested as a compromise between Option 1 and Option 2, and to address the concern on the threshold for FR1 and FR2 could be very different. Question 2 is related to issue 2-3-3/4/5, i.e. if different configurable offset for RLM/BFD are agreed, then Option 1 (separate configured) is needed.*

*Recommendations for 2nd round:*

Suggested WF:

* The offset X dB can be configured separately for RLM and BFD, if different configurable offset for RLM/BFD are agreed.
* The offset X dB for the cell quality criteria is per UE with FR differentiation.

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

*Summary of the status:*

* Suggested WF in 1st round: (MTK, QC, Apple, vivo, Xiaomi, Huawei, Intel, Oppo, Nokia)
  + 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.
* Need more clarification: vivo, CMCC
* No need discussion: Ericsson

*Moderator’s note:*

* *@vivo, the suggested WF should already cover the 1st OOS, where UE does send OOS.*
* *@CMCC, as Huawei clarified, if the serving cell quality is worse than Qin but still better than Qout/Qout\_LR, the good cell quality is not satisfied. Then UE is not allowed to apply relaxed RLM/BFD requirements.*
* *@Ericsson, the intention is to settle the agreeable wording to be captured in the corresponding CR.*

*Recommendations for 2nd round:* Most companies are on the same page, suggest to directly work on the corresponding requirement applicability CR.

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

*Summary of the status:*

* Item 1: The relaxation factor for FR1:
* Option 1b: (CMCC, Nokia, MTK, vivo, Apple, Ericsson, CATT, Xiaomi, Huawei, OPPO)
  + K1, FR1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
  + K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms

*Moderator’s Note: to consider the inconsistency across 80 ms and 160 ms DRX cycles caused by K=4 in FR1.*

* Option 3: (Qualcomm)
  + K1, FR1 = 4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
  + K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms
  + allow relaxation for 80ms < DRx <= 320ms via replacing 1.5 by 2

*Moderator’s Note: to address the inconsistency across 80 ms and 160 ms DRX cycles*

* Item 2: The relaxation factor for FR2 SSB:
* Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms. (Apple, CATT, Huawei, Nokia, Huawei, Qualcomm, Huawei, [Nokia))
* Option 2: (CMCC, Ericsson, MTK, vivo, Xiaomi, OPPO)
  + K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
  + K=2 for MAX(TDRX, TSSB) ≤ 60 ms

*Moderator’s Note:*

* *@Qaulcomm, Option 1b would not perfectly resolve the inconsistency, as indicated. However, relax 80ms < DRx <= 320ms will violate the agreement in RAN4#100-e meeting*
  + **Issue 1-6: When DRX cycles > 80ms**
  + If the UE applies a DRX cycle longer than 80ms, the UE is assumed not to perform relaxed RLM/BFD measurements and the existing RLM/BFD requirements would apply.
* *Thus, for FR1, Option 1b is suggested.*
* *For FR2, it appears companies have more interested on Option 1 and show concerns on Option 2 regarding the implementation difficulty, thus Option 1 is suggested.*

*Recommendations for 2nd round:* WF is suggested as

* 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
* The relaxation factor for FR2 SSB:
  + K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms.

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

*Summary of the status:*

* Companies think this can be covered by Issue 2-4-1.

*Recommendations for 2nd round:* no need to discuss here. Work with Issue 2-4-1.

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

*Summary of the status:*

* Companies see no need to introduce the additional values.

Tentative Agreement

* In R17 UE power saving, different values of the RLF parameters, e.g. T310/N310/N311, for the relaxed operation are not support.

*Recommendations for 2nd round:* suggest no further discussion

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

*Background:* 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:*

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

*Summary of the status:*

* Option 2: MTK, QC, vivo, Xiaomi, Huawei
* CATT suggest to capture the good serving cell quality criterion in RAN4.

*Moderator’s Note:*

* *It is more preferable to avoid contradiction conclusion with RAN2 assumption.*
* *@CATT, regarding the downlink radio link quality and meaning of threshold, it should be ok for RAN2 to cite the corresponding RAN4 spec if needed.*

Tentative Agreement

* Capture the relaxation criteria for RLM/BFD relaxation in the RAN2 specifications

*Recommendations for 2nd round:* suggest no further discussion

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

* 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, 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, Xiaomi)
  + Option 4: pending by other issues (Intel)

*Moderator’s Note:*

* *Companies are not changing the position.*
* *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. If we could not conclude it in this meeting, then it will be postponed to the maintenance phase if this clarification is needed.*

*Recommendations for 2nd round:* continue discuss, compromise proposal is welcome.

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

*Summary of the status:*

* Most companies don’t see the need to discuss.

*Recommendations for 2nd round:* Nokia could further clarify what applicability condition would be needed. If no consensus, thus the applicability condition will not be introduced.

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

*Summary of the status:*

* Most companies don’t see the need to revise the P factor

Tentative Agreement

* Reuse the legacy P factor when relaxed RLM/BFD requirements are applied.

*Recommendations for 2nd round:*

• Comment if still concerning on the Tentative Agreement. The WF will be draft based on the Tentative agreement.

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

*Summary of the status:*

* Most companies don’t see the need to discuss

*Recommendations for 2nd round:* suggest no further discussion

## 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”.*

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

*Moderator’s note:*

* *Majority is fine with both case 1 and case 2. Ericsson provides suggestion on Case1 to clarify that the signaling indicates that the low mobility state of the UE.*

*Recommendations for 2nd round:* The WF is suggested as

UE is allowed to apply the relaxed RLM/BFD requirement,

* provided UE is configured the explicit signalling and UE has fulfilled good serving cell criterion, if the low mobility criteria is NOT configured, or
* provided UE is configured the explicit signalling and UE has fulfilled both good serving cell criterion and low mobility criterion if low mobility criteria is configured
* Note: the explicit signalling indicates that the low mobility state of the UE, if low mobility criteria is NOT configured

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei** | The explicit signaling should be the enabling signaling indicating whether to enable the RLM/BFD relaxation feature, not for the low mobility state of the UE. |
| **Intel** | Similar view as Huawei. Explicit signaling should be whether to enable RLM/BFD relaxation feature. |

#### **Issue 2-2-2: Clarification on the specific SSB to be measured for the low mobility criterion evaluation.**

*Summary of the status:*

* 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
* Support: MTK, vivo, apple, CMCC, Ericsson, CATT, Xiaomi, Huawei, Intel
* need clarification: Qualcomm, Nokia
* 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)

*Moderator’s note:*

* *Majority is fine with Option 1. If no censuses, then no additional clarification will be introduced.*

*Recommendations for 2nd round:* Continue discuss. The WF is suggested as the majority view

* 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.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei** | Agree with the suggested WF. |
| **Intel** | Fine with the suggested WF. |

#### **Issue 2-2-3: Additional Low mobility criteria**

*Summary of the status:*

* Option 1a: The UE shall not operate RLM/BFD in relaxed mode if any Rx beam changes have occurred during the last evaluation period. (Ericson, Nokia)
* Option 2: No additional low mobility criterion is needed besides R16 low mobility criterion. (MTK, QC, vivo, Apple, CMCC, CATT, Xiaomi, Huawei, Intel)

*Moderator’s note:*

* *Majority is fine with Option 2. If no censuses, then no additional rule will be introduced.*

*Recommendations for 2nd round:* Continue discuss. The WF is suggested as the majority view

* In R17 UE power saving, no additional low mobility criterion is needed besides R16 low mobility criterion.

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| **Company** | **Comments** |
| **Huawei** | Agree with the suggested WF. |
| **Intel** | Fine with the suggested WF. |

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

*Background:*

The agreement in RAN4 101-e meeting (R4-2202640):

* + *Low mobility criterion is configured on per-UE basis.*

*Summary of the status:*

* The GTW agreement
  + the low mobility criteria is evaluated on the
    - NR PCell for the case of NR single carrier, NR CA, NE-DC
    - NR PSCell for the case of EN-DC
    - NR PCell for the case of NR-DC
    - FFS how to handle scenarios when BFD is configured in SCell

*Recommendations for 2nd round after GTW:*

* Further discuss on the FFS. By following the discussion in GTW, WF is suggested as below to cover the case that BFD is not in SpCells (s). Please be specific if you have any concern and provide alternative.
* Suggested WF:

when BFD is configured in SCell but not in SpCell(s), the low mobility criteria is evaluated on the SCell.

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| **Company** | **Comments** |
| **Intel** | Fine with the suggested WF. |
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#### **Issue 2-2-5: Clarification on L3 filtering for intra-frequency L3 RSRP measurement of serving cell is used for low mobility criterion**

*Summary of the status:*

* + Option 1: The applicability of L3 filter on low mobility measurement is up to UE implementation. (MTK, QC, Huawei, Intel)
  + 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. (MTK, vivo, Nokia)
  + Option 3: shall apply L3 filtering (CATT)
  + No spec impact: Ericsson

*Recommendations for 2nd round:* Discuss if spec impact is expected. To moderator’s understanding, there is no spec impact needed. WF is suggested. Please be specific if you have any concern and provide alternative.

* Suggested WF:
  + No RRM requirement impact with respect to the L3 filtering for intra-frequency L3 RSRP measurement of serving cell is used for low mobility criterion.

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| **Company** | **Comments** |
| **Huawei** | Agree with the suggested WF. |
| **Intel** | Fine with the suggested WF. |

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

*Summary of the status:*

* + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, Ericsson, MTK, CMCC, CATT, Huawei, Intel, Oppo, Nokia)
  + Option 2: [-3, 3, 6, 9] dB. (vivo)
    - Not support the negative value: CATT
  + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC, CATT, Huawei)

Tentative Agreement

* For RLM, the offset X dB can be configured from a set of [2, 4, 6, 8] dB.

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| **Company** | **Comments** |
| **Huawei** | Agree with the tentative agreement |
| **Intel** | Fine with the suggested WF. |

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

*Background:* 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*

*Summary of the status:*

* Option 1: Qx = Qin is used as the reference threshold. (Qualcomm, Apple, Intel, Ericsson, vivo, CMCC, Nokia, Huawei)
  + Option 1a: and the predefined offset is 0 dB. (MTK, Qualcomm, vivo, Apple, CMCC, Nokia)
    - Ericsson can comprise to Option 1a if the offset X can be configured from [3,6,9,12] dB
  + Note: Qin corresponds to the in-sync block error rate (BLERin) as defined in Table 8.1.1-1.
* Option 2: Qx = Qout\_LR. (CATT, Oppo, [Xiaomi])
  + Option 2b: the offset should be larger than 5dB. If the offset is not configured, the predefined offset is 5 dB (CATT).

*Moderator’s clarification in the 1st round:*

* *@ CATT: Thank you for check the R15 simulation results and I agree 4.5 dB is just an example and some extra margin would be needed. In this observation “we think Qin+0dB is about Qout\_LR+ 3dB”, according to the simulation result of delta SINR submitted in RAN4#98-bis-e, although there are few cases beyond 3dB, could these case be handled by configuring a higher offset?*
* *@ Xiaomi: my understanding, as companies clarified, Qin is as for RLM in-synch. There is no Qin\_LR BLER is defined, thus it should be clear.*
* *@ Intel/CMCC, I understand the idea is to use the Qin (defined for RLM) to standard for certain cell quality and ensure the signal quality is sufficiently higher than Qou\_LR to cover the variations due to relaxation around 3 dB, according to the simulation results.*
* *For Qin, the PDCCH parameter shall follow RLM Qin’s parameter, since there is no Qin parameters for BFD. Agree the Qout\_LR PDCCH parameters are different from Qin’s, thus when it applies the Qout\_LR PDCCH parameter at the signal quality of Qin it will get BLER < 2%, so the predefined value = 0dB should be fine. Besides, we have configurable method to protect it if higher threshold is needed.*
* *@ OPPO, agree using Qin (defined for RLM) as the signal quality for BFD to ensure the SINR margin apart from Qout\_LR is a bit confusion, but the majority seems fine with it and we can work on the clear wording to avoid the confusion. Thank you for the willing to compromise to the majority view.*

*Moderator’s Note:*

* *Option 1/1a got majority support, while some companies think Option 2 is more straightforward for BFD to avoid confusion. Hope the above clarification make it clearer.*
* *The critical part is the exact SINR level corresponding to Qin/Qou\_LR, and it should provide sufficient margin from Qout\_LR, How to adopt it in the spec is the matter of preference, and the configurable value should be sufficient to cover most cases.*

*Recommendations for 2nd round:* Please note the critical part is the exact SINR level corresponding to Qin/Qou\_LR, and it should provide sufficient margin from Qout\_LR. Please justify based on the previous simulation results, if still strong concerns on the suggested WF.

Suggested WF:

* For BFD, confirm Qx = Qin and the predefined offset value X is 0 dB*.*

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| **Company** | **Comments** |
| **Huawei** | Agree with the suggested WF. |
| **Intel** | To move forward, fine with the suggested WF. |

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

*Summary of the status:*

* + Option 1: [2, 4, 6, 8] dB (Qualcomm, Apple, MTK, Huawei, CMCC)
  + Option 2: [-3, 3, 6, 9] dB. (vivo)
  + Option 3: [2, 4, 8, 12] dB. (MTK, CMCC)
  + Option 4: [7,9,11,12] dB for BFD (Ericsson)
  + Option 4a: [3,6,9,12] dB for BFD (Ericsson, Nokia)

*Moderator’s note:*

* *Option 1 is the majority view. Option 4a is the compromise suggested from Ericsson to set higher threshold for BFD. Option 4a covers the lowest value close to Option 1 and the highest value as Option 3 and 4.*

*Recommendations for 2nd round:* Suggest to consider Option 4a as a compromise.

Suggested WF:

* For BFD, the offset X dB can be configured from a set of [3, 6, 9, 12] dB.

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| **Company** | **Comments** |
| **Huawei** | We suggest that the configurable values of offset X are aligned between RLM and BFD.  So, we prefer option 1. |
| **Intel** | Prefer option 1. |

#### **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. |

* + In this RAN2#117-e meeting (Feb., 2022), RAN2 agreed the following for the UE capability

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| * **Introduce 2 separate capability bits for RLM relaxation feature and for BFD relaxation feature** * **The capability bit(s) for RLM and BFD relaxation shall be per UE with FR differentiation** |

*Summary of the status:*

* GTW Agreement
  + The offset X dB for the cell quality criteria is configured per UE. Separate values can be configured per FR.
  + The offset X dB can be configured separately for RLM and BFD

*Recommendations for 2nd round:* no need to discuss. This issue is close per GTW agreement.

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

*Summary of the status:*

* Item 1: The relaxation factor for FR1:
* Option 1b: (CMCC, Nokia, MTK, vivo, Apple, Ericsson, CATT, Xiaomi, Huawei, OPPO)
  + K1, FR1 = 2 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
  + K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms

*Moderator’s Note: to consider the inconsistency across 80 ms and 160 ms DRX cycles caused by K=4 in FR1.*

* Option 3: (Qualcomm)
  + K1, FR1 = 4 for 40 ms < MAX(TDRX, TRS) ≤ 80 ms
  + K2, FR1 = 4 for MAX(TDRX, TRS) ≤ 40 ms
  + allow relaxation for 80ms < DRx <= 320ms via replacing 1.5 by 2

*Moderator’s Note: to address the inconsistency across 80 ms and 160 ms DRX cycles*

* Item 2: The relaxation factor for FR2 SSB:
* Option 1: K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms. (Apple, CATT, Huawei, Nokia, Huawei, Qualcomm, Huawei, [Nokia))
* Option 2: (CMCC, Ericsson, MTK, vivo, Xiaomi, OPPO)
  + K=1.5 for 60 ms ≤ MAX(TDRX, TSSB) ≤ 80 ms.
  + K=2 for MAX(TDRX, TSSB) ≤ 60 ms

*Moderator’s Note:*

* *@Qaulcomm, Option 1b would not perfectly resolve the inconsistency, as indicated. However, relax 80ms < DRx <= 320ms will violate the agreement in RAN4#100-e meeting*
  + **Issue 1-6: When DRX cycles > 80ms**
  + If the UE applies a DRX cycle longer than 80ms, the UE is assumed not to perform relaxed RLM/BFD measurements and the existing RLM/BFD requirements would apply.
* *Thus, for FR1, Option 1b is suggested.*
* *For FR2, it appears companies have more interested on Option 1 and show concerns on Option 2 regarding the implementation difficulty, thus Option 1 is suggested.*

*Recommendations for 2nd round:* WF is suggested as the reasoning provided above. Please propose alternative and provide justification, if still strong concerns on the suggested WF.

* Suggested WF
* 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
* The relaxation factor for FR2 SSB:
  + K1, FR2, SSB= 2 for MAX(TDRX, TSSB) ≤ 80 ms.

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| **Company** | **Comments** |
| **Huawei** | We can agree with the suggested WF. |
| **Intel** | Fine with the suggested WF. |

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

* 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, 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, Xiaomi)
  + Option 4: pending by other issues (Intel)

*Moderator’s Note:*

* *Companies are not changing the position.*
* *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. If we could not conclude it in this meeting, then it will be postponed to the maintenance phase if this clarification is needed.*

*Recommendations for 2nd round:* continue discuss, compromise proposal is welcome.

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| **Company** | **Comments** |
| **Huawei** | We support option 1 for both entering condition and exiting condition.  Whether to apply relaxed RLM/BFD requirements is from per-cell perspective. |
| **Intel** | For entering condition, Option 1.  For exiting condition, Option 1. |

#### **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, vivo, Apple, CMCC, CATT, Huawei)

*Recommendations for 2nd round:* Nokia could further clarify what applicability condition would be needed. If no consensus, thus the applicability condition will not be introduced.

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| **Company** | **Comments** |
| **Huawei** | Option 2. |
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# 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**   |  |  |  | | --- | --- | --- | |  | **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 | |
| [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** |
| **QC** | Agree with proposal 1 and 2 and IS part. Proposal 3 OOS part should be discussed in 3-2 or 3-4 |
| **vivo** | **We are OK to proposal 1 and 2. For proposal 3, we thin in-sync test is not needed, but out-of-sync and beam failure test cases might be needed.** |
| **Apple** | **Support. For proposal 3, it depends on exit criterion. Proposal assume Qout will be used as exit criterion.** |
| **CMCC** | **We support Proposal 1 and Proposal 2**  **For Proposal 3, we think test cases should be defined for RLM/BFD measurement relaxation. However, no need to differentiate OOS or IS test, or only OOS tests are needed.** |
| **CATT** | **Support option 1 and 2.** |

#### **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** |
| QC | Agree with proposal 1. |
| **Vivo** | **For proposal 1, we think it is slightly early to conclude that low mobility criterion has to be configured. We suggest FFS.**  **For proposal 2, we are OK to the principle, but we think both SSB and CSI-RS based should be tested, and would like to switch EN-DC an NR-SA in the above 2 tests.**   * RLM: Out-of-sync SSB and CSI-RS based non-DRx in FR1 in NR-SA * BFD: SSB and CSI-RS based DRx in FR2 in EN-DC   **We think EN-DC would be the more typical scenario in FR2. We are also OK to FFS this issue.** |
| **Apple** | **Discussion after exit criterion is agreed.**  **If Qout is used as exit criterion, UE will exit relaxation mode.** |
| **CMCC** | **We are ok with proposal 1.**  **Following test cases can be introduced.**   * ***Relaxed RLM Test for FR1 and FR2 PCell configured with SSB and CSI-RS-based RLM RS in DRX mode*** * ***Relaxed BFD Test for FR1 and FR2 PCell configured with SSB and CSI-RS-based BFD RS in DRX mode*** |
| **CATT** | **Support proposal 1.**  **For proposal 2, we don’t think non-DRX should be tested for relaxation.** |

#### **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** |
| QC | Open to discuss both options. |
| **vivo** | **We think 40ms should be tested. Therefore, we support option 2.** |
| **CMCC** | **First, different K may be applied for different DRX period.**  **With this assumption. Option 1 can guarantee test coverage and limit the test numbers.**  **We are also ok with “Different DRX period can be configured for SSB-RS and CSI-RS test cases”**  **The example DRX values can be 40ms and 80ms.** |
| **CATT** | **Option 2 is fine for us, those test cases can be referred to R15 test cases. But we are open to add more cases to increase the test coverage.** |

#### **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 | QC,vivo,  CMCC |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms |  | QC, vivo,  CMCC |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms | Vivo  CMCC | QC |
| 4 | Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms |  | QC, vivo  CMCC |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms | CMCC | QC, vivo |
| 6 | Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms |  | QC, vivo  CMCC |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms | CMCC | QC, vivo |
| 8 | Radio Link Monitoring In-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms |  | QC, vivo  CMCC |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in DRX= TBDms | CMCC | QC, vivo |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | CMCC | QC, vivo |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with SSB-based BFD and LR in DRX= TBDms | Vivo(for EN-DC)  CMCC | QC |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | QC, vivo(for EN-DC)  CMCC |  |

* 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** |
| **CATT** | **We support all test cases here.** |

#### **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?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| QC | We can discuss these proposals after core requirements are finalized. |
| **vivo** | **For proposal 1, same comment as that in issue 3-2.**  **For proposal 2, we are OK to the proposal for the Qout case.**  **For proposal 3, we are OK to the proposal for the Qout case.** |
| **CMCC** | **We think we can come back to this issue after Issue 2-4-1 achieving agreement.** |
| **CATT** | **Can come back later.** |

## 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.*

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

* Proposal 1: No RRM requirement for R17 idle mode UE power saving enhancement. (Apple, QC, vivo, CMCC, CATT)
* Proposal 2: No additional accuracy requirement for serving cell quality criterion. (Apple, QC, vivo, CMCC, CATT)
* Proposal 3a: No need to define radio link monitoring out-of-sync test cases for RLM/BFD measurement relaxation. (Apple)
* Proposal 3b: No need to define radio link monitoring in-sync test cases for RLM/BFD measurement relaxation. (Apple, QC, vivo)

*Summary of the status:*

* No objection on proposal 1, 2, 3b.

*Recommendations for 2nd round:*

• Continue discuss. The WF is suggested

* No RRM requirement for R17 idle mode UE power saving enhancement.
* No additional accuracy requirement for serving cell quality criterion
* No need to define radio link monitoring in-sync test cases for RLM/BFD measurement relaxation

#### **Issue 3-2: General test configuration**

* *Summary of the status:*
  + CATT suggest non-DRX mode is not needed.
* 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, QC)
  + 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
* *Recommendations for 2nd round:*  continue discussion

#### **Issue 3-3: DRX period setting**

*Summary of the status:*

* Proposals
  + Option 1: Different DRX period can be configured for FR1 and FR2 test cases. (CMCC)
    - The example DRX values can be 40ms and 80ms.
  + Option 2: DRX period are the same for FR1 and FR2 test cases. (CATT, vivo, CATT)
    - DRX period is 40 ms.
* *Recommendations for 2nd round:*  continue discussion

#### **Issue 3-4: Test case list**

*Summary of the status:*

* No objection on the following test cases
  + Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms
  + Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms

*Recommendations for 2nd round:*  continue discussion.

* The WF is suggested
  + For NR-SA
    - Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms
    - Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms
  + For EN-DC: FFS
  + Other test cases are not precluded. Please provide views on the test lists below.

*Moderator’s Note:*

* *The test list could be not very stable in this meeting. The CR split will be triggered next meeting.*
* *Suggest at least the following cases for EN-DC*
  + *Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms*
  + *Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with SSB-based BFD and LR in DRX= TBDms*
* *The INS tests depending on Issue 3-1.*
* *The full lists are provided below for discussion. It would be good to equally split the tests into NR-SA and EN-DC. Based on the comments, the suggestion on each tests is provided on the “Agreed” field. Please leave your comment on the “comment” field.*
* For NR-SA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **No.** | **Test case** | **Agreed** | **Note** | **Comment** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms | Yes |  |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms | [No] |  |  |
| 4 | Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms | [No] |  |  |
| 6 | Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms | [YES] |  |  |
| 8 | Radio Link Monitoring In-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [No] |  |  |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with SSB-based BFD and LR in DRX= TBDms | [No] |  |  |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | Yes |  |  |

* For EN-DC

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|  | **No.** | **Test case** | **Agreed** | **Note** | **Comment** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with SSB-based RLM RS in DRX=TBDms | [No] |  |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms | [YES] |  |  |
| 4 | Radio Link Monitoring In-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PSCell configured with SSB-based RLM RS in DRX= TBDms | [YES] |  |  |
| 6 | Radio Link Monitoring In-sync Test for FR2 PSCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PSCell configured with CSI-RS-based RLM in DRX= TBDms | [No] |  |  |
| 8 | Radio Link Monitoring In-sync Test for FR2 PSCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PSCell configured with SSB-based BFD and LR in DRX= TBDms | [No] |  |  |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PSCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with SSB-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [No] |  |  |

#### **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.

*Recommendations for 2nd round:*  continue discussion

## 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”.*

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

* Proposal 1: No RRM requirement for R17 idle mode UE power saving enhancement. (Apple, QC, vivo, CMCC, CATT)
* Proposal 2: No additional accuracy requirement for serving cell quality criterion. (Apple, QC, vivo, CMCC, CATT)
* Proposal 3a: No need to define radio link monitoring out-of-sync test cases for RLM/BFD measurement relaxation. (Apple)
* Proposal 3b: No need to define radio link monitoring in-sync test cases for RLM/BFD measurement relaxation. (Apple, QC, vivo)

*Summary of the status:*

* No objection on proposal 1, 2, 3b.

*Recommendations for 2nd round:*

• Continue discuss. The WF is suggested

* No RRM requirement for R17 idle mode UE power saving enhancement.
* No additional accuracy requirement for serving cell quality criterion
* No need to define radio link monitoring in-sync test cases for RLM/BFD measurement relaxation

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

* *Summary of the status:*
  + CATT suggest non-DRX mode is not needed.
* 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, QC)
  + 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
* *Recommendations for 2nd round:*  continue discussion. Proposal 2 can be discussed in issue 3-4 test case list.

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

*Summary of the status:*

* Proposals
  + Option 1: Different DRX period can be configured for FR1 and FR2 test cases. (CMCC)
    - The example DRX values can be 40ms and 80ms.
  + Option 2: DRX period are the same for FR1 and FR2 test cases. (CATT, vivo)
    - DRX period is 40 ms.
* *Recommendations for 2nd round:*  continue discussion

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

*Summary of the status:*

* No objection on the following test cases
  + Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms
  + Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms

*Moderator’s Note:*

* *The test list could be not very stable in this meeting. The CR split will be triggered next meeting.*
* *Suggest at least the following cases for EN-DC*
  + *Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms*
  + *Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with SSB-based BFD and LR in DRX= TBDms*
* *The INS tests depending on Issue 3-1.*
* *The full lists are provided below for discussion. It would be good to equally split the tests into NR-SA and EN-DC. Based on the comments, the suggestion on each tests is provided on the “Agreed” field. Please leave your comment on the “comment” field.*

*Recommendations for 2nd round:*  continue discussion.

* The WF is suggested
  + For NR-SA
    - Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms
    - Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms
  + For EN-DC: FFS
  + Other test cases are not precluded. Please provide views on the test lists below.
* For NR-SA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **No.** | **Test case** | **Agreed** | **Note** | **Comment** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX=TBDms | Yes |  |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms | [No] |  |  |
| 4 | Radio Link Monitoring In-sync Test for FR1 PCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms | [No] |  |  |
| 6 | Radio Link Monitoring In-sync Test for FR2 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms | [YES] |  |  |
| 8 | Radio Link Monitoring In-sync Test for FR2 PCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with SSB-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [No] |  |  |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with SSB-based BFD and LR in DRX= TBDms | [No] |  |  |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PCell configured with CSI-RS-based BFD and LR in DRX= TBDms | Yes |  |  |

* For EN-DC

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| --- | --- | --- | --- | --- | --- |
|  | **No.** | **Test case** | **Agreed** | **Note** | **Comment** |
| RLM | 1 | Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with SSB-based RLM RS in DRX=TBDms | [No] |  |  |
| 2 | Radio Link Monitoring In-sync Test for FR1 PCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 3 | Radio Link Monitoring Out-of-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms | [YES] |  |  |
| 4 | Radio Link Monitoring In-sync Test for FR1 PSCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 5 | Radio Link Monitoring Out-of-sync Test for FR2 PSCell configured with SSB-based RLM RS in DRX= TBDms | [YES] |  |  |
| 6 | Radio Link Monitoring In-sync Test for FR2 PSCell configured with SSB-based RLM RS in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| 7 | Radio Link Monitoring Out-of-sync Test for FR2 PSCell configured with CSI-RS-based RLM in DRX= TBDms | [No] |  |  |
| 8 | Radio Link Monitoring In-sync Test for FR2 PSCell configured with CSI-RS-based RLM in DRX= TBDms | FFS | Related to Issue 3-1 |  |
| BFD | 1 | Beam Failure Detection and Link Recovery Test for FR1 PSCell configured with SSB-based BFD and LR in DRX= TBDms | [No] |  |  |
| 2 | Beam Failure Detection and Link Recovery Test for FR1 PSCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 3 | Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with SSB-based BFD and LR in DRX= TBDms | [YES] |  |  |
| 4 | Beam Failure Detection and Link Recovery Test for FR2 PSCell configured with CSI-RS-based BFD and LR in DRX= TBDms | [No] |  |  |

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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.

*Recommendations for 2nd round:*  continue discussion.

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| **Company** | **Comments** |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| LS on RLM and BFD relaxation in R17 UE power saving | MediaTek Inc | To: RAN\_2 |
| WF on RLM/BFD relaxation for UE Power Saving enhancements | MediaTek Inc |  |
| Draft CR Minimum requirement for CSI-RS based beam failure detection for UE configured with relaxed measurement criterion | Xiaomi |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| [R4-2205661](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205661.zip) | CR on TS38.133 for applicability of RLM measurement relaxation | MediaTek inc, Ericsson | Revised |  |
| [R4-2205332](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205332.zip) | DraftCR on SSB based relaxed RLM requirements | Huawei, HiSilicon | Revised |  |
| [R4-2204338](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204338.zip) | draft CR on CSI-RS RLM requirements relaxation for R17 UE power saving | vivo | Revised |  |
| [R4-2204707](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204707.zip) | 38.133 draft CR on RLM relaxation criteria | Nokia, Nokia Shanghai Bell | Postponed | Majority suggests to capture the criteria in RAN2 as issue 2-6-1 |
| [R4-2205636](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205636.zip) | Draft CR to TS 38.133: Applicability of relaxed BFD requirements | Ericsson, MediaTek Inc. | Revised |  |
| [R4-2204533](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204533.zip) | Draft CR for TS 38.133 Minimum requirement for SSB based BFD for UE configured with relaxed measurement criterion | CMCC | Revised |  |
| [R4-2203904](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203904.zip) | Draft CR on relaxed measurement criteria for BFD | CATT | Postponed | Majority suggests to capture the criteria in RAN2 as issue 2-6-1 |
| [R4-2205850](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205850.zip) | Clause title change on big CR | Qualcomm communications-France | Return to | No comment received in 1st round. It will be suggested as agreeable if no comment received in the 2nd round. |

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**

|  |  |
| --- | --- |
| **Title** | **Source** |
|  |  |

**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

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