**3GPP TSG-RAN WG4 Meeting # 99-e R4-2108403**

**Electronic Meeting, May. 19-27, 2021.**

**Agenda item:** 9.13

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

**Title:** Email discussion summary for [99-e][231] NR\_UE\_pow\_sav\_enh\_RRM

**Document for:** Information

# Introduction

This document is the email discussion summary for UE Power Saving Enhancements (AI 9.13), including the following topics covered

* Topic 1: General and work plan (AI 9.13.1)
* Topic 2: UE measurements relaxation for RLM and/or BFD (AI 9.13.2)

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 8.9.1)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2111266** | vivo | *Proposal 1 At least the details of low mobility criterion should be further discussed in RAN2. It is better for RAN4 to only agree on some general principles for low mobility criterion.*  *Proposal 2 Send LS to RAN2 to inform RAN2 the overall conclusion on low mobility criterion in this RAN4 #99e meeting, in order to trigger RAN2 discussion.* |

## Open issues summary

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

### Sub-topic 1-1 General

**Issue 1-1: Whether RAN4 or RAN2 to define the low mobility criterion**

* Proposals
  + Option 1: If RAN4 could conclude with reusing the Rel-16 low mobility criteria, an LS shall be sent to RAN2 asking for the feasibility and confirming the RAN4 decision. (**Nokia**)
  + Option 2: (**vivo**)
    - At least the details of low mobility criterion should be further discussed in RAN2. It is better for RAN4 to only agree on some general principles for low mobility criterion.
    - Send LS to RAN2 to inform RAN2 the overall conclusion on low mobility criterion in this RAN4 #99e meeting, in order to trigger RAN2 discussion.
* Recommended WF
  + Companies to discuss the proposal.

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1 General**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | **Issue 1-1: Whether RAN4 or RAN2 to define the low mobility criterion**  For the low mobility criterion, as discussed in our paper, **RAN4 can firstly achieve some general principles on the low mobility criterion**. This is because RAN4 is the leading group of this item in WID, and such discussion has already started. **Based on RAN4 general principles, in the second step, it should be RAN2’s responsibility to further discuss the details of low mobility criterion.** This is because legacy low mobility criterions are all captured in RAN2 spec previously. Generally, it is not an issue of conformance requirements, but more like an issue of mechanism, which is not a typical RAN4 issue. The original plan to directly provide RAN2 with RRC parameters seems may not work well, given that quite many companies still prefer to define a threshold-based mechanism to identify UE mobility. Therefore, adjustment to the work plan is needed in our view.  For other issues, we see the possibility to follow work plan, i.e. send another LS in future meeting with only RRC parameters, since those issues are highly related to the UE behavior that may have conformance requirements, such as cell quality criterion and spec impacts on the requirements.  Note that the number of meeting cycles for further discussion in RAN2 is only 3 to 4, if the LS is sent in this meeting. It can be even less if it is not sent in this meeting.  We also see some other companies also have drafted LS embedded in this meeting. Therefore, we propose to allocate tdoc number for this LS in the 2nd round, so that companies can check whether this LS can be agreeable in this meeting. |
| Nokia | We prefer Option 1. We don’t see the reason why low mobility criterion in idle mode cannot be used for connected mode. At least this could be the starting point of the Rel17 discussion. If RAN2 concludes infeasible, they can suggest other solutions. RAN4 can also discuss other criteria and suggest to RAN2 if there are any agreements. |
| Ericsson | **Issue 1-1: Whether RAN4 or RAN2 to define the low mobility criterion**  As it has been discussed for several meetings, we don’ think the criteria can be identical to Rel-16.  We think the decision can be made in RAN4 since RAN4 has already spent several meetings discussing this issue. In the WF agreed at last meeting [R4-2105797], following agreement was made:   * *“Low mobility criterion for identifying low mobility scenario under which the UE is allowed to apply the RLM/BM requirements is determined and configured to UE by the network, and it is up to the UE whether to apply relaxed RLM/BM requirements when configured.“*   It is already clear from the above agreement that the low mobility criterion is determined by the NW node and configured to the UE. The agreement is contains follows:   * *“Given the this feature is enabled by the network, the low mobility criterion is defined based on*   1. *FFS until RAN4 #99e*      1. *Option A: UE will need to verify whether the low mobility criterion is fulfilled based on the channel condition*         1. *Option A1: RSRP variation (reuse R16 low mobility criterion and procedure)*         2. *Option A2: SINR variation*      2. *Option B: UE will* ***not*** *need to verify whether the low mobility criterion is fulfilled based on the channel condition*         1. *Option B1: UE defines if the low mobility criterion is fulfilled (e.g. fixed UE) or not fulfilled (e.g. vehicular UE).*         2. *Option B2: Network configures whether the low mobility criterion is fulfilled or not*      3. *Option C: The low mobility criterion can be left for RAN2 to decide. Send LS to RAN2 to trigger RAN2 discussion.*      4. *Option D: Other options on how often UE verifies the low mobility criterion is open for discussions at next meeting.”*   Depending on what option is agreed, RAN2 can be informed about RAN4 agreement in a LS. For example, if option B2 is agreed, then RAN4 can send a LS to RAN2 about the agreement and so that siganling support work can be started. |
| CMCC | Issue 1-1-1: We prefer to discuss the low mobility criterion in RAN4, since this objective is led by RAN4. After RAN4 achieving the conclusion, we are OK with send a LS to RAN2 for confirming the RAN4’s decision. |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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: Whether RAN4 or RAN2 to define the low mobility criterion**

|  |
| --- |
| **Status summary** |
| *Tentative agreements: No clear consensus.*  *Candidate options:*  *Recommendations for 2nd round: According to the agreed Work Plan, LS to RAN2 for RAN4’s agreement in the next meeting.*  *Would it be agreeable:*  *“LS to RAN2 for RAN4’s agreement on low mobility criteria in the next meeting”* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### Sub-topic 1-1 General

**Issue 1-1: Whether RAN4 or RAN2 to define the low mobility criterion**

|  |
| --- |
| **Status summary** |
| *Tentative agreements: No clear consensus.*  *Candidate options:*   * Option 1: If RAN4 could conclude with reusing the Rel-16 low mobility criteria, an LS shall be sent to RAN2 asking for the feasibility and confirming the RAN4 decision. (**Nokia**) * Option 2: (**vivo**)   + At least the details of low mobility criterion should be further discussed in RAN2. It is better for RAN4 to only agree on some general principles for low mobility criterion.   + Send LS to RAN2 to inform RAN2 the overall conclusion on low mobility criterion in this RAN4 #99e meeting, in order to trigger RAN2 discussion.   *Recommendations for 2nd round: According to the agreed Work Plan, LS to RAN2 for RAN4’s agreement in the next meeting. Would it be agreeable:*  *Recommended WF: LS to RAN2 for RAN4’s agreement on low mobility criteria in the next meeting* |

|  |  |
| --- | --- |
| Company |  |

# Topic #2: UE measurements relaxation for RLM and/or BFD (AI 8.9.2)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2108764**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2108764.zip) | ZTE Corporation | **Proposal 1: Negative system level impact due to RLM/BFD relaxation should be minimized.**  Proposal 2: The thresholds are configured to the UE by the network.  **Proposal 3: When relaxing, the evaluation period can be scaled with a relaxation factor. Detailed value for different scenarios are FFS.**  **Proposal 4: The network configures whether the low mobility criterion is fulfilled or not.**  **Proposal 5: The UE exits relaxation mode of RLM when any relaxation criterion is not met.**  **Proposal 6: The UE exits relaxation mode of BFD when any relaxation criterion is not met.**  **Proposal 7: The relaxation criteria shall be configured by the network to the UE. If the threshold (criteria) is not configured, it means the UE cannot go into relaxation mode.** |
| [**R4-2109067**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109067.zip) | CATT | **Proposal 1: Both SSB-based and CSI-RS based RLM/BFD measurement in FR1/FR2 are feasible to relax. RAN4 further discuss whether the beneficial scenario is a reasonable case for network configuration.**  **Proposal 2: Relaxation can be applied for short DRX cycles. No need for adjustment to other long DRX cycles. For different DRX cycle and RS periodicity, the maximum relaxation factor can be different.**  **Proposal 3: The radio link quality is based on SINR and it is on UE implementation. One possible way is reusing SINR for RLM/BFD. The thresholds can be configured by networks for RLM and BFD. RAN4 further discuss whether the thresholds can be different from SSB based and CSI-RS based measurement.**  **Proposal 4: Use different relaxation factors between FR1 and FR2 with consideration of N in FR2 and with consideration the simulation results.**  **Proposal 5: For low mobility criteria of RLM/BFD relaxation, we prefer option A and option C.**  **Proposal 6: Revert to normal RLM/BFD operation when the relaxation criterion is not fulfilled. Considering the cell quality can be less than a threshold with margin. The threshold can be configured by network.**  **Proposal 7: The relaxation criteria and related parameters shall be configured by the network to the UE. UE uses these settings to determine whether the relaxation criteria can be fulfilled or not.**  **Proposal 8: For intra-band CA/DC, if UE has fulfilled the criterion for the RLM in relaxed mode in PCell and PSCell, then it is allowed to operate RLM in relaxed mode in all other serving cells.**  **Proposal 9: For intra-band CA/DC, if UE has fulfilled the criterion for the BFD in relaxed mode in PCell and PSCell, then it is allowed to operate BFD in relaxed mode in all other serving cells.**  **Proposal 10: For intra-band CA/DC, if UE meets the conditions of reverting to the normal RLM/BFD in PCell and PSCell, it is expected the reversion operations are applied to other serving cells.** |
| [**R4-2109242**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109242.zip) | Intel Corporation | **Proposal 1: Exit relaxation threshold (Thexit) of RLM will be Qout+X1dB or simpley Qin, which is higher than Qout.**  **Proposal 2: Entering relaxation threshold (Thenter) for RLM will be Qin+X2 dB.**  **Proposal 3: R16 low-mobility relaxation criterion is not suitable to be re-used in Rel-17.**  **Proposal 4: For Rel-17, it’s better to consider the “low variation of SINR”, which is more relevant to RLM/BFD performance. support option A2.**  **Proposal 5: RSRP is also needed to be considered for relaxation criteria of BFD, the entering threshold(Thenter) will be *rsrp-ThresholdSSB* +X3dB, where X3 dB is margin.**  **Proposal 6: For exit relaxation of BFD, we prefer option 2a.** |
| [**R4-2109246**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109246.zip) | Xiaomi | **Proposal 1: SINR threshold value for RLM / BFD relaxation should be derived from the SINR value corresponding to the Qout / Qout\_LR plus a margin X / Y (dB) respectively.**  **Proposal 2: The R16 low mobility criterion for RRM relaxation that based on the variation of RSRP could be reused (Option A1).**  **Proposal 3: RAN4 would further study the feasibility of designing low mobility criteria of RLM/BFD relaxation based on Option B2.**  **Proposal 4: In considering to the full utilization of the existing procedure of RLM/BFD operation, Option 3 is preferable.**  **Proposal 5: The relaxed RLM/BFD evaluation period is to be specified in the way of Option 3.**  **Proposal 6: For good serving cell quality criteria, the margin X and Y could be predefined. For low mobility criteria, the RSRP thresholds could be configurable by the network.**  **Proposal 7: Based on current RAN4 spec, the relaxation scenario for intra-band CA is not feasible.** |
| [**R4-2109364**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109364.zip) | Apple | **Proposal 1: Maximum relaxation factor should be related to DRX cycle and RS periodicity**  **Proposal 2: Extend R16 optional RSRP and RSRQ criterion for serving cell quality evaluation.**  **Proposal 3: Enable optional SINR criterion for serving cell quality evaluation.**  **Proposal 4: The relaxation threshold for optional RSRP, RSRQ and SINR can be configured by RRC signaling.**  **Proposal 5: Reuse R16 low mobility criterion. The threshold is configured by the network**  **Proposal 6: The UE to evaluate and determine whether the serving cell quality and the low mobility criterion are fulfilled or not.**  **Proposal 7: Exit RLM relaxation mode when any relaxation criterion is not met, or when N310 starts to count.**  **Proposal 8: Exit BFD relaxation mode when any relaxation criterion is not met, or upon detecting the 1 beam failure instance.**  **Proposal 9: Reuse definition of evaluation period to capture the scaling factor as Max(T, Ceil([Y] x P x N) x Max(TDRX,TSSB)).** |
| [**R4-2109494**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109494.zip) | CMCC | Proposal 1: UE could use the RLM/BFD-RS being relaxed to do the inter frequency/RAT RRM measurements.  Proposal 2: Focus on DRX<=80ms cases, do not adjust the evaluation times for other DRX cycles.  Proposal 3: UE reuse the SINR for RLM/BFD evaluation when determine whether the serving cell quality criteria is fulfilled or not.  Proposal 4: RSRP is not needed for BFD relaxation criteria.  Proposal 5: Pre-defined a set of discrete threshold values. When network configure the serving cell quality criteria, it chooses a reasonable one from the set.  Proposal 6: The low mobility criterion is based on SINR variation.  • Define an evaluation period, to check the L3 SINR values always higher than the SINR threshold (the threshold used in serving cell quality criteria).  Proposal 7: The RLF exit relaxation mode should at least based on out-of-sync indication. We prefer Option 3a and Option 3d.  Proposal 8: The BFD exit relaxation mode should at least based on beam failure instance indication.  Proposal 9: After UE revering, UE couldn’t go into relaxation mode again during a certain punish period, such as when a new timer is active. UE can decide whether go into relaxation mode by relaxation criteria after the timer expires. The timer is configured by network.  Proposal 10: After UE revering to normal RLM measurement, and UE does not trigger the RLF, UE couldn’t go into relaxation mode again during a certain punish period, the punish period will end when UE report a few consecutive In-sync Indication, the number of In-sync indication can be configured by network.  Proposal 11:  The relaxation criteria and the parameters in the criteria shall be configured by the network to the UE.  • If the threshold (criteria) is not configured, it means the UE cannot go into relaxation mode.  • The parameters can be pre-defined with some values which are obtained by simulation.  Proposal 12: Use implicitly defined relaxation factor (Option 1) as the baseline. Further down-selection the following defining methods:  • Use a fixed relaxation factor in all scenarios. For this way, we should consider worst case.  • Use different relaxation factors in different scenarios. For this way, we should consider typical cases.  Proposal 13: Use explicitly defined relaxation factor (Option 2) as the enhanced method with per-UE relaxation factor configuration.  Proposal 14: Either Option1 and Option3 can be used as long as the total evaluation period after relaxation is aligned with simulation results. |
| [**R4-2109550**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109550.zip) | Nokia, Nokia Shanghai Bell | Observation 1: Based on our simulations, substantial power saving gains can be obtained for Case 1, 2, and 4.  Observation 2: Based on our simulations, the power saving gains may be quite limited for Case 3, especially for no WUS scenarios.  Observation 3: The SSB based delta SINR values are higher than CSI-RS based delta SINR values by about 1 dB and slightly higher in FR1 compared to FR2.  Observation 4: The delta SINR values are generally higher for in-synch compared to out-of-synch.  Observation 5: In case the relaxation is obtained by applying the relaxation factor, K, to the RLM evaluation period, TEvaluate\_out\_ SSB, the maximum additional delay introduced in RLF declaration, which is equal to the additional delay of the 1st OoS evaluation, can be given as function of K and Max(TDRX,TSSB) and is equal to (K-1) x TDRX.  Observation 6: In case relaxation is obtained by reducing the number of measurement samples collected during an evaluation period with equidistant sampling, while the evaluation period is not changed (i.e. not relaxed), there is no additional delay in RLF declaration  Observation 7: In case relaxation is obtained by reducing the number of measurement samples collected during an evaluation period with non-equidistant sampling, while the evaluation period is not changed (i.e. not relaxed), the additional delay depends on where the out-of-sync may be observed and can in worst case be one half of the evaluation period, i.e. TEvaluate\_out\_SSB.  Observation 8: The time the UE spends in outage increases when the relaxation factor for RLM and BFD measurements increases due to the late detection of failure and initiating the recovery procedure. The increase is much more significant if RRM measurements are also relaxed.  Proposal 1: It is up to network to configure the thresholds as well as whether only one criterion is used (either low mobility criterion or good serving cell quality criterion) or both criteria are used separately, or both are to be used in combination e.g. to enter relaxation.  Proposal 2: The principle of Rel-16 low mobility criteria based on SS-RSRP variation can be reused for Rel-17 power saving UEs in connected mode.  Proposal 3: If RAN4 could conclude with reusing the Rel-16 low mobility criteria, an LS shall be sent to RAN2 asking for the feasibility and confirming the RAN4 decision.  Proposal 4: RAN4 additionally to define a low mobility criterion based on the number of serving beam changes over time (e.g. TCI state change).  Proposal 5: Allow specific network signalling configuring the UE when it is allowed to relax the RLM/BFD measurements.  Proposal 6: RAN4 to use SS-SINR as one possible threshold and, in addition to SS-SINR, RAN4 to define SS-RSRP and SS-RSRQ as configurable good serving cell quality criteria.  Proposal 7: Any threshold related to UE power saving in connected mode are network configurable.  Proposal 8: UE shall revert to non-relaxed RLM/BFD measurement and evaluation period at the 1st Qout based on relaxed RLM/BFD measurements and evaluation period.  Proposal 9: The evaluation period, Tevaluate\_out\_xxx is unchanged when UE is allowed to relax RLM/BFD measurements. The UE is allowed to perform less RLM/BFD measurement samples during the Tevaluate\_out\_xxx evaluation period when relaxation is applied and not required to send Out of Sync indication to higher layers.  Proposal 10: When the UE has reverted to non-relaxed measurement (e.g. after Qout-exit has been detected), it is required to send Qout indications to higher layers based on non-relaxed RLM/BFD measurements.  Proposal 11: The UE is allowed to perform less RLM/BFD measurement samples during the Tevaluate\_out\_xxx evaluation period when relaxation is applied and not required to send the first Qout indication to higher layers.  Observation 9: The UE is to determine the number of samples needed for the RLM/BFD evaluation during the relaxed measurement mode.  Observation 10: The UE is to determine the number of samples needed for the RLM/BFD evaluation during the relaxed measurement mode.  Proposal 12: It should be allowed for the NW 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. |
| [**R4-2109551**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109551.zip) | Nokia, Nokia Shanghai Bell | *Simulation results are provided* |
| [**R4-2109561**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109561.zip) | Qualcomm, Inc. | **Proposal 1: RAN4 should evaluate the maximum additional delay of RLF declaration introduced by power saving measurement relaxation to determine the feasibility of relaxation scheme options.**  **Observation 1: the additional delay of each proposal in [1] is listed in the following:**   |  |  | | --- | --- | | Options | Additional delay | | * Option 1: exit relaxation mode when any relaxation criterion is not met   + Option 1a: a hysteresis value (e.g. 3dB) could be used to avoid ping-ping effect.   + Relaxation exiting condition: Qualitymeasured + Hys < Thresh * Option 2: exit relaxation mode when the radio link quality is worse than a certain SINR threshold Thexit, which is higher than Qout.   + Option 2a: set different radio link quality threshold for entering and exiting the relaxation   + Option 2b: either the averaged SINR based on reduced number of samples is below Thexit, or the one-shot SINR is below Qout. * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3a: exit when N310 starts to count, i.e. 1 out-of-sync indication. | (K-1)Tevaluation | | * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3b: exit when T310 is running witch is triggered by a new counter | (K-1) Tevaluation+(K-1)\*N310\* TIndication\_interval | | * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3c: exit when certain number of out-of-indications   + Option 3d: exit when certain consecutive out-of-sync indications | (K-1) Tevaluation + (K-1)\**n*\* TIndication\_interval |   **Observation 2: Reducing N310 or T310 degrade the RLF declaration reliability.**  **Proposal 2: R16 low mobility condition applies to RLM/BFD relaxation when configured together with serving cell quality condition.**  **Proposal 3: Serving cell quality evaluation uses RLM/BFD SINR measurement.**  **Proposal 4: UE enters power saving mode when RLM SNR is larger than Qout/Qin + margin. The threshold can be configured by the network.**  **Observation 3: With the proposed scheme, the additional delay for RFL declaration is within TEvaluate\_out\_SSB.**  **Observation 4: Low mobility condition is violated in the system level simulation submitted in the previous meetings. Therefore, these simulations are not appropriate for deriving SINR margin.**  **Proposal 5: If R16 low mobility condition is adapted, RAN4 derives SINR distribution for margin derivation from link level simulation without mobility and with small scale fading.**  **Proposal 6: If power saving conditions are satisfied, allow TEvaluate\_ps\_out\_SSB for the first OOS indication and the original TEvaluate\_out\_SSB doesn’t apply. After the first OOS indication, the original TEvaluate\_out\_SSB and TIndication\_interval applies to UE.**   |  |  | | --- | --- | | Configuration | TEvaluate\_ps\_out\_SSB (ms) | | no DRX | Max(200, Ceil(10 × P) × TSSB) | | DRX cycle≤80ms | Max(200, Ceil(30 × P) × Max(TDRX,TSSB)) | | 80ms<DRX cycle≤320ms | Max(200, Ceil(20 × P) × Max(TDRX,TSSB)) | | DRX cycle>320ms | Ceil(10 × P) × TDRX | | NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |
| [**R4-2109886**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109886.zip) | MediaTek inc. | In this contribution, we have the following observations:  ***Observation 1: LLS simulation results are needed if evaluation period in RLM/BFD measurement relaxation is not extended***  ***Observation 2: For method scaling the evaluation period by relaxation factor, the maximum additional delay of RLF declaration is merely 200ms or 600ms and the probability that RLF declaration occurs is very low. There seems to be no serious system impact***  And we propose  ***Proposal 1: RAN4 to confirm that RLM/BFD measurement relaxation is allowed for following 3 scenarios***  ***1. Network configures only serving cell quality criterion***   * + ***UE can enter power saving mode when***     1. ***serving cell quality criterion is fulfilled***  1. ***Network configure only low mobility criterion***    * ***UE can enter power saving mode when***      1. ***low mobility criterion is fulfilled*** 2. ***Network configure both serving cell quality criterion and low mobility criteria criterion***    * ***UE can enter power saving mode when***      1. ***only serving cell quality criterion is fulfilled***      2. ***only low mobility criterion is fulfilled***      3. ***both serving cell quality criterion and low mobility criterion are fulfilled***   ***Proposal 2: Whether the low mobility is fulfilled can be up to UE’s definition (B1) or determined by evaluating the SINR variation***  ***Proposal 3: UE should back to normal RLM measurement when any relaxation criterion is not met or when SINR is lower than Qout. For the first case, a hysteresis value could be used to avoid the ping-pong effect, i.e., the SINRexit = SINRenter - 3dB. For the second case, in addition to back to normal measurement, UE should also start the N310 counter immediately***  ***Proposal 4: RAN4 to specify the RLM/BFD relaxation requirement by scaling the evaluation period***  ***Proposal 5: RAN4 to confirm the new evaluation period TEvaluate\_out\_SSB-Relaxed is specified as K\* TEvaluate\_out\_SSB and the new indication period TIndication\_interval-Relaxed is specified as K\* TIndication\_interval*** |
| [**R4-2110303**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110303.zip) | Huawei, HiSilicon | ***Proposal 1: The good serving cell quality criteria for RLM relaxation can be defined as the radio link quality is 10dB better than the threshold Qout, i.e. radio link quality > Qout + 10dB.***  ***Proposal 2: The good serving cell quality criteria for BFD relaxation can be defined as the radio link quality is 6dB better than the threshold Qout,LR, i.e. radio link quality > Qout,LR + 6dB.***  ***Proposal 3: The exiting criteria for RLM relaxation can be defined as the radio link quality is worse than the level of (Qout + 7dB).***  ***Proposal 4: The*** ***exiting criteria for BFD relaxation can be defined as the radio link quality is worse than the level of (Qout,LR + 3dB).***  ***Proposal 5: It is up to UE to determine whether and how to perform the evaluation for low mobility criterion.***  ***Proposal 6: It is suggested to use Option 1 for defining the relaxed RLM/BFD*** ***evaluation period, and the factor Y used in option 1 can be defined as a fixed value.***   * ***Option 1:The similar definition of RLM/BFD evaluation period in Rel-15 can be reused as Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS))***   ***Proposal 7: The factor Y used*** ***for defining relaxed RLM/BFD evaluation period can be defined as:***   |  |  | | --- | --- | | ***Evaluation Period Type*** | ***Value of Y used for defining relaxed RLM/BFD Measurements*** | | ***SSB based RLM for OOS*** | *30* | | ***CSI-RS based RLM for OOS*** | *60* | | ***SSB based BFD*** | *15* | | ***CSI-RS based BFD*** | *30* |   ***Observation 1: For intra-band CA, the UE is required only to perform RLM/BFD measurements on the SpCell (PCell or PSCell).***  ***Proposal 8: The*** ***relaxation condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is better than the threshold (Qout + 10dB) for any RLM-RS resource.***  ***Proposal 9: The exiting condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is worse than the threshold (Qout + 7dB) for all the RLM-RS resources.*** |
| [**R4-2111248**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111248.zip) | Ericsson | **Observation:** Assuming high SINR threshold for entering the relaxed mode, no significant impact on latency for triggering RLF. |
| [**R4-2111249**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111249.zip) | Ericsson | * **Observation #1:** The WID does not limit the relaxed RLM/BFD feature to any specific deployment scenario. * **Observation #2:** It is agreed in [R4-2105797] that scaling factor defining the relaxed RLM/BFD evaluation period is defined based on max(TDRX, TSSB). * **Observation #3:** In release 17 UE power saving, it is possible to treat each UE separately by setting the relaxation criteria separately for each UE. * **Proposal #1:** Relaxed BFD/RLM requirements shall be supported for all deployment scenarios supported by current specification which includes: NR SA, NR EN-DC, NR NE-DC, NR intra-band CA, NR inter-band CA and NR-DC. * **Proposal #2:** The relaxation criteria includes the serving cell quality expressed as follows:   + radio link quality > Qout + X (dB) for RLM,   + Qout,LR + Y (dB) for BFD relaxation,   + X and Y are FFS. * **Proposal #3:** Our preferred option is that the network configures whether the low mobility criterion is fulfilled or not. However, we are also open for A assuming that the UE evaluates the criteria configured by the network. * **Proposal #4:** Relaxation factors are different for FR1 and FR2. * **Proposal #5:** RAN4 shall discuss whether to apply different relaxation factors for SSB and CSI-RS based evaluations in FR2. * **Proposal #6:** RAN4 to discuss applying different relaxation factor for the different SINR regions. * **Proposal #7:** UE shall revert to normal RLM operation mode when when X number of out-of-indications are sent to the higher layers, where X can be e.g. 1. * **Proposal #8:** The UE while performing relaxed BM upon beam failure detection (e.g. 1st indication) reverts to the normal BFD operation (i.e. without relaxation). * **Proposal #9:** Relaxed RLM/BFD requirements are introduced in new subsections within the existing RLM/BFD sections TS 38.133. * **Proposal #10:** Confirm use of option 1 in the way forward document from last meeting for entering and exiting conditions for relaxed RLM/BFD as follows:   + For intra-band CA, if UE has fulfilled the criterion for operating RLM/BFD in relaxed mode in one serving cell, then it is allowed to operate RLM/BFD in relaxed mode in all other serving cells if same type of RS are used for RLM/BFD in the serving cell and other serving cells.   + For intra-band CA, if UE meets the conditions of reverting to the normal RLM/BFD in one serving cell, it is expected the reversion operations are applied to other serving cell(s) if same type of RS are used for RLM/BFD in the serving cell and other serving cells. |
| [**R4-2111267**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111267.zip) | vivo | **Observation 1 According to current spec, the UE is required to perform RLM/BFD at least twice per 3 DRX cycles when DRX cycle length is less than or equal to 320ms, no matter what mobility state UE is in and whether UE is in the high/medium SINR.**  **Proposal 1 For RLM, the oos triggering latency requirements should be extended with an additional delay not shorter than (K-1)** ×**1.5 DRX cycles, while K is the relaxation factor.**  **Proposal 2 For BFD, the beam failure instance triggering latency requirements should be extended with an additional delay not shorter than (K-1)** ×**1.5 DRX cycles, while K is the relaxation factor.**  **Proposal 3 Extending the out-of-sync evaluation period requirements and beam failure evaluation period requirements by a same factor X can be considered. X can be 2 for DRX <= 40ms, and X can be 1.5 for 40ms <DRX <= 80ms.**  **Proposal 4 Low mobility cell can be configured by network in RRC without any thresholds, e.g. for indoor cells.**  **Proposal 5 The following configuration for low mobility criterion is preferred and can be further discussed in this meeting:**   1. **No cell quality criterion or low mobility criterion is configured, in which UE is not allowed to relax RLM/BFD.** 2. **Only cell quality criterion is configured, in which UE is allowed to relax RLM/BFD if only cell quality criterion is fulfilled. (In this case network decides whether the UE meets low mobility criterion.)** 3. **Both low mobility and cell quality criterions are configured, in which UE is allowed to relax RLM/BFD only if both low mobility criterion and cell quality criterion are fulfilled.**   **Proposal 6 Define network-configured thresholds reflecting the feasible SINR regions for UE entering RLM and BFD relaxation.**  **Proposal 7 The SINR threshold for entering relaxation is the same for RLM and BFD.**  **Proposal 8 The RSRP thresholds for entering relaxation can be further discussed.**  **Proposal 9 Different thresholds for entering relaxation are supported for SSB based RLM/BFD and CSI-RS based RLM/BFD.**  **Proposal 10 Leave the fall back mechanism as UE implementation, as long as UE makes sure it has already fallen back to normal measurement if it has identified one out-of-sync indication.**  **Proposal 11 RLM/BFD requirements can be applicable to CA/DC scenarios, but the issue for entering criteria among different cells in intra-band CA will not be further discussed.** |

## Open issues summary

### Sub-topic 2-1 Relaxation Scenarios

**Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**

* Proposals
  + Option 1: UE is not allowed to relax RLM/BFD. (**Vivo, ZTE, CMCC**)
* Recommended WF: Is Option1 agreeable?

**Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**

* Proposals
  + Option 1: when the serving cell quality criterion is fulfilled, the UE can enter the relaxation mode. (**MTK, vivo**)
* Recommended WF: Is Option1 agreeable?

**Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**

* Proposals
  + Option 1: when **either** serving cell quality criterion **or** low mobility criterion is fulfilled. (**MTK**)
  + Option 2: **both** serving cell quality criterion **and** low mobility criterion are fulfilled. (**vivo**)
  + Option 3: whether only one criterion is used (either low mobility criterion or good serving cell quality criterion) or both criteria are used separately, or both are to be used in combination e.g. to enter relaxation. (**Nokia**)
* Recommended WF: Discuss the proposal

**Issue 2-1-2: Relaxation for DRX cycles > 80ms**

* Proposals:
  + Option 1: No relaxation for DRX cycles > 80ms. (**CMCC,** **CATT**)
  + Option 2: Adjust evaluation time for DRx cycles > 80ms when power saving condition is satisfied to keep monotonicity of evaluation time w.r.t. DRx cycle length, i.e., if power saving condition is satisfied, longer DRx cycles still has longer evaluation time.
* Recommended WF: Is Option1 agreeable?

**Issue 2-1-3: Relaxation for deployment scenarios**

* Proposals
  + Option 1: Relaxed BFD/RLM requirements shall be supported for all deployment scenarios supported by current specification which includes: NR SA, NR EN-DC, NR NE-DC, NR intra-band CA, NR inter-band CA and NR-DC. (**Ericsson, vivo**)
* *Moderator’s comment*: Does NR EN-DC/NR NE-DC mean EN-DC/NE-DC?
* Recommended WF: Discuss the proposal

**Issue 2-1-4: System impact due to relaxation**

* Proposals:
  + Option 1: Negative system level impact due to RLM/BFD relaxation should be minimized. (**ZTE**)
  + Option 2: RAN4 further discuss whether the beneficial scenario is a reasonable case for network configuration. (**CATT**)
  + Option 3: RAN4 should evaluate the maximum additional delay of RLF declaration introduced by power saving measurement relaxation to determine the feasibility of relaxation scheme options,as the analysis in the following for options on the previous WF:

|  |  |
| --- | --- |
| Options | Additional delay |
| * Option 1: exit relaxation mode when any relaxation criterion is not met   + Option 1a: a hysteresis value (e.g. 3dB) could be used to avoid ping-ping effect. * Option 2: exit relaxation mode when the radio link quality is worse than a certain SINR threshold Thexit, which is higher than Qout. (includes option 2a and 2b) * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3a: exit when N310 starts to count, i.e. 1 out-of-sync indication. | (K-1)Tevaluation |
| * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3b: exit when T310 is running witch is triggered by a new counter | (K-1) Tevaluation+(K-1)\*N310\* TIndication\_interval |
| * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3c: exit when certain number of out-of-indications   + Option 3d: exit when certain consecutive out-of-sync indications | (K-1) Tevaluation + (K-1)\**n*\* TIndication\_interval |

* + **(Qualcomm)**
* Recommended WF: Could proponents of the above options provide more specific scenarios/metric and corresponding system impact for companies to discuss?

**Issue 2-1-5: RLM/BFD-RS being relaxed for inter frequency/RAT RRM measurements.**

* Proposals:
  + Option 1: UE could use the RLM/BFD-RS being relaxed to do the inter frequency/RAT RRM measurements. (**CMCC**)
* Recommended WF: Discuss the proposal

### Sub-topic 2-2 Entering Relaxation criteria

* Background: the agreement on relaxation criteria of RLM/BFD relaxation in RAN4 98-e-Bis meeting
  + 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
  + Good serving cell quality criteria of RLM/BFD relaxation is defined as the radio link quality is better than a threshold.
    - FFS radio link quality > Qout + X (dB) for RLM
    - FFS radio link quality > Qout,LR + Y (dB) for BFD relaxation.
    - FFS how to derive the values of X, Y
  + The radio link quality in good serving cell quality criteria for R17 RLM/BFD relaxation is based on SINR
    - FFS how to derive the corresponding SINR level of the threshold used in good serving cell quality criteria
    - FFS which SINR is used

**Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**

* Proposals
* Option 1: UE reuse the SINR for RLM/BFD evaluation when determine whether the serving cell quality criteria is fulfilled or not. (**CMCC,** **CATT, Qualcomm, vivo**)
* Option 2: Optional SS-RSRP and SS-RSRQ as in R16 idle mode UE power saving. (**Apple**)
* Option 3: RAN4 to use SS-SINR as one possible threshold and, in addition to SS-SINR, RAN4 to define SS-RSRP and SS-RSRQ as configurable good serving cell quality criteria. (**Nokia, Apple**)
* Recommended WF: Discuss the proposals.

**Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**

* Proposals
  + Option 1: The thresholds are configured to the UE by the network. (**ZTE, CATT, vivo, Qualcomm, Nokia, Apple)**
    - **Option 1a: The threshold is for entering power saving only. Exiting threshold is discussed separately in reverting/exiting condition (QC)**
  + Option 2: Pre-defined a set of discrete threshold values. When network configure the serving cell quality criteria, it chooses a reasonable one from the set. (**CMCC**)
  + Option 3: The parameters can be pre-defined. (**Xiaomi,Huawei**)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**

* Proposals
  + Option 1: SINR > Qout +X dB, where X dB is margin. (**Huawei, Xiaomi, Ericsson, , Intel, vivo**)
    - Option 1a: X = 10dB (**Huawei**)
    - Option 1b: X = (Qin – Qout) + margin (**Intel**)
    - Option 1c: FFS X (**Ericsson**)
  + Option 2: If option 1 in 2-2-2 is agreed, no need to discuss 2-2-3a (QC)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**

* Proposals
  + Option 1: SINR > Qout, LR + Y dB, where Y dB is margin. (**Huawei, Xiaomi, Ericsson, , CMCC,vivo**)
    - Option 1a: Y = 6dB (**Huawei**)
    - Option 1b: FFS Y (**Ericsson**)
    - Option 1c: SINR threshold for BFD is the same as the SINR threshold for RLM. (**vivo**)
  + Option 2: RSRP > *rsrp-ThresholdSSB* +Y dB, where Y dB is margin. (**Intel**)
  + Option 3: FFS the additional RSRP threshold for BFD. (**vivo**)
  + Option 4: If option 1 in 2-2-2 is agreed, no need to discuss 2-2-3b (QC)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**

* Proposals
  + Option 1: Different thresholds for entering relaxation are supported for SSB based and CSI-RS based RLM. (**vivo**)
  + Option 2: FFS (**CATT**)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**

* Proposals
  + Option 1: Different thresholds for entering relaxation are supported for SSB based and CSI-RS based BFD. (**vivo**)
  + Option 2: FFS (**CATT**)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**

* Proposals
  + Option A: UE verifies whether the low mobility criterion is fulfilled or not based on the RSRP variation or SINR variation (**CATT, Xiaomi, Qualcomm, Nokia, Intel, [Ericsson], MTK, Apple, CMCC, vivo)**
  + Option B: Network configures whether the low mobility criterion is fulfilled or not. (**ZTE, Ericsson, Nokia, Vivo**)
  + Option C: It is up to UE to determine whether and how to perform the evaluation for low mobility criterion. (**Huawei, MTK, CATT**)
  + Option D: RAN4 additionally to define a low mobility criterion based on the number of serving beam changes over time (e.g. TCI state change). (**Nokia**)
* Recommended WF: Discuss the proposals.

**Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**

* Proposals: UE verifies whether the low mobility criterion is fulfilled or not based on
  + Option 1: RSRP variation (reuse R16 low mobility criterion and procedure) (**CATT, Xiaomi, Qualcomm, Nokia, vivo**)
    - Option 1a: If R16 low mobility condition is adapted, RAN4 derives SINR distribution for margin derivation from link level simulation without mobility and with small scale fading. (**Qualcomm**)
  + Option 2: SINR variation (**MTK, Intel, CMCC**)
    - Option 2a: Define an evaluation period, to check the L3 SINR values always higher than the SINR threshold (the threshold used in serving cell quality criteria). (**CMCC**)
* Recommended WF: Discuss the proposals if the Option A of issue 2-2-5 is agreed.

**Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**

* Proposals
  + Option 1: The parameters are configured to the UE by the network. (**Xiaomi, CATT, Nokia, Apple, CMCC**)
    - Option 1a: the RSRP thresholds could be configurable by the network. (**Xiaomi**)
* *Moderator’s comment*: Proponent may clarify what are the parameters? Does Option 1 also apply to Option B/C/D of issue 2-2-5?
* Recommended WF: Discuss this proposal if the Option A of issue 2-2-5 is agreed.

### Sub-topic 2-3 Exiting Relaxation criteria

**Issue 2-3-1: Exiting criteria of RLM/BFD relaxation - Basic**

* Background:
  + 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 98-e, R4-2103670).
* Proposals
  + Option 1: exit relaxation mode at least when any entering relaxation criterion is not met (**CATT**, **Apple**, **ZTE**, **MTK**)
  + Option 2: exit relaxation mode to fulfil the maximum additional delay requirement (QC)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**

* Proposals
  + Option 1: exit relaxation mode when the radio link quality of the serving cell is worse than a certain threshold, which is higher than Qout. (**MTK, Intel, Huawei, CATT**)
    - Option 1a: a hysteresis value could be used to avoid ping-ping effect, e.g. SINRexit = SINRenter - 3dB (**MTK, Huawei**)
    - Option 1b: SINRexit = Qout + 7dB (**Huawei**)
    - Option 1c: SINRexit = Qout +Margin or SINRexit = Qin (**Intel**)
    - Option 1d: The threshold can be configured by network with margin (**CATT**)
  + Option 2: exit relaxation mode when the radio link quality is worse than Qout, and the UE is still in the relaxation mode when the radio link quality is better than Qout. (**vivo, Xiaomi, Ericsson, Nokia, Apple, CMCC**)
    - Option 2a: Leave the fall back mechanism as UE implementation, as long as UE makes sure it has already fallen back to normal measurement if it has identified one out-of-sync indication. (**vivo, QC**)
      * Option 2a(1) (QC): UE implementation has to satisfy the maximum additional delay requirement defined in RAN4
* Option 3: exit when certain consecutive out-of-sync indications (**CMCC**)Recommended WF: Discuss the proposal

**Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**

* Proposals
  + Option 1: UE should start N310 immediately (**MTK**)
  + Option 2: When relaxation is applied, UE is not required to send the first Qout indication to higher layers. (**Nokia, QC**)
* Recommended WF: Discuss the proposal

**Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**

* Proposals
  + Option 1: exit relaxation mode when the SINR is worse than a certain threshold (Qout, LR + Y), which is different from the entering threshold. (**Intel, Huawei**)
    - Option 2a: the radio link quality is worse than the level of Qout, LR + 6dB (**Huawei**)
  + Option 2: exit relaxation mode upon detect 1 beam failure instance indication. (**Ericsson**, **Xiaomi, Apple, CMCC**)
  + Option 3: Leave the fall back mechanism as UE implementation. (vivo, QC)
* Recommended WF: Discuss the proposal

**Issue 2-3-5: Re-entry to the relaxation mode**

* Proposals:
  + Option 1: (**CMCC**)
    - After UE revering, UE couldn’t go into relaxation mode again during a certain punish period, such as when a new timer is active. UE can decide whether go into relaxation mode by relaxation criteria after the timer expires. The timer is configured by network.
    - After UE revering to normal RLM measurement, and UE does not trigger the RLF, UE couldn’t go into relaxation mode again during a certain punish period, the punish period will end when UE report a few consecutive In-sync Indication, the number of In-sync indication can be configured by network.
* Recommended WF: Discuss the proposal.

### Sub-topic 2-4 During Relaxation

* Background
  + Use of a scaling factor to extend the RLM/BFD evaluation period. (Agreement in RAN4 98-e, R4-2103670).
  + Scaling factor defining the relaxed RLM/BFD evaluation period is defined based on max(TDRX, TSSB). (Agreement in RAN4 98-e-Bis, R4-2105797)

**Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**

* Proposals:
  + Option 1: Based on the previous agreement to extend the RLM/BFD evaluation period. (**ZTE**, **Huawei,** **, MTK, Xiaomi, vivo, Apple**)
  + Option 2: The evaluation period, Tevaluate\_out\_xxx is unchangedwhen UE is allowed to relax RLM/BFD measurements. The UE is allowed to perform less RLM/BFD measurement samples during the Tevaluate\_out\_xxx evaluation period when relaxation is applied and not required to send Out of Sync indication to higher layers. (**Nokia, QC, Huawei**)
    - Option 2a: UE is allowed to measure less RLM/BFD samples in Tevaluate\_out\_xxx\_ps when UE is in power saving mode. UE has to revert to normal mode and follow Tevaluation\_out\_xxx to indicate first OOS indication, and ensure Tevaluate\_out\_xxx\_ps+ Tevaluation\_out\_xxx do not exceed RAN4 requirement. Tevaluate\_out\_xxx\_ps value is FFS. (QC)
      * Note: Tevaluate\_out\_xxx\_ps+ Tevaluation\_out\_xxx can still be represented as a scale version of RLM/BFD evaluation period, but it is possible that non-integer scaling is used.
* Recommended WF: Option 2 seems not aligned with the previous agreement on the extended RLM/BFD evaluation period. Proponent of Option 2 may clarify the proposal. This issue would depends on Issue 2-3-3.

**Issue 2-4-2: Relaxed evaluation period of RLM/BFD**

* Proposals:
  + Option 1: The similar definition of RLM/BFD evaluation period in Rel-15 can be reused as Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS)). (**Huawei, Apple, CMCC**)
    - Option 1a (Huawei): the Y can be defined as below:

|  |  |
| --- | --- |
| ***Evaluation Period Type*** | ***Value of Y used for defining relaxed RLM/BFD Measurements*** |
| ***SSB based RLM for OOS*** | *30* |
| ***CSI-RS based RLM for OOS*** | *60* |
| ***SSB based BFD*** | *15* |
| ***CSI-RS based BFD*** | *30* |

* + Option 2: For FR1, If power saving conditions are satisfied, allow TEvaluate\_ps\_out\_SSB for the first OOS indication and the original TEvaluate\_out\_SSB doesn’t apply. Only DRx cycles <= 80ms are listed, other DRx cycles are FFS pending issue 2-1-2 conclusion. (**Qualcomm**)

|  |  |
| --- | --- |
| Configuration | TEvaluate\_ps\_out\_SSB (ms) |
| no DRX | Max(200, Ceil(10 × P) × TSSB) |
| DRX cycle≤80ms | Max(200, Ceil(30 × P) × Max(TDRX,TSSB)) |
| NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | |

* + - Option 3 (**MTK, Xiaomi, CMCC**): extended based on the legacy RLM/BFD requirements by considering the scaling factors.
      * the new evaluation period TEvaluate\_out\_SSB-Relaxed is specified as K1\* TEvaluate\_out\_SSB, where TEvaluate\_out\_SSB is as specified in clause 8.1.3.2 in TS 38.133 .
      * the new indication period TIndication\_interval-Relaxed is specified as K2\* TIndication\_interval where TIndication\_interval is as specified in clause 8.1.6 in TS 38.133.
    - Option 4 (**vivo**):
      * For RLM, the oos triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.
      * For BFD, the beam failure instance triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.
      * Extending the out-of-sync evaluation period requirements and beam failure evaluation period requirements by a same factor X can be considered. X can be 2 for DRX <= 40ms, and X can be 1.5 for 40ms <DRX <= 80ms.
* Recommended WF: Is Option 1 agreeable?

**Issue 2-4-3: Relaxation scheme and specification impact**

* Proposals
  + Option 1: Relaxed RLM/BFD requirements are introduced in new subsections within the existing RLM/BFD sections TS 38.133. (**Ericsson**)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**

* Proposals
  + Option 1: Different Relaxation factors are allowed for FR1 and FR2. (CMCC, Xiaomi, **Ericsson**, **CATT**)
    - FFS whether to apply different relaxation factors for SSB and CSI-RS based evaluations in FR2 (**Ericsson**)
* Recommended WF: Is Option 1 agreeable?

**Issue 2-4-4b: Different Relaxation factors for different SINR range**

* Proposals
  + Option 1: Different Relaxation factors are allowed for different SINR range (**Ericsson**)
* Recommended WF: Discuss the proposal.

**Issue 2-4-4c: Other consideration on Relaxation factors**

* Proposals:
  + Option1: Maximum relaxation factor should be related to DRX cycle and RS periodicity. (**Apple, Ericsson**).
* Recommended WF: Given the relaxed RLM/BFD evaluation period is agreed to be defined based on max(TDRX, TSSB), do we need to further discuss this issue? If the intention is to discuss different relaxation factors for different DRX cycle length, it would suggest to focus on DRX cycle length <= 80ms as the issues discussed above and revisit the relaxation factors if DRX cycle length > 80ms is agreed.

**Issue 2-4-5: Additional N310/N311 values for relaxation mode**

* Proposals
  + Option 1: It should be allowed for the network to configure different values of the RLF parameters, e.g. T310/N310/N311, for the relaxed operation (**Nokia**)
* Recommended WF: Discuss the proposals.

### Sub-topic 2-5 Other Aspects

**Issue 2-5-1: Entering relaxation mode in intra-band CA**

* Background of Issue 2-5-1 and Issue 2-5-2:
  + The following comments were received in the last meeting.
  + No band combination for intra-band NR DC.
  + RLM measurements on SpCell (PCell or PSCell) and BFD requirements apply for one serving cell per band.
  + However, the current specification does not exclude RLM on SpCell and BFD on SCell in the same band.
* Proposal:
  + Option 1: For intra-band CA, if UE has fulfilled the criterion for operating RLM/BFD in relaxed mode in **one** serving cell, then it is allowed to operate RLM/BFD in relaxed mode in all other serving cells if same type of RS are used for RLM/BFD in the serving cell and other serving cells. (**CATT, Ericsson**)
  + Option 2: No need to further discuss. (**vivo, Xiaomi, Huawei**)
* Recommended WF: Discuss the proposals.

**Issue 2-5-2: Exiting Relaxation criteria in intra-band CA**

* Proposal:
  + Option 1: For intra-band CA, if UE meets the conditions of reverting to the normal RLM/BFD in **one** serving cell, it is expected the reversion operations are applied to all other serving cell(s) if same type of RS are used for RLM/BFD in the serving cell and other serving cells. (**CATT, Ericsson**)
  + Option 2: No need to further discuss. (**vivo, Huawei**)
* Recommended WF: Discuss the proposals.

**Issue 2-5-3: Entering and Exiting Relaxation criteria for multiple RLM-RS/BFD-RS**

* Proposal:
  + Option 1 (**Huawei**):
    - The relaxation condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is better than the threshold (Qout + 10dB) for **any** RLM-RS resource.
    - The exiting condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is worse than the threshold (Qout + 7dB) for **all** the RLM-RS resources.
* Recommended WF: Discuss the proposals.

## Companies views’ collection for 1st round

### Open issues

#### Sub-topic 2-1 Relaxation Scenarios

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | **Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**  Option 1 make sense and can be agreeable.  **Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**  Option 1 make sense and can be agreeable.  **Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**  Support option 2. Note that in the agreed WF of R4-2105797, we find the following.  “*whether relaxed RLM/BFD requirements can be applied depends on both the serving cell quality and UE mobility state*”  Maybe at least option 1 conflicts with the above agreements.  **Issue 2-1-2: Relaxation for DRX cycles > 80ms**  We can accept option 1. Monotonicity needs to be considered, and it can be solved in other ways in our understanding.  **Issue 2-1-3: Relaxation for deployment scenarios**  Support option 1. Power saving technique should be applicable to all NR carriers in CA/DC scenarios.  **Issue 2-1-4: System impact due to relaxation**  For option 1, we think there could be a good balance point between UE power saving gain and network performance impact. At least based on our evaluation results in previous meetings, we see the UE can achieve power saving gain in most scenarios, and there is very limited impact to RLF triggering latency.  For option 2, we think this issue is mainly related to CA/DC scenarios based on companies’ views. We don’t think there is any issue left for single carrier case.  For option 3, we support the motivation behind the proposal. RAN4 should introduce relaxation based on evaluation results, and at least 2 companies have shown results that, in the case that UE is using longer evaluation period in High SINR, the needed addition delay is (K-1) x Tevaluation, in which we think Tevaluation should be 1.5 x DRX cycles.  Therefore, we think RAN4 can move forward with option 3.  **Issue 2-1-5: RLM/BFD-RS being relaxed for inter frequency/RAT RRM measurements.**  We think this is not within scope of R17 power saving.  The feasibility for this can be further discussed. |
| ZTE | **Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**  Option 1 is agreeable and is very reasonable in our view. |
| QC | **Issue 2-1-1a/b:**  Agree with option 1.  **Issue 2-1-1c:**  Option 2, if NW wants UE only evaluation one, it can configure only one. However, in our opinion, good cell condition is mandatory.  **Issue 2-1-2**  Since option 2 is to keep monotonicity of evaluation time w.r.t. DRx cycle length in relaxation mode, we suggest to defer this discussion after evaluation time in relaxation mode finalized. |
| Apple | Issue 2-1-1a: Agree with WF.  Issue 2-1-1c, option 2: “**both** serving cell quality criterion **and** low mobility criterion are fulfilled”  Issue 2-1-2: OK with option 1. Depending on max relaxation factor, for example, if it is 4 for 40ms DRX cycle, 2 for 80ms DRX cycle, option 2 is met automatically.  Issue 2-1-5: Relaxation is for UE power saving. Do not see the motivation here to do inter-RAT measurement. |
| Nokia | **Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**  Option 1. The relaxation needs to be network configured. If network does not configure relaxation, the UE is not allowed to perform relaxation. This is also aligned with Rel16 power saving solutions.  **Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**  We understood it is up to network to configure either only serving cell quality criterion or only UE mobility criterion, or both serving cell quality criterion and UE mobility criterion. The UE is only allowed to perform relaxation if the criterion is configured.  **Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**  We support Option 3. We understood Option 3 also covers Option 1 and 2.  **Issue 2-1-2: Relaxation for DRX cycles > 80ms**  Prefer Option 1. Could components of Option 2 explain a bit more on the benefit of Option 2?  **Issue 2-1-3: Relaxation for deployment scenarios**  Fine with Option 1. We also have the same question with Moderator. Some clarification is needed  **Issue 2-1-4: System impact due to relaxation**  We would see Option 1 as a general principle for discussing relaxation but would be good to further clarify what metrics are used to evaluate the system impact. We are fine with Option 3, where the maximum additional delay of RLF declaration needs to be evaluated as one metric. In addition, we may also need consider other system level metrics e.g. increase of time-of-outage.  **Issue 2-1-5: RLM/BFD-RS being relaxed for inter frequency/RAT RRM measurements.**  We think using some of the unused RLM/BFD measurement occasions for performing inter-frequency/RAT RRM measurements could be discussed further. But we need consider the impact to power saving performance. |
| Intel | **Issue 2-1-1a**: Agree with option 1.  **Issue 2-1-1b**: Agree with option 1.  **Issue 2-1-1c:** support option 2. |
| Huawei | **Issue 2-1-1a/1b/1c/1d:**  How to define good serving cell criterion and whether/how to specify low mobility criterion are under discussion. Whether the related parameters used for relaxation criterion is configured or predefined is still discussed. If the relaxation criterion is predefined, it seems that there is no need for network to configure the relaxation criterion.  **Issue 2-1-2: Relaxation for DRX cycles > 80ms**  Support option 1.  **Issue 2-1-4: System impact due to relaxation**  Support option 1 and option 2. |
| Ericsson | **Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**  Option 1 is agreeable. UE should not enter the relaxation state if these conditions are not fulfilled.  **Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**  Option 1 is not agreeable to us. Relaxation is agreeable only when UE has met the short-DRX condition (<= 80 ms) and has fulfilled the low mobility criterion, this is also in line with the WI objective:   * 1. *“Study the feasibility and performance impact of relaxing UE measurements for RLM and/or BFD, particularly for low mobility UE with short DRX periodicity/cycle, and specify, if agreed, relaxation in the corresponding requirements [RAN4]”*   **Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**  Option 1 is agreeable if the condition on the short DRX is also added. See the WI objective cited above under issue 2-1-1b.  **Issue 2-1-2: Relaxation for DRX cycles > 80ms**  It was already agreed at last meeting and captured in WF that relaxation is applicable only for DRX <= 80 ms, see agreement below [**R4**-2105797]:   * *“Relaxation is applicable for DRX<=80ms.*   + *FFS adjustment to other DRx cycles is needed to keep the monotonicity of DRx cycles w.r.t. evaluation time*   + *FFS Maximum relaxation factor should be related to DRX cycle and RS periodicity.”*   Thus no need to revisit the agreement.  **Issue 2-1-3: Relaxation for deployment scenarios**  Option 1 is agreeable. Correct, it means EN-DC/NE-DC.  **Issue 2-1-4: System impact due to relaxation**  We agree to option 1, but it is too general and need to be clarified further.  **Issue 2-1-5: RLM/BFD-RS being relaxed for inter frequency/RAT RRM measurements.**  This is not part of the scope of the WID, but can be discussed further in future enhancements. |
| CMCC | Issue 2-1-1a/b/c: From our point of view, UE can perform relaxed RLM/BFD measurement only if the serving cell quality criterion and low mobility criterion is fulfilled. Because the RLF and BFD are performed at RRC\_CONNECTED mode, it is more important to guarantee the measurement performance. The relaxation condition should be stricter than which we used in RRC\_IDLE relaxation. Therefore, Option1 for Issue 2-1-1a, Option2 for Issue 2-1-1c. Issue 2-1-1b is not a valid issue for us since network will always configure two criterions.  Issue 2-1-2: We prefer Option1. First, this WI is focus on small DRX cycles. Second, without sufficient evaluation about the relaxation for DRX cycles>80ms+, it is risky to do the relaxation directly. Last, if most of companies think the monotonicity is necessary, we can set the limitations to the relaxation factor below DRX cycle 80ms.  Issue 2-1-3: Option 1 is fine for us. Whether the thresholds in relaxation criteria for these scenarios are same or different should be further discussed.  Issue 2-1-4: We agree with Option1 and Option2 which are general guidance. As for Option3, we agree with measurement relaxation will introduce additional delay for RLF declaration, how much the additional delay is tolerable can be further studied and evaluated in the revert scheme related issues.  Issue 2-1-5: After RLM/BFD relaxation, some of RLM/BFD-RS measurements will be skipped. UE can use these RS to perform extra RRM measurements by network configuration, such as network configure smaller MGRP. This RRM enhanced measurement is suitable for the specific UE which fulfill the RLM/BFD relaxation criteria but have no need of power saving. |
| Xiaomi | Issue 2-1-1a: Support option 1.  Issue 2-1-1b: We prefer the UE mobility status to be taken into consideration as well.  Issue 2-1-1c: Support option 2.  In our understanding, the agreement on the criteria of RLM/BFD relaxation in last meeting means both serving cell quality and UE mobility status should be considered.  Issue 2-1-2: Prefer option 1. |
| MTK | **Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**  Option 1 is agreeable.  **Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**  Option 1 is agreeable.  **Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**  Support option 1. As we clarify in our Tdoc R4-2109886. If UE can only enter power saving mode when both 2 criteria are fulfilled, and low mobility is configured by Network. Then UE can’t enter power saving mode even when serving cell quality criterion is fulfilled. The power saving scenarios would be very limited. Considering that Network might not be able to precisely evaluate the UE speed. We prefer option 1.  **Issue 2-1-2: Relaxation for DRX cycles > 80ms**  Option 1 is agreeable.  **Issue 2-1-3: Relaxation for deployment scenarios**  Option 1 is agreeable.  **Issue 2-1-4: System impact due to relaxation**  For option 1 and 2, we need specific scenarios and performance metric to proceed the evaluation.  For option 3, even though we know the additional delay, how RAN4 should link the additional delay to the system impact?  More details for evaluation methodology is needed.  **Issue 2-1-5: RLM/BFD-RS being relaxed for inter frequency/RAT RRM measurements.**  It can be discussed further in future enhancements. |
| CATT | **Issue 2-1-1a:**  **Support option 1.**  **Issue 2-1-1b:**  **Do not agree option 1. This is not only condition to determine UE enter the relaxation mode.**  **Issue 2-1-1c:**  **Support option 2.**  **Issue 2-1-2:**  **Support option 1.**  **Issue 2-1-3:**  **Option 1 can be acceptable.**  **Issue 2-1-5:**  **It is not the scope of this WI.** |

#### Sub-topic 2-2 Entering Relaxation criteria

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | **Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**  We support option 1. For cell quality criteria, the SINR can be directly re-used. Otherwise, the performance of RLM/BFD cannot be ensured.  **Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**  We support option 1 and option 2. The threshold should be configurable so that the network may have more flexibility to control the balance between UE power saving gain and network performance. Option 2 should be the details of such configuration. In our view it should be issue 1b.  **Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**  We support option 1. In our understanding this should be for how the threshold is configured and we don’t think we need to configure absolute SINR threshold. A relative value to Qout seems a good solution.  In our understanding, if option 2 in 2-2-2 is agreed, no need to further discuss 1a or 1b.  **Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**  We support option 1,1b,1c and 3.  In our understanding, if option 2 in 2-2-2 is agreed, no need to further discuss 1a.  The motivation of option 3 is to ensure power saving gain for RLM/BFD relaxation. If only one is relaxed but the other one is not, there is almost no power saving gain.  For option 4, in our understanding this should be for how the threshold is configured and we don’t think we need to configure absolute SINR threshold. A relative value to Qout,LR seems a good solution.  **Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**  We support option 1. Measurement results on different RSs is normally different. UE relaxation behavior on different RS can also be different.  **Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**  Option 1, same comment as 2-2-4a.  **Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**  We support option A, B.  For option A, we see it is possible to identify UE mobility based on RSRP, and R16 low mobility criteria can be a baseline. Such discussion can be continued in RAN2 if RAN4 can agree on option A.  For option B, we see it is also possible, since network may have various kinds of UE mobility information in our understanding, and it is possible for network to judge whether UE is in low mobility. Moreover, if companies cannot converge on using RSRP or SINR thresholds, we see option B can be the only solution, since in this way we can left the issue to network implementation.  For option C, since it is based on UE implementation, we see potential testability issue.  For option D, we think this can be a special version of option B. Since network may indicate TCI state change, we see it feasible to further indicated that UE is left from RLM/BFD relaxation.  **Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**  We support option 1. Option 1a can be FFS.  Option 2 seems not feasible from our perspective. SINR is not only related to the UE mobility, but also to the interference. In practice, the interference may vary from time to time. It is not feasible to identify UE mobility based on SINR.  **Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**  In our understanding this low mobility criteria can be configuration, if it is threshold-based. Anyway this can be further discussed in RAN2.  Therefore, we further propose option 2 for this issue:  Option 2: Up to RAN2 to decide. This is further studied in RAN2. An LS is sent to RAN2 in this meeting to trigger such discussion. |
| ZTE | **Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**  Support Option 1. In Option 2, it says “ When network configure the serving cell quality criteria, it chooses a reasonable one from the set.” here it means the network right? In principle this sounds reasonable, but the benefit may not be significant while flexibility is lost.  **Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**  We can support option A and B. |
| QC | **Issue 2-2-1:**  Option 1, this simplifies UE implementation and we don’t see obvious issues with this measurement.  **Issue 2-2-2:**  After reviewing companies’ contribution, we would like to support option 3. Since this threshold is based on Qout, which is a fixed value instead of network configured, it makes more sense to have a fixed threshold. Can proponents of option 1/2 explain why network may configure different values in different circumstances? The only factors we can think of is mobility or SNR variation. However, this should be captured in low mobility condition. Therefore, good cell quality condition can be a pre-defined value.  **Issue 2-2-3a/b:**  We support option 1 and X,Y FFS.  **Issue 2-2-5:**  We support option A, but network can configure whether low mobility condition should be evaluated or not, while good cell condition is mandatory.  **Issue 2-2-7:**  Option 1 is good for us. |
| Apple | Issue 2-2-1: Option 3. SS-SINR can be used as one possible threshold. However, SS-SINR measurement is optional UE feature. For UE does not support SS-SINR measurement, UE should still be allowed for RLM/BFD relaxation.  Issue 2-2-2: support WF  Issue 2-2-3a and 2-2-3b: If we agree on WF of 2-2-2, no need to further discuss the pre-defined threshold.  Issue 2-2-4a and 2-2-4b: If we agree on WF of 2-2-2, no need to further discuss the pre-defined threshold.  Issue 2-2-5. Support option A. Need clarification on the difference of option C and option A.  Issue 2-2-6: support option 1.  Issue 2-2-7: parameters include the threshold for delta\_RSRP / delta\_time. |
| Nokia | **Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**  Prefer Option 3. Could proponents of Option 1 clarify what SINR it is?  **Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**  Agree with the recommended WF.  **Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**  Could companies clarify what SINR refers to? Is it referring to SS-SINR? Qout has been defined corresponding to the out-of-sync block error rate (BLERout). But SINR is observed by UE and depends on the UE receiver performance. It is challenging to set a margin of XdB by network assuming different receiver performance. We would like to add our proposal as another option:  Option 3: SS-RSRP > X dB  **Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**  We can use the same criteria as for SSB based RLM i.e. Option x: SS-RSRP > X dB.  **Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**  In principle Option 1 is ok. We would expect separate parameters up to network configuration.  **Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**  In principle Option 1 is ok. We would expect separate parameters up to network configuration.  **Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**  These options are not exclusive to each other. We are fine with Option A, option B and Option D.  **Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**  We support Option1. And RSRP variation could be defined based on Rel16 principles  **Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**  Option 1. Yes, the parameters for low mobility criteria comprising e.g. enabling the criteria, the thresholds shall be configured by network. |
| Intel | **Issue 2-2-1:** support option 1 for RLM. For BFD, L1-RSRP may be used as the criteria as well.  **Issue 2-2-2:** support option 3 or option 2. The threshold is based on Qout/Qin+Margin. If Margin is a fixed value, it goes for option 3. If margin is a set of values corresponding to different cases, it goes for option 2.  **Issue 2-2-3a:** support option 1. To the question of Nokia, for the testcase of RLM OOS and INS, there are 5 level SINR values which is designed based on SINRout and SINRin, UE needs to declare OOS and INS when SINR changes. It means the threshold can be based on SINR.  **Issue 2-2-3b:** support option 2. For BFD, the good channel quality is based on L1-RSRP. |
| Huawei | **Issue 2-2-1**: Support option 1.  UE perform SINR-like measurements for RLM/BFD evaluation. The link quality is also more related to SINR level. For R16 power saving in idle mode, RRM relaxation is allowed and SS-RSRP and SS-RSRQ can be used in the criteria. However, For R17 power saving in connected mode, RLM/BFD relaxation is only allowed and SINR shall be used in the criteria. So, we support to use SINR for determining whether the serving cell quality criteria is fulfilled or not.  **Issue 2-2-2**: Support option 3  The threshold for good serving cell quality criteria can be defined as (Qout+margin1) or (Qin+margin2), which is predefined.  **Issue 2-2-3a**: Support option 1a, option 1b is also acceptable for us.  The threshold Qin corresponds the level that UE starts to recovery. The threshold for good serving cell quality criteria can be defined as the level better than the threshold Qin.  **Issue 2-2-3b**: Support option 1a or 1c.  A RS resource can be configured as for both RLM and BFD evaluation. We suggest that the threshold for good serving cell quality criteria for BFD can be defined as same as the threshold for RLM.  **Issue 2-2-4a**: Support option 2  The corresponding level of good serving cell quality is independent of RLM-RS type and shall be same for different RLM-RS types.  **Issue 2-2-4b**: Support option 2  Same comments as issue 2-2-4a.  **Issue 2-2-5**: Support option C.  For option A, RLM/BFD evaluation period will be much shorter than RSRP measurement period used in R16 low mobility criterion. So the observed RSRP/SINR variation might be more impacted by the propagation characteristics than the mobility state. For option B, UE mobility state could change dynamically changing, and it is difficult for network to predict whether the low mobility criterion is fulfilled. So, we suggest that it is up to UE implementation on whether/how to perform the evaluation of low mobility criteria.  **Issue 2-2-6**: Support option 2.  UE perform SINR-like measurements for RLM/BFD evaluation. So, whether to perform RLM/BFD relaxation is more related to SINR variation. |
| Ericsson | **Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**  Option 1 is also acceptable to us.  **Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**  We support option 1.  **Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**  We support option 1. We prefer to first agree on the principle of using option 1. If option 1 is agreed, then RAN4 can further discuss the values of X dB.  **Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**  We support option 1. We prefer to first agree on the principle of using option 1. If option 1 is agreed, then RAN4 can further discuss the values of Y dB.  **Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**  We are fine to use different thresholds if there are significant differences. It should be based on the performance(simulation results) that were carried out and summarized at last meeting. Thus it is OK to keep it as FFS.  **Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**  We are fine to use different thresholds if there are significant differences. It should be based on the performance(simulation results) that were carried out and summarized at last meeting. Thus it is OK to keep it as FFS.  **Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**  We support option B, but can compromise to option A provided that the variation thresholds are configured by the NW.  **Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**  We prefer to first resolve issue 2-2-5, i.e. agree on the principle before details can be discussed. If issue 2-2-5 is resolved and option is A is agreed then issue 2-2-6 can be discussed.  **Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**  We prefer to first resolve issue 2-2-5, i.e. agree on the principle. If issue 2-2-5 is resolved and option is A is agreed then RAN4 can discuss the details of the parameters in issue 2-2-7. |
| CMCC | Issue 2-2-1: Option1.  Issue 2-2-2: Option2, Option1 is also fine for us. For this issue, we first prefer network configured the threshold. Moreover, in order to reduce the complexity of the network configuration, We can pre-defined a set of discrete threshold values or the upper/lower bound of threshold. When network do the configuration, it can choose a reasonable one from the set or the range.  Issue 2-2-3a/b: This issue is based on the conclusion of Issue 2-2-2. We can come back to these two issues after a conclusion is achieved in Issue 2-2-2.  Issue 2-2-4a/b: Similar with Issue 2-2-3, this issue is based on the conclusion of Issue 2-2-2. If the threshold is configured by network, then of course different thresholds can be used for different scenarios and it does not need to be reflected in the spec explicitly.  Issue 2-2-5: Option A. We are fine with add RSRP variation in low mobility criterion. Besides, we still think the SINR variation is important for RLM/BFD relaxation especially when the SINR threshold for power saving relaxation is not very high. L3 SINR can be used for SINR variation evaluation. The evaluation period of RSRP variation and SINR variation can be the same. |
| Xiaomi | Issue 2-2-1: Option 1.  Issue 2-2-2: Prefer pre-defined thresholds values for serving cell quality criteria. Support Option 3 and can compromise to option 2.  Issue 2-2-3a: Support Option1.  Issue 2-2-3b: Support Option1.  Issue 2-2-5: Prefer option A.  Issue 2-2-6: Slightly prefer option 1.  Issue 2-2-7: Option1 and 1a. Prefer to follow the same mechanism as the low-mobility criterion in R16 RRM relaxation. |
| MTK | **Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**  We support option 1.  **Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**  We support option 1 and option 2.  **Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**  Option 1 is agreeable  **Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**  Option 1 is agreeable  **Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**  Option 1 is agreeable  **Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**  Option 1 is agreeable  **Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**  We support option A, C.  For option A, it is reasonable to identify UE mobility based on SINR, because it can reflect the SINR variation for “RLM/BFD” performance.  For option C, UE has its own algorithm to monitor the UE speed. As a UE vendor, we do have confidence that option C is applicable. However, considering that RAN4 still needs a clear low mobility definition for UE to test, so we can compromise to the majority view, i.e., option A.  **Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**  We support option 2.  SINR value (as the performance metric for the RLM/BFD) is an averaged value. That can reduce the interference impact. RSRP is a L3 measurement, UE has different implementation for L1 and L3 measurement. It is not suitable to be used to determine the L1 measurement performance.  **Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**  Low mobility criteria can be configuration. |
| CATT | **Issue 2-2-1:**  **Support option 1. For RLM, it is SINR based. For option 3, it just only SS-SINR. How about CSI-RS as the RLM resource?**  **Issue 2-2-2**  **Agree the recommended WF.**  **Issue 2-2-3a & Issue 2-2-3b**  **Support option 1 and leave Y as FFS**  **Issue 2-2-4a & Issue 2-2-4b:**  **Depends on conclusion on other open issues.**  **Issue 2-2-5:**  **The Options are not exclusive.**  **Issue 2-2-6&Issue 2-2-7:**  **Wait for the conclusion of 2-2-5.** |

#### Sub-topic 2-3 Exiting Relaxation criteria

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 2-3-1: Exiting criteria of RLM/BFD relaxation - Basic**  We are not sure about the meaning of option 1. Our understanding is aligned with option 2. Such delay requirement in option 2 is only defined for the first out-of-sync indication. UE will make sure it has already fallen back to normal measurement if it has identified one out-of-sync indication.  **Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**  We support option 2a. After double check we find out that the wording of option 2 is not aligned with option 2a. Therefore, we think option 2a should be option 3. QC’s further proposal is also fine.  We can also accept option 1 or 1a. But option 2 seems don’t work since there could be ping-pong effect. 1b/1c/1d can be FFS if option 1 is agreed.  **Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**  Firstly, we are not sure whether the SINR here refers to the measured SINR in UE, or the actual SINR. It seems only measured SINR make sense. It is better clarified in the title.  Secondly, if it is measured SINR, UE should be able to fall back to the normal mode if this SINR is below Qout, and therefore **option 1 is supported**. This is aligned with our proposal that “UE will make sure it has already fallen back to normal measurement if it has identified one out-of-sync indication.”  Thirdly, we do not quite understand the wording of option 2, and some clarification is needed. For example, if UE is not required to send the first out-of-sync indication, does that mean the UE is only allowed not to send the indication, but is still required to identify the second o-o-s in time, while the requirement for identifying the second o-o-s is still the R16 requirement plus 1.5 DRX cycle? If so we think this is not relaxation. This contradicts with the previous agreements on the feasible scenarios for relaxation. Based on that, **if no further clarification can be provided on option 2, we object option 2**.  **Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**  Similar comments as 2-3-2. We support option 3.  Option 2 also make sense, if it can be interpreted as “UE will make sure it has already fallen back to normal measurement if it has identified one beam failure indication.”  For option 1, we think it is also OK. Proposal from Huawei on the fixed 6dB margin is not necessary. We think this margin can be configurable.  **Issue 2-3-5: Re-entry to the relaxation mode**  We think this issue can be further discussed in RAN2. Timer based solutions are normally discussed in RAN2. |
| ZTE | 2-3-1:  Support Option 1, which is to exit relaxation mode at least when any entering relaxation criterion is not met. Here we say “at least” so this should be agreeable. |
| QC | **Issue 2-3-1:**  We suggest not to discuss this issue and focus on issue 2-3-2 in the second round. If we compare the opinion of 2-2-3a, 2-3-1 and 2-3-2, most of them contradict each other. List the contradictions of proponents of option 1 below.  Huawei:  Entering condition: SINR > Qout + 10dB (from 2-2-3a)  Exiting condition:  a. at least when any entering condition not satisfied, i.e., SINR<=Qout+10dB (from 2-3-1)  b. SINR<=Qout+7dB (from 2-3-2)  When Qout + 7dB <=SNR <=Qout+10dB, a indicates exiting but b indicating stay, which is a contradiction. In fact, b is a subset of a. Hence only when 2-3-1 is skipped, 2-3-2 discussion is meaningful.  MTK:  2-3-1 option 1: exit relaxation mode at least when any entering relaxation criterion is not met  2-3-2 option 1a： a hysteresis value could be used to avoid ping-ping effect, e.g. SINRexit = SINRenter - 3dB  When SINRexit < SINR < SINRenter, based on option 1 in 2-3-1, UE should exit relaxation mode. However, based on option 1a in 2-3-2, UE should stay in relaxation mode. We consider this as a conflict between options. In fact, b is a subset of a. Hence only when 2-3-1 is skipped, 2-3-2 discussion is meaningful.  Intel:  Entering condition: SINR > Qin + margin (from 2-2-3a)  Exiting condition:  a. at least when any entering condition not satisfied, i.e., SINR<=Qin+margin (from 2-3-1)  b. SINR<=Qout+margin or Qout (from 2-3-2)  Since Qin > Qout, when Qout + margin <=SNR <=Qin+margin, a indicates exiting but b indicating stay, which is a contradiction. b is obviously a subset of a. Hence only when 2-3-1 is skipped, 2-3-2 discussion is meaningful.  **Issue 2-3-2:**  We support option 2. But how the “radio link quality” is evaluated is subject to discussion in sub-topic 2-4. Since UE doesn’t report “exit power saving mode”, only when SINR <= Qout UE has to report OOS and network/TE can determine whether UE correctly exit power saving mode through OOS indication. Therefore, setting the exit threshold as Qout is a better option.  **Issue 2-3-3:**  Since this is the behavior in relaxation mode, should we discuss this in sub-topic 2-4?  Our understanding of option 2 is that when UE is in relaxation mode, UE is not required to send the first Qout indication to higher layers, and the measurement samples taken within relaxation mode are not used for OOS indication evaluation.  With such clarification, since the measurement samples taken within relaxation mode are not used for OOS indication evaluation, Tevaluation is needed after UE exits relaxation mode. Hope this clarification can address Vivo’s question posted above.  **Issue 2-3-4:**  Since BFD can reuse RLM mechanism, we suggest coming back to BFD related mechanism after RLM is finalized.  **Issue 2-3-5:**  We are open to discuss timer to ensure entering relaxation mode only when SNR is stable, but the proposed mechanism seems to complicated and depends on RLF, we prefer a version of simple timer taken into consideration in entering condition. |
| Apple | Issue 2-3-1: Support WF  Issue 2-3-2: We do not see the benefit of defining additional exit criterion. We see option 2 and option 3 are already agreed as summarized in the background.  Issue 2-3-3: option 1.  Issue 2-3-4: similar comment as 2-3-2.  Issue 2-3-5: Do not see the motivation to define punish period. |
| Nokia | **Issue 2-3-1: Exiting criteria of RLM/BFD relaxation – Basic**  We think the exit criterion is also up to network configuration as entering criterion. For option 1, it would be good to clarify what is “entering relaxation criterion is not met”. This shall be properly designed to avoid Ping-pong. The exit criterion may not be the same as entering criterion  **Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**  We support Option 2 in principle. And we would like to add Option 2b in case it is not exactly the same with Option 2a.   * Option 2b: UE shall revert to non-relaxed RLM/BFD measurement and evaluation period at the 1st Qout based on relaxed RLM/BFD measurements and evaluation period. (Nokia)   **Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**  We support Option 2.  **Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**  We prefer the solution in line with the solution for RLM. Need further discussion.  **Issue 2-3-5: Re-entry to the relaxation mode**  It would be difficult to discuss re-entry without conclusion on the entering and exit criteria. This can be postponed until the basic criteria are concluded. |
| Intel | **Issue 2-3-1:** We don’t agree with option 1. From our understanding, entering and existing criteria are two different levels. Which are similar with that of INS and OOS. Otherwise, there will be ping-pong issues for frequently entering and existing power saving mode.  **Issue 2-3-2:** support option 1c.  **Issue 2-3-4:** Support option 1. |
| Huawei | **Issue 2-3-1**: Support option 1.  UE revert to normal RLM evaluation when the entering relaxation criteria is not fulfilled.  **Issue 2-3-2**: Support option 1a or 1b.  If the entering threshold is defined as Qout+10dB, then the exiting threshold can be defined as Qout+7dB. A hysteresis value can be used. The difference between entering threshold and exiting threshold can be defined as 3dB.  **Issue 2-3-3**:  Both entering threshold and exiting threshold are higher than Qout. UE will not perform RLM/BFD relaxation when the link quality starts to get worse. UE shall revert to normal RLM evaluation before SINR is worse than Qout.  **Issue 2-3-4**: Support option 1  The same methodology of deriving exiting threshold for RLM relaxation can be used for BFD relaxation.  **Issue 2-3-5**:  When both entering threshold and exiting threshold are higher than Qout and a hysteresis value is used to avoid ping-ping effect, then there is no need to introduce the punish period. UE starts to perform in-sync evaluation after out-of-sync is detected. However, UE will revert to normal RLM evaluation before out-of-sync is detected. |
| Ericsson | **Issue 2-3-1: Exiting criteria of RLM/BFD relaxation – Basic**  We already have a number conditions for exiting agreed from earlier meeting cited in the background. Does option 1 mean if the UE is no longer fulfilling any of serving cell quality condition, DRX cycle length allowed for relaxation and low mobility condition, then UE shall exit? If that is the understanding, we can agree to option 1.  **Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**  Option 2 needs to be clarified, it seems it includes both condition to exiting and re-entering (re-entering should be separated), but the issue is about exiting only. We can agree that the UE shall exit the relaxation mode when the radio link quality is worse than Qout.  **Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**  We would like to introduce a new option (aka option 3)  Option 3: The legacy RLM/BFD behavior shall apply.  **Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**  We also support option 2. Upon the first detection of BFD, UE should revert to normal mode and search for candidate beams to avoid failure.  **Issue 2-3-5: Re-entry to the relaxation mode**  Since this option is brought up for the first time, we would like to keep it open and study it until next meeting. It can be captured as FFS. |
| CMCC | Issue 2-3-1: Option1 may lead to Ping-Pong effect. We prefer exiting the relaxation mode when any exit relaxation criterions are met  Issue 2-3-2: We prefer Option3. Based on our contribution, we would like to update Option3 to “exit when certain consecutive OOS indications or 1 OOS indication”. We think Option3 is a sub-set of Option2 if UE exit right after 1 OOS indication. In order to further reduce the revert latency, we can compromise to Option1+Option3.  Issue 2-3-3: Option1, UE should start N310 immediately and revert to normal measurement mode.  Issue 2-3-4: Option2. In order to further decrease the revert latency, we can compromise to Option1+Option2.  Issue 2-3-5: Option1. UE will revert due to the serving cell’s quality lower than revert threshold or the channel quality is not stable. UE does not need to perform the power saving evaluation in the punish period. If the channel quality is not stable, the punish period can avoid UE enter and quit relaxation mode frequently. Therefore, we think a punish time is feasible and necessary. |
| Xiaomi | Issue 2-3-2: Support option 2. For Option 3, we prefer UE to exit relaxation mode upon 1 OOS indication.  Based on the current RLM/BFD operation, the indication of OOS / Beam Failure Instance has already implied the bad or unstable connection between the UE and the serving cell. We prefer to take full advantage of existing mechanism and minimized the additional cost.  Issue 2-3-3: Clarification is needed about the SINR here.  In our understanding, the UE compares the SINR of each RLM RS to Qout, and if the SINR of all RLM RSs is worse than Qout, out-of-sync indication would be indicated to higher layers. Does the SINR here means the SINR of a single RLM-RS?  Issue 2-3-4: Support option 2.  Issue 2-3-5: We think there is no necessity to consider the re-entry requirement as RAN4 has decided to define the enter and exist requirement. |
| MTK | **Issue 2-3-1: Exiting criteria of RLM/BFD relaxation - Basic**  Option 1 is agreeable. We share the same understanding with Ericsson for the meaning of option 1.  **Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**  We support option 1. The intention for option 1 is to avoid the ping-pong effect, under the assumption that “UE should exit relaxation mode when serving cell quality criterion is not met”  **Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**  When UE stays in the relaxation mode and the SINR value is worse than Qout, UE should start the N310 counter immediately and back to the RLM/BFD normal measurement. That is our understanding for option 1.  **Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**  Support option 1 |
| CATT | Issue 2-3-2: support option 1. For option 2. It is the same as option 1 with no margin.  Issue 2-3-3: UE revert to normal RLM and the use the same behavior in normal RLM then.  Issue 2-3-5: Do not think UE should be punished to re-entry to the relaxation mode. As long as the condition is met, it can be relaxed again. |

#### Sub-topic 2-4 During Relaxation

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**  We can accept option 1. This is aligned with previous agreements. However, in our understanding, the scope of option 1 should be limited based on the out-come of 2-3-3.  For option 2, since it says that “The evaluation period, Tevaluate\_out\_xxx is unchangedwhen UE is allowed to relax RLM/BFD measurements.”, we object this option 2. In previous meetings the feasible scenarios on RLM/BFD relaxation is already agreed. We do not understand why the requirements are unchanged and not relaxed.  Regarding the indication period, we see the requirement is that UE needs to separate o-o-s indications by at least Tindication\_interval, and there are no requirements on whether UE has to send o-o-s indication to higher layer once per Tindication\_interval in TS 38.133. The only restriction lies in the RAN1 spec TS 38.213, while UE needs to assess RLM resources once per indication period. In our understanding this indication period refers to the Tindication\_interval, because only in this case the R15/R16 requirements on the oos evaluation periods can be fulfilled. However, if Tevaluate\_out\_xxx is relaxed, we do not see the necessity to ensure UE assess RLM resources once per indication period. The restrictions in TS 38.213 should be removed or revised for R17 power-saving capable UE, but there is no need to modify Tindication\_interval.  Option 2a aligns to our proposal best. In our understanding this is not under option 2, but a more reasonable solution. In our understanding, the requirements to identify the first o-o-s in option 2a are Tevaluate\_out\_xxx\_ps+ Tevaluation\_out\_xxx, and clearly the requirements are no longer Tevaluate\_out\_xxx.  In all, we prefer option 2a, can accept option 1 if the scope is limited by 2-3-3. We object option 2.  **Issue 2-4-2: Relaxed evaluation period of RLM/BFD**  We support option 4. The proposal is based on previous evaluation results and the observations achieved in previous meetings.  Option 1 and 2 are also acceptable for us. Option 1a may cause monotonicity issue, since o-o-s evaluation periods of 120ms DRX are less than that for 80ms, and it can be FFS.  For option 3, as discussed in 2-4-1, we think indication period defines the minimal separation for o-o-s indication. It is not needed to be extended. Only TS 38.213 needs to be revised based on the outcome of this WI.  **Issue 2-4-3: Relaxation scheme and specification impact**  **Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**  **Issue 2-4-4b: Different Relaxation factors for different SINR range**  These can be FFS pending on issue 2-4-1 and 2-4-2.  **Issue 2-4-4c: Other consideration on Relaxation factors**  In our understanding, if option 1 in 2-4-1 is agreed, this proposal is automatically confirmed.  **Issue 2-4-5: Additional N310/N311 values for relaxation mode**  This issue is up to RAN2. They should be further discussed in RAN2. |
| QC | **Issue 2-4-1**  It seems to us that difference between companies’ opinions are not whether to extend the period, the difference is what the “evaluation period” refers to? Based on Nokia’s description and combine with their opinion in issue 2-3-3, the “evaluation period” they refer to is the evaluation period before UE exit relaxation mode, and no OOS is indicated in this evaluation period. However, for the proponents of option 1, the evaluation period including OOS indication, i.e., the OOS indication has to be sent in the end of evaluation period if SNR is below Qout. Therefore, we suggest discussing the following topics:   * Topic A: evaluation period in relaxation mode   Option 1: Do not send OOS indication during relaxation mode. OOS indication is evaluated following R15 procedure after exit relaxation mode. Total evaluation period is the summation of evaluation period in relaxation mode and the R15 evaluation period (after exit relaxation mode until the first OOS indication). Total evaluation period can be presented as a scaled version of RLM/BFD evaluation period in R15.  Option 1a: evaluation period in relaxation mode is equal to the evaluation period in R15  Option 2: In relaxation mode, UE can send OOS indication. The evaluation period for the first OOS indication can be presented as a scaling version of RLM/BFD evaluation period in R15.  Note that the measurement used in the exiting relaxation criterion wasn’t defined in sub-topic 2-3. The number of samples is also mentioned in option 2, therefore, we suggest to separate the discussion as the following topic:   * Topic B: SNR evaluation during relaxation mode   Option 1: UE is allowed to take less samples in relaxation mode within the evaluation period if UE can guarantee the miss detection of SNR<Qout probability is negligible.  Option 2: UE is expected to take 10 samples as R15 in evaluation period in relaxation mode. |
| Apple | Issue 2-4-1: Option 1.  Issue 2-4-2: We support first part of option 1 “Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS))”. Value of Y in the table needs FFS.  Issue 2-4-3: OK  Issue 2-4-4a: Support WF  Issue 2-4-4b: Open to discuss  Issue 2-4-4c: support option 1.  Issue 2-4-5: : If UE exist relaxation mode once N310 starts to count, we do not see how the new set of value is used. |
| Nokia | **Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**  Option 2. For option 2a, it seems not aligned with the general statement in Option 2? Could company clarify it a bit?  **Issue 2-4-2: Relaxed evaluation period of RLM/BFD**  We can come to the details after conclusion on Issue 2-4-1.  **Issue 2-4-3: Relaxation scheme and specification impact**  Option 1 is agreeable.  **Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**  Option 1 is agreeable  **Issue 2-4-4b: Different Relaxation factors for different SINR range**  SINR is not defined. And how much benefit there would be considering the complexity of UE implementation? This seems overdesigning the relaxation behaviour.  **Issue 2-4-4c: Other consideration on Relaxation factors**  We can come to the details after the general principles are concluded.  **Issue 2-4-5: Additional N310/N311 values for relaxation mode**  Support Option 1. |
| Intel | **Issue 2-4-1:** Partly agree with option 2. we are fine that UE can use less samples at good channel conditions. But it’s FFS whether UE can use less samples during the whole relaxation period. Since if less samples are used, the measurement accuracy will be reduced. The applied condition may needs further check. |
| Huawei | **Issue 2-4-1**:  Both option 1 and option 2 are acceptable for us.  **Issue 2-4-2**:  Both option 1 and reusing the RLM/BFD evaluation period are acceptable for us.  **Issue 2-4-3**:  Since RLM/BFD relaxation can be allowed for short DRX cycle. However, the existing RLM/BFD requirements will be applied for both non-DRX mode and DRX mode. We do not suggest to introduce new section only for short DRX cycle.  **Issue 2-4-4a/b/c**:  The relaxation factor used by UE is up to UE implementation. But the UEs with different implementations shall apply the same evaluation period requirements.  **Issue 2-4-5**:  As we commented above, UE shall revert to normal RLM evaluation before the link quality starts to get worse. There is no need to configure another set of T310/N310/N311 parameters. |
| Ericsson | **Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**  We prefer to maintain the previous agreement which is option 1.  **Issue 2-4-2: Relaxed evaluation period of RLM/BFD**  We support option 3. Option 3 may further be modified to only include the scaling of the evaluation period, and not the indication interval. Option 3 is also a simple approach compared to the other options, and this approach was also used for the IDLE mode relaxation in release 16.  **Issue 2-4-3: Relaxation scheme and specification impact**  We support option 1. For clarity and convenience specification reading, also following earlier approach from release 16 IDLE mode relaxed requirements, it is proposed to define the relaxed RLM/BFD requirements in new sections.  **Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**  We support option 1. We support option 1. The simulation results show different performance between FR1 and FR2 which is the motivation for allowing different relaxation factor s for FR1 and FR2.  **Issue 2-4-4b: Different Relaxation factors for different SINR range**  We support option 1. The simulation results show different performance depending on the SINR region. Thus it is reasonable to assume different level of relaxation depending on the SINR range.  **Issue 2-4-4c: Other consideration on Relaxation factors**  We have observed different performance depending on how frequent UE measures. For example, our results show that more relaxation canb e allowed when UE is configured with short DRX cycles (shorter than 80 ms) especially for FR2. Therefore we support that relaxation factor can differently for the even shorter DRX cycles (shorter than 80 ms).  **Issue 2-4-5: Additional N310/N311 values for relaxation mode**  Our understanding is also that it is possible for the NW to configure different values of the RLF parameters as these parameters are configurable values. |
| CMCC | Issue 2-4-1: Option 1.  Issue 2-4-2: Option1 and Option 3. Besides, for Option1, we would like to further clarify that the indication period should Max(10ms, [Y]×1.5 × DRX\_cycle\_length, [Y]×1.5 × TRLM-RS,M))  Issue 2-4-3: We can come back to this issue after we achieve a conclusion about how to capture the relaxation factor.  Issue 2-4-4a/b/c: Basically, we are Ok with Option1 for these three issues. However, if the maximum relaxation factor=2, then we need not to further discuss this issue.  Issue 2-4-5: Based on our understanding, network can always reconfigure the counter and timer values, a new counter or timer is more suitable for power saving mode in case of network frequent configure and re-configure. However, with Option1 and Option3 in Issue 2-3-2, this additional N310/N311 value is not needed from our point of view. |
| Xiaomi | **Issue 2-4-1**:  Prefer option 1.  **Issue 2-4-2**:  Prefer option 3.  **Issue 2-4-3**:  Ok with the proposal.  **Issue 2-4-5**:  Wait for the conclusion of other open issues. |
| MTK | **Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**  Support option 1.  **Issue 2-4-2: Relaxed evaluation period of RLM/BFD**  We support option 3. Option 1 is also agreeable if the values of Y can be further extended when K=4.  **Issue 2-4-3: Relaxation scheme and specification impact**  Option 1 is agreeable.  **Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**  Option 1 is agreeable.  **Issue 2-4-4b: Different Relaxation factors for different SINR range**  These can be FFS pending on issue 2-4-1 and 2-4-2.  **Issue 2-4-4c: Other consideration on Relaxation factors**  Based on our SLS evaluation results, different relaxation factors should be allowed for different DRX cycle. |
| QC  (added by Moderator) | **Issue 2-4-1**  To Nokia and supporter of option 2: could you please check our previous comment above, and see if option 1 in newly proposed Topic A and Topic B aligns to your understanding of option 2? We hope these new options are more clear than our previous proposed option. |
| CATT | **Issue 2-4-1:**  **Support option 1.**  **Issue 2-4-2:**  **Support option 1. But the Y is not in option 1a.**  **Issue 2-4-3:**  **Decide it later when it is more clear.**  **Issue 2-4-4a: option 1.**  **Issue 2-4-4b: need more evidence.**  **Issue 2-4-4c: The proposal is agreeable.** |

#### Sub-topic 2-5 Other Aspects

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 2-5-1: Entering relaxation mode in intra-band CA**  **Issue 2-5-2: Exiting Relaxation criteria in intra-band CA**  We support option 2 for both issues. We do not see the feasible scenarios for option 1.  **Issue 2-5-3: Entering and Exiting Relaxation criteria for multiple RLM-RS/BFD-RS**  The motivation behind the proposal is fine. The threshold is anyway FFS in sub-topic 2-2 and 2-3. Therefore, this issue can also be FFS. |
| Nokia | To be further discussed after the RLF/BFD relaxation is concluded. |
| Huawei | **Issue 2-5-1/2**: Option 2.  For intra-band CA, the existing RLM/BFD requirements are applied when the UE is required to perform both RLM and BFD evaluation on one serving cell (PCell or PSCell). There is no need to further discuss the case UE will perform RLM/BFD evaluation on multiple serving cells. |
| Ericsson | **Issue 2-5-1: Entering relaxation mode in intra-band CA**  Option 1 is agreeable to us. We have checked the specification further and the scenario is still a valid. In 38.133, it is stated that the BFD requirements are not applicable if the UE is required to perform beam failure detection on more than 1 serving cell per band. The specification still allows the NW to configure CSI-RS for RLM on SpCell and CSI-RS for BFD on SCell (in same band as SpCell). Also, for BFD, two searchers are assumed in the BFD evaluation requirements as they are defined based on PBFD, see below text from TS 38.133:  *“The values of PBFD used in Table 8.5.3.2-1 and Table 8.5.3.2-2 are defined as*  *For each CSI-RS resource in the set  configured for PCell or PSCell in EN-DC or NE-DC or SA; or PCell in NR-DC*  *-     PBFD = 1.*  *For each CSI-RS resource in the set  configured for PSCell in NR-DC*  *PBFD = 2 if UE is configured for beam failure detection on SCell, 1 otherwise.*  *For each CSI-RS resource in the set  configured for a SCell*  *-     PBFD = Z in EN-DC or NE-DC or SA.*  *-     PBFD = 2\* Z in NR-DC.*  *Where Z is the number of band(s) on which UE is performing beam failure detection only for SCell.*  ***Table 8.5.3.2-1: Evaluation period TEvaluate\_BFD\_CSI-RS for FR1***   |  |  | | --- | --- | | *Configuration* | *TEvaluate\_BFD\_CSI-RS (ms)* | | *no DRX* | *Max(50, [MBFD  P  PBFD]  TCSI-RS)* | | *DRX cycle ≤ 320ms* | *Max(50, [1.5 × MBFD  P  PBFD]  Max(TDRX, TCSI-RS))* | | *DRX cycle > 320ms* | *[MBFD  P  PBFD]  TDRX* | | *Note:      TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length.* | |   “  Based on the above, NW can configure the UE to CSI-RS based RLM on SpCell and CSI-RS based BFD in SCell in the same band. Such configuration can be useful in the NW, e.g. for distributing the load of the RLM-RS and BFD-RS on the different serving cells. Since it is a valid and realistic scenario allowed by specification, we propose to agree on option 1.  **Issue 2-5-2: Exiting Relaxation criteria in intra-band CA**  For the same argument as in issue 2-5-1, we propose to agree on option1.  **Issue 2-5-3: Entering and Exiting Relaxation criteria for multiple RLM-RS/BFD-RS**  We are fine with the proposal but would like to keep the value as FFS for now. |
| CMCC | Issue 2-5-1: Option2  Issue 2-5-2: Option 2  Issue 2-5-3: In our view, the relaxation criteria should keep same for all RLM-RS/BFD-RS. UE can perform relaxed measurement only if all the RS-SINR can fulfill the criteria. |
| Xiaomi | **Issue 2-5-1/2**: Option 2.  In our understanding, the BFD operation for SCell is independent from other SCell(s) or SpCell. Thus, it is a realistic scenario that on the same band the UE does BFD on SCell while performs RLM on SpCell.  However, in our view, UE would always have to perform BFD on SpCell through explicitly configured RS or implicitly indicated RS. Then, for the case UE does BFD on SCell while performs RLM on SpCell, there would be no requirements for BFD as BFD on SpCell would be applied anyhow. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

Sub-topic 2-1 Relaxation Scenarios



**Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**

|  |
| --- |
| **Status summary** |
| *Statuss: Majority view is Option 1.*  *Recommendations for 2nd round:*  *@ Huawei, if the concern is the predefined criteria, would it be agreeable:*  *“when any configurable criteria is configured, UE is not allowed to relax RLM/BFD”* |

**Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**

|  |
| --- |
| **Status summary** |
| *Tentative agreements: No*  *Status: Majority view is Option 1, but some concerns raised by companies. E.g. this is an invalid configuration.*  *Recommendations for 2nd round: Further discuss in the 2nd round. Proponent of Option 1 would provide clarification in the 2nd round.* |

**Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**

|  |
| --- |
| **Status summary** |
| *Tentative agreements: No*  *Status: Majority view is Option 2, but some concerns raised by companies.*  *Recommendations for 2nd round: Further discuss in the 2nd round.* |

**Issue 2-1-2: Relaxation for DRX cycles > 80ms**

|  |
| --- |
| **Status summary** |
| *Tentative agreements: Majority view is Option 1, but it may not need to have new agreement.*  *Recommendations for 2nd round: Proponent of Option 2 would provide clarification in the 2nd round.* |

**Issue 2-1-3: Relaxation for deployment scenarios**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* Relaxed BFD/RLM requirements shall be supported for all deployment scenarios supported by current specification which includes: NR SA, EN-DC, NE-DC, NR intra-band CA, NR inter-band CA and NR-DC. |

**Issue 2-1-4: System impact due to relaxation**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Status: All options are questioned by some companies.*  *Recommendations for 2nd round: Further discuss in the 2nd round.* |

Sub-topic 2-2 Entering Relaxation criteria

**Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Option 1 is the majority’s view.*  *My understanding on SINR in Option 1 is the SINR used as the legacy RLM/BFD to compare with Qin/Qout, which is based on Hypothetical PDCCH BLER. Beased on the mojority’s view, the WF is suggested.*  *Recommended WF:* UE reuse the SINR for RLM/BFD evaluation when determine whether the serving cell quality criteria is fulfilled or not |

**Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: My understanding is Option 2 and Option 1 can be merged, because the configured threshold will be based on a set of predefined values.*  *Recommended WF:* *Further discuss in the 2nd round.*   * Option 1: The thresholds are configured to the UE by the network based on a set of discrete threshold values. * Option 3: The parameters can be pre-defined. |

**Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Come back later. Focus on Issue 2-2-2.* |

**Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Focus on RLM first.* |

**Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**

**Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Not clear consensus. Come back next meeting.* |

**Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Option A is the majority’s view.*  *Recommended WF:* UE verifies whether the low mobility criterion is fulfilled or not based on the RSRP variation or SINR variation, provided that the variation thresholds are configured by the NW. |

**Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: No clear consensus, further discuss in the 2nd round.* |

**Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Merged into Issue 2-2-5.* |

Sub-topic 2-3 Exiting Relaxation criteria

**Issue 2-3-1: Exiting criteria of RLM/BFD relaxation – Basic**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Based on the comments, the option 1 can be clarified as*  *Option 1a: if the UE is no longer fulfilling any of serving cell quality condition, DRX cycle length allowed for relaxation and low mobility condition, UE will exit relaxation mode.*  Proponent may clarify the concerns from companies. |

**Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: No clear consensus. Further discuss in the 2nd round.* |

**Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: The issue will be triggered as Issue 2-4-0.*  *Based on the comments, the option 2 can be clarified as*   * Option 1:   + UE is required to send the first OOS indication to higher layers and start N310 immediately   + The evaluation period of the first OOS indication is the relaxed evaluation period in the relaxation mode. * Option 2:   + UE is not required to send the first OOS indication to higher layers.   + After exit, UE is required to send the first OOS indication after normal evaluation period if SNR<Qout. The evaluation period of the first OOS indication is the summation of the evaluation period in the relaxation mode + normal evaluation period. * Option 3: The legacy RLM/BFD behavior shall apply. |

**Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Focus on RLM first.* |

**Issue 2-3-5: Re-entry to the relaxation mode**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Come back next meeting.* |

Sub-topic 2-4 During Relaxation

**Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: This issue con be discussed and merged into Issue 2-4-0. (from Issue 2-3-3)* |

**Issue 2-4-2: Relaxed evaluation period of RLM/BFD**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: According to the received comments, work on WF based on:*   * + - Option 1: The similar definition of RLM/BFD evaluation period in Rel-15 can be reused as Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS)).     - FFS the Y     - Option 2: For FR1, If power saving conditions are satisfied, allow TEvaluate\_ps\_out\_SSB for the first OOS indication and the original TEvaluate\_out\_SSB doesn’t apply.     - Option 3: extended based on the legacy RLM/BFD requirements by considering the scaling factors.       * the new evaluation period TEvaluate\_out\_SSB-Relaxed is specified as K1\* TEvaluate\_out\_SSB, where TEvaluate\_out\_SSB is as specified in clause 8.1.3.2 in TS 38.133 .       * FFS the new indication period TIndication\_interval-Relaxed is specified as K2\* TIndication\_interval where TIndication\_interval is as specified in clause 8.1.6 in TS 38.133.     - Option 4 (**vivo**):       * For RLM, the oos triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.       * For BFD, the beam failure instance triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.       * Extending the out-of-sync evaluation period requirements and beam failure evaluation period requirements by a same factor X can be considered. X can be 2 for DRX <= 40ms, and X can be 1.5 for 40ms <DRX <= 80ms. |

**Issue 2-4-3: Relaxation scheme and specification impact**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Further discuss in the 2nd round.* |

**Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: Option 1 is the major’s view.*  *Recommended WF*: Different Relaxation factors are allowed for FR1 and FR2. |

**Issue 2-4-4b: Different Relaxation factors for different SINR range**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: No clear consensus. Come back next meeting.* |

**Issue 2-4-4c: Other consideration on Relaxation factors**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: No clear consensus. Come back next meeting.* |

**Issue 2-4-5: Additional N310/N311 values for relaxation mode**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommendations for 2nd round: No clear consensus. Come back next meeting.* |

**Sub-topic 2-5 Other Aspects**

**Issue 2-5-1: Entering relaxation mode in intra-band CA**

**Issue 2-5-2: Exiting Relaxation criteria in intra-band CA**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommended WF:* Company please indication should RAN4 specify RLM/BFD relaxation for the scenario that “CSI-RS based RLM on SpCell and CSI-RS based BFD in SCell in the same band.” |

**Issue 2-5-3: Entering and Exiting Relaxation criteria for multiple RLM-RS/BFD-RS**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* No.  *Recommended WF:*   * The relaxation condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is better than the threshold (Qout + X1) for **any** RLM-RS resource. * The exiting condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is worse than the threshold (Qout + X2) for **all** the RLM-RS resources. * FFS X1, X2 |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## 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”.*

### Sub-topic 2-1 Relaxation Scenarios

**Issue 2-1-1a: Relaxation when neither serving cell quality criteria nor low mobility criteria is configured**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: UE is not allowed to relax RLM/BFD. (Vivo, ZTE, CMCC, QC, Apple, Nokia, Intel, Ericsson, Xiaomi, MTK, CATT)   *Recommendations for 2nd round:*  *One company raised concern that “If the relaxation criterion is predefined, it seems that there is no need for network to configure the relaxation criterion.”*  *@ Huawei, if the concern is the predefined criteria, would the recommended WF be agreeable:*  *Recommended WF: when any configurable criteria is not configured, UE is not allowed to relax RLM/BFD* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-1-1b: Relaxation when only serving cell quality criterion is configured**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: when the serving cell quality criterion is fulfilled, the UE can enter the relaxation mode. (MTK, vivo, QC, [Nokia], Intel)   + Option 2 (new): disagree with Option 1. (Ericsson, CMCC, Xiaomi, CATT)   *Recommendations for 2nd round: Further discuss in the 2nd round.*  *Some concerns raised by companies in the 1st round. E.g. network will always configure two criterions, relaxation is only allow with short DRX cycle and low mobility. Proponent of Option 1 would provide clarification.* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-1-1c: Relaxation when both serving cell quality criteria and low mobility criteria are configured**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: when **either** serving cell quality criterion **or** low mobility criterion is fulfilled. (MTK)   + Option 2: **both** serving cell quality criterion **and** low mobility criterion are fulfilled. **(vivo.** Apple, Intel, CMCC, Xiaomi, CATT)   + Option 3: whether only one criterion is used (either low mobility criterion or good serving cell quality criterion) or both criteria are used separately, or both are to be used in combination e.g. to enter relaxation. (Nokia)   *Recommendations for 2nd round: Further discuss in the 2nd round. Majority view is Option 2, but some concerns raised by companies. Proponent of Option 2 would provide clarification.* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-1-2: Relaxation for DRX cycles > 80ms**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: No relaxation for DRX cycles > 80ms. (CMCC, CATT, vivo, Apple, Nokia, Xiaomi, MTK)   + Option 2: Adjust evaluation time for DRx cycles > 80ms when power saving condition is satisfied to keep monotonicity of evaluation time w.r.t. DRx cycle length, i.e., if power saving condition is satisfied, longer DRx cycles still has longer evaluation time. (QC)   + Option 3: defer this discussion. (QC)   *Recommendations for 2nd round: Majority view is Option 1, but it may not need to have new agreement because the agreement in last meeting seems sufficient. Besides, proponent of Option 2 also proposed to defer this discussion, so it suggests no further discuss in the 2nd round.* |

**Issue 2-1-3: Relaxation for deployment scenarios**

|  |
| --- |
| **Status summary** |
| *Tentative agreements:* Relaxed BFD/RLM requirements shall be supported for all deployment scenarios supported by current specification which includes: NR SA, EN-DC, NE-DC, NR intra-band CA, NR inter-band CA and NR-DC.  *Recommendations for 2nd round: No need to further discuss in the 2nd round. The WF will be prepared based on the Tentative agreements* |

**Issue 2-1-4: System impact due to relaxation**

|  |
| --- |
| **Status summary** |
| * Proposals:   + Option 1: Negative system level impact due to RLM/BFD relaxation should be minimized. (ZTE, [Nokia], Huawei, Ericsson, CMCC)   + Option 2: RAN4 further discuss whether the beneficial scenario is a reasonable case for network configuration. (CATT, Huawei, CMCC)   + Option 3: RAN4 should evaluate the maximum additional delay of RLF declaration introduced by power saving measurement relaxation to determine the feasibility of relaxation scheme options,as the analysis in the following for options on the previous WF: (Qualcomm, Nokia, [vivo])  |  |  | | --- | --- | | Options | Additional delay | | * Option 1: exit relaxation mode when any relaxation criterion is not met   + Option 1a: a hysteresis value (e.g. 3dB) could be used to avoid ping-ping effect. * Option 2: exit relaxation mode when the radio link quality is worse than a certain SINR threshold Thexit, which is higher than Qout. (includes option 2a and 2b) * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3a: exit when N310 starts to count, i.e. 1 out-of-sync indication. | (K-1)Tevaluation | | * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3b: exit when T310 is running witch is triggered by a new counter | (K-1) Tevaluation+(K-1)\*N310\* TIndication\_interval | | * Option 3: exit relaxation mode based on out-of-sync indication.   + Option 3c: exit when certain number of out-of-indications   + Option 3d: exit when certain consecutive out-of-sync indications | (K-1) Tevaluation + (K-1)\**n*\* TIndication\_interval |   *Recommendations for 2nd round: Further discuss in the 2nd round. Option 1 and Option 2 may not be specific enough to reach a concrete agreement. More clarification would be needed.* |

|  |  |
| --- | --- |
| Company |  |

### Sub-topic 2-2 Entering Relaxation criteria

**Issue 2-2-1: Good serving cell quality criteria for RLM/BFD: the radio link quality metric for RLM**

|  |
| --- |
| **Status summary** |
| * Supporting companies in the 1st round * Option 1: UE reuse the SINR for RLM/BFD evaluation when determine whether the serving cell quality criteria is fulfilled or not. (CMCC, CATT, Qualcomm, vivo, Intel, Huawei, Ericsson, Xiaomi, MTK) * Option 3: RAN4 to use SS-SINR as one possible threshold and, in addition to SS-SINR, RAN4 to define SS-RSRP and SS-RSRQ as configurable good serving cell quality criteria. (Nokia, Apple)   *Recommendations for 2nd round: The WF is suggested below based on Option 1, which is the majority’s view.*  *One companies asked clarification on “Could proponents of Option 1 clarify what SINR it is?”. Proponent of Option 1 could clarify. My understanding on SINR in Option 1 is the SINR used as the legacy RLM/BFD to compare with Qin/Qout, which is based on Hypothetical PDCCH BLER. Proponents of Option 1 could provide further clarification.*  *Recommended WF:* UE reuse the SINR for RLM/BFD evaluation when determine whether the serving cell quality criteria is fulfilled or not |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-2-2: Good serving cell quality criteria for RLM/BFD: predefined or configured threshold**

|  |
| --- |
| **Status summary** |
| * Supporting companies in the 1st round   + Option 1: The thresholds are configured to the UE by the network. (ZTE, CATT**,** vivo**,** Nokia, Apple, Ericsson, CMCC, MTK**)**   + Option 2: Pre-defined a set of discrete threshold values. When network configure the serving cell quality criteria, it chooses a reasonable one from the set. (CMCC, vivo, [Intel], [Xiaomi], MTK)   + Option 3: The parameters can be pre-defined. (Xiaomi, Huawei,QC, Intel)   *Recommendations for 2nd round: Further discuss in the 2nd round. My understanding is Option 2 and Option 1 can be merged, because the configured threshold will be based on a set of predefined values. And let us focus on entering criteria.*  *Recommended WF:* For the Good serving cell quality criteria to enter the RLM/BFD relaxation,   * Option A (merged): The thresholds are configured to the UE by the network based on a set of discrete threshold values. * Option B: The parameters can be pre-defined. |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-2-3a: Entering relaxation threshold of good serving cell quality criteria: for SSB based RLM**

|  |
| --- |
| **Status summary** |
| *Recommendations for 2nd round: Come back later. Focus on Issue 2-2-2.* |

**Issue 2-2-3b: Entering relaxation threshold of good serving cell quality criteria: for SSB based BFD**

*Focus on RLM first*

**Issue 2-2-4a: Whether the same or different threshold for SSB based and CSI-RS based RLM**

**Issue 2-2-4b: Whether the same or different threshold for SSB based and CSI-RS based BFD**

*Come back next meeting.*

**Issue 2-2-5: Low mobility criteria of RLM/BFD relaxation**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option A: UE verifies whether the low mobility criterion is fulfilled or not based on the RSRP variation or SINR variation (Xiaomi, Qualcomm**,** Nokia,[Ericsson], MTK, Apple**,** vivo, CMCC, ZTE**)**   + Option B: Network configures whether the low mobility criterion is fulfilled or not. (ZTE, Ericsson, Nokia, Vivo)   + Option C: It is up to UE to determine whether and how to perform the evaluation for low mobility criterion. (Huawei,MTK)   + Option D: RAN4 additionally to define a low mobility criterion based on the number of serving beam changes over time (e.g. TCI state change). (Nokia)   *Recommendations for 2nd round: Option A is the majority’s view and is fine for most of companies. Companies could compromise to Option A if the threshold are configurable.*  *Recommended WF:* UE verifies whether the low mobility criterion is fulfilled or not based on the RSRP variation or SINR variation, provided that the variation thresholds are configured by the NW. |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-2-6: Low mobility criteria of RLM/BFD relaxation – if Option A of issue 2-2-5 is agreed**

|  |
| --- |
| **Status summary** |
| * Proposals: UE verifies whether the low mobility criterion is fulfilled or not based on   + Option 1: RSRP variation (reuse R16 low mobility criterion and procedure) (Xiaomi, Nokia, vivo, Apple)     - Option 1a: If R16 low mobility condition is adapted, RAN4 derives SINR distribution for margin derivation from link level simulation without mobility and with small scale fading. ()   + Option 2: SINR variation (MTK, Huawei)     - Option 2a: Define an evaluation period, to check the L3 SINR values always higher than the SINR threshold (the threshold used in serving cell quality criteria). ()   *Recommendations for 2nd round: No clear consensus, further discuss in the 2nd round.* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-2-7: Low mobility criteria of RLM/BFD relaxation: predefined or configured parameters of Option A of issue 2-2-5**

*Merged into Issue 2-2-5.*

### Sub-topic 2-3 Exiting Relaxation criteria

**Issue 2-3-1: Exiting criteria of RLM/BFD relaxation – Basic**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: exit relaxation mode at least when any entering relaxation criterion is not met (CATT, Apple, ZTE, MTK, Huawei)   + Option 2: exit relaxation mode to fulfil the maximum additional delay requirement (QC, vivo)   *Recommendations for 2nd round: Based on the comments, in my view, the option 1 can be clarified as*   * *Option 1a: if the UE is no longer fulfilling any of serving cell quality condition, DRX cycle length allowed for relaxation and low mobility condition, UE will exit relaxation mode.*   Proponent may clarify the concerns from companies, e.g. ping-pong. |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-3-2: Exiting criteria of RLM relaxation – Additional**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: exit relaxation mode when the radio link quality of the serving cell is worse than a certain threshold, which is higher than Qout. (MTK, Intel, Huawei, CATT, vivo)     - Option 1a: a hysteresis value could be used to avoid ping-ping effect, e.g. SINRexit = SINRenter - 3dB (MTK, Huawei,vivo)     - Option 1b: SINRexit = Qout + 7dB (Huawei)     - Option 1c: SINRexit = Qout +Margin or SINRexit = Qin (Intel)     - Option 1d: The threshold can be configured by network with margin (CATT)   + Option 2: exit relaxation mode when the radio link quality is worse than Qout, and the UE is still in the relaxation mode when the radio link quality is better than Qout. (Xiaomi, Nokia, CMCC, QC)     - Option 2b: UE shall revert to non-relaxed RLM/BFD measurement and evaluation period at the 1st Qout based on relaxed RLM/BFD measurements and evaluation period. (Nokia)   + Option 2a: Leave the fall back mechanism as UE implementation, as long as UE makes sure it has already fallen back to normal measurement if it has identified one out-of-sync indication. (vivo**,** QC)   + Option 3: exit when certain consecutive out-of-sync indications (CMCC)   *Recommendations for 2nd round: Further discuss in the 2nd round. Proponents please provide clarification regarding the question raised in the 1st round.* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-3-3: UE behaviour when the SINR is worse than Qout during the relaxation mode**

*To be discussed in Issue 2-4-0.*

**Issue 2-3-4: Exiting criteria of BFD relaxation – Additional**

*Focus on RLM first.*

**Issue 2-3-5: Re-entry to the relaxation mode**

*Come back next meeting.*

### Sub-topic 2-4 During Relaxation

**Issue 2-4-0: UE behaviour when the measured SINR is worse than Qout during the relaxation mode**

|  |
| --- |
| **Status summary** |
| * Proposals for Issue 2-3-3   + Option 1: UE should start N310 immediately (MTK, vivo, Apple, CMCC)   + Option 2: When relaxation is applied, UE is not required to send the first Qout indication to higher layers. (Nokia, QC)   + Option 3 (new): The legacy RLM/BFD behavior shall apply. (Ericsson)   *Recommendations for 2nd round: The issue is re-numbered from Issue 2-3-3. The title is clarified as “measured SINR”. Continue discussion, and the conclusion will be capture in WF.*  *Based on the comments, the options can be clarified as*   * Option 1:   + UE is required to send the first OOS indication to higher layers and start N310 immediately   + The evaluation period of the first OOS indication is the relaxed evaluation period in the relaxation mode. * Option 2:   + UE is not required to send the first OOS indication to higher layers.   + After exit, UE is required to send the first OOS indication after normal evaluation period if SNR<Qout. The evaluation period of the first OOS indication is the summation of the evaluation period in the relaxation mode + normal evaluation period. * Option 3: The legacy RLM/BFD behavior shall apply.   All options seem to exit relaxation mode, but the main difference between Option 1 and Option 2 would be the “observation period” for the exit criteria. It would be good to clarify the general UE behavior before other issues of topic 2-4.  Companies please also provide your preference and pros/cons for the following questions:  Given the evaluation period of the 1st OOS, i.e. the time period that UE is required to send the OOS indication when UE has been in the relaxation mode, is K\*(normal OOS evaluation period),  Q1: what is the observation period for the exit criteria during the relaxation mode?   * Option A1: K\*(normal OOS evaluation period).   + Note: It is related to Option 1 to my understanding. * Option A2: (K-1)\*(normal OOS evaluation period).   + Note: It is related to Option 2 to my understanding. * Any other options?   Q2: what is the evaluation period of OOS during the relaxation mode?   * Option B1: K\*(normal OOS evaluation period). UE may already exist relaxation in some cases.   + Note: It is related to Option 1 to my understanding. * Option B2: no OOS will be send in the relaxation mode. The OOS will be sent “after” exiting the relaxation mode.   + Note: It is related to Option 2 to my understanding. * Any other options?   Besides, based my observation on the following figures, there is no big difference on the OOS delay observed between Option 1 and Option 2. Companies may provide further clarification on in which scenario the Option 1 and Option 2 will have different OOS delay. |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-4-1: Clarification about the previous agreement on extended RLM/BFD evaluation period in relaxation mode**

*merged into Issue 2-4-0. (from Issue 2-3-3)*

**Issue 2-4-2: Relaxed evaluation period of RLM/BFD**

|  |
| --- |
| **Status summary** |
| *Recommendations for 2nd round: Continue discussion, and the conclusion will be capture in WF. According to the received comments, work on WF based on:*   * + - Option 1 (Apple, Huawei, CMCC, MTK, CATT):     - The similar definition of RLM/BFD evaluation period in Rel-15 can be reused as Max(T, Ceil([Y] x P x N) x Max(TDRX, TRLM-RS/BFD-RS)).       * FFS the Y     - Option 2 ():     - For FR1, If power saving conditions are satisfied, allow TEvaluate\_ps\_out\_SSB for the first OOS indication and the original TEvaluate\_out\_SSB doesn’t apply.     - Option 3 (Huawei, Ericsson, CMCC, Xiaomi, MTK): extended based on the legacy RLM/BFD requirements by considering the scaling factors.       * the new evaluation period TEvaluate\_out\_SSB-Relaxed is specified as K1\* TEvaluate\_out\_SSB, where TEvaluate\_out\_SSB is as specified in clause 8.1.3.2 in TS 38.133 .       * FFS the new indication period TIndication\_interval-Relaxed is specified as K2\* TIndication\_interval where TIndication\_interval is as specified in clause 8.1.6 in TS 38.133.     - Option 4 (vivo):       * For RLM, the oos triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.       * For BFD, the beam failure instance triggering latency requirements should be extended with an additional delay not shorter than (K-1) ×1.5 DRX cycles, while K is the relaxation factor.       * Extending the out-of-sync evaluation period requirements and beam failure evaluation period requirements by a same factor X can be considered. X can be 2 for DRX <= 40ms, and X can be 1.5 for 40ms <DRX <= 80ms. |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-4-3: Relaxation scheme and specification impact**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: Relaxed RLM/BFD requirements are introduced in new subsections within the existing RLM/BFD sections TS 38.133. (Ericsson, Apple, Nokia, Xiaomi, MTK)   + Option 2 (new): no new subsection only for short DRX (Huawei)   *Recommendations for 2nd round: Further discuss in the 2nd round.* |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-4-4a: Different Relaxation factors between FR1 and FR2**

|  |
| --- |
| **Status summary** |
| * Proposals   + Option 1: Different Relaxation factors are allowed for FR1 and FR2. (CMCC, Xiaomi, Ericsson, CATT, Apple, Nokia, MTK)     - FFS whether to apply different relaxation factors for SSB and CSI-RS based evaluations in FR2 (Ericsson)   *Recommendations for 2nd round: Option 1 is the major’s view.*  *Recommended WF*:   * Different Relaxation factors are allowed for FR1 and FR2.   + FFS whether to apply different relaxation factors for SSB and CSI-RS based evaluations in FR2 |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-4-4b: Different Relaxation factors for different SINR range**

*Come back next meeting.*

**Issue 2-4-4c: Other consideration on Relaxation factors**

*Come back next meeting.*

**Issue 2-4-5: Additional N310/N311 values for relaxation mode**

*Come back next meeting.*

### Sub-topic 2-5 Other Aspects

**Issue 2-5-1/2: Entering and exiting relaxation mode in intra-band CA**

|  |
| --- |
| **Status summary** |
| * Proposal:   + Option 1: (Ericsson)     - For intra-band CA, if UE has fulfilled the criterion for operating RLM/BFD in relaxed mode in **one** serving cell, then it is allowed to operate RLM/BFD in relaxed mode in all other serving cells if same type of RS are used for RLM/BFD in the serving cell and other serving cells.     - For intra-band CA, if UE meets the conditions of reverting to the normal RLM/BFD in **one** serving cell, it is expected the reversion operations are applied to all other serving cell(s) if same type of RS are used for RLM/BFD in the serving cell and other serving cells.   + Option 2: No need to further discuss. (vivo, Xiaomi, Huawei, CMCC)   *Recommendation in the 2nd round:* Company please indication should RAN4 specify RLM/BFD relaxation for the scenario that “CSI-RS based RLM on SpCell and CSI-RS based BFD in SCell in the same band.” |

|  |  |
| --- | --- |
| Company |  |

**Issue 2-5-3: Entering and Exiting Relaxation criteria for multiple RLM-RS/BFD-RS**

|  |
| --- |
| **Status summary** |
| * Proposal:   + Option 1 (**Huawei**):     - The relaxation condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is better than the threshold (Qout + 10dB) for **any** RLM-RS resource.     - The exiting condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is worse than the threshold (Qout + 7dB) for **all** the RLM-RS resources.   *Recommendations for 2nd round: continue discussion in 2nd round, and the conclusion will be captured in the WF. Most company seem fine with Option 1 but thresholds need FFS. One company commented relaxation is enabled only when all RLM-RS should fulfilled the requirement.*  *Recommended WF:*   * The relaxation condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is better than the threshold (Qout + X1) for **any** RLM-RS resource. * The exiting condition of RLM relaxation for multiple RLM-RS resources can be defined as when the radio link quality is worse than the threshold (Qout + X2) for **all** the RLM-RS resources. * FFS X1, X2 |

|  |  |
| --- | --- |
| Company |  |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on RLM/BFD relaxation | MTK |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

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