**3GPP TSG-RAN WG4 Meeting #97-e R4-201xxxx**

Electronic Meeting, 2-13 Nov., 2020

**Agenda item:** 12.9.1, 12.9.2

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

**Title:** Email discussion summary for [97e][233] NR\_UE\_pow\_sav\_enh

**Document for:** Information

# Introduction

This document is the email discussion summary for the following topics covered

* Topic 1: General and work plan (AI 12.9.1)
* Topic 2: Feasibility and performance impact of relaxing UE measurements for RLM and/or BFD (AI 12.9.2)

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 (12.9.1)

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014366**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014366.zip) | MediaTek inc. | **Proposal 1: RAN4 to endorse the RRM work plan for R17 UE powers saving enhancements as presented in this contribution.*** **Note: If R17 timeline suggested in [3] is agreed in RAN Plenary #90 e-meeting, there will add one more meeting for study phase and two more meeting for work phase.**
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| *Moderator’s note:* [*R4-2014367*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014367.zip) *(MTK) and* [*R4-2014534*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014534.zip) *(Vivo, MTK) has been moved to AI 12.9.2 for evaluation assumption 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 Work plan

**Issue 1-1-1: Work plan**

* Background:
	+ RRM work plan for R17 UE powers saving enhancements is proposed. ([R4-2014366](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014366.zip))
* Proposals
	+ Option 1: RAN4 to endorse the RRM work plan for R17 UE powers saving enhancements as presented in [R4-2014366](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014366.zip). (MTK)
* Recommended WF:
	+ Companies are encouraged to provide views in 1st round.
	+ Rapporteur to provide revised Work plan in 2nd round.

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1-1: Work plan**

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| --- | --- |
| **Company** | **Comments** |
| vivo | Support work plan in R4-2014366. |
| CATT | Prefer the second work plan in R4-2014366. But it depends on whether it can be extended.  |
| Ericsson | This is WI so we do not see the need for the study phase. Agree that RAN4 should discuss and analyze criteria and other aspects for RLM/BM relaxation. Agree with moderator that we should revisit the work plan in the 2nd round. |
| OPPO | Support the proposals in R4-2014366. |
| Xiaomi | Support the first work plan which has been approved in RAN #89-e. |
| MTK | Support WF. Reply to Xiaomi: this is for connected mode power saving, why we have to adopt work plan for IDLE mode power saving. |
| Nokia | The proposed work plan is ok for us. |

### CRs/TPs comments collection

*Moderator’s note: No CRs/TPs in this topic.*

## 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.*

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|  | **Status summary**  |
| **Issue 1-1-1** |  |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
|  |  |  |

### CRs/TPs

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

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

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Feasibility and performance impact of relaxing UE measurements for RLM and/or BFD (AI 12.9.2)

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014219.zip) | Apple | ***Observation:*** *Overlapping RLM-RS configuration with DRX on duration by network can use UE power saving* ***Observation:*** *Roughly 11% to 13% power saving gain is observed with 2x relaxation. Roughly 16% to 20% power saving gain is observed when 4x relaxation is used.* **Proposal 1: RLM/BFD relaxation should be studied for short DRX cycles. R16 RRM relaxation criterion can be used as a starting point.**  |
| [**R4-2014367**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014367.zip) | MediaTek inc. | *Observation 1: UE power saving gain will be more significant if the evaluation period can be extended and scaled up to 8 times**Observation 2: Delta SINR can be used to justify whether the Rel-17 method has the same performance as the Rel-15 method**Proposal 1: RAN4 to prioritize the extended evaluation period method for RLM/BFD measurement relaxation**Proposal 2: RAN4 to discuss the evaluation methodology for RLM/BFD measurement relaxation and determine SLS assumption and performance metric in RAN4#97e meeting* ***Proposal 3: RAN4 to adopt the IMT 2020 setting specified in TS37.910 as the SLS assumption to evaluate the extended evaluation period impact on RLM/BFD performance****Proposal 4: RAN4 to study the relaxation method based on UE power saving gain with the setting in TR38.840 and LS R1-2007419**Proposal 5: RAN4 to apply delta SINR as one of the performance statistic to evaluate the RLM/BFD performance impact, where delta SINR is the difference between the averaged SINR sampled with Rel-15 baseline UE behavior and Rel-17 relaxed UE behavior**Proposal 6: RAN4 to determine the confidence level applied in the evaluation of delta SINR**P****roposal 7: RAN4 to collect the SLS evaluation results and determine the scaling factor that UE can apply under different UE mobility and serving cell SINR in RAN4#98e***  |
| [**R4-2014428**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014428.zip) | CATT | Proposal #1: RAN4 should investigate how to relax on RLM/BFD measurement. The basic idea is that UE can achieve power saving gain by increasing measurement period which can be done by adding new relaxation factor on RLM/BFD measurement.Proposal #2: RAN4 should investigate on the relaxation condition. 1. RLM-RS is based on SSB or CSI-RS or both?

RLM-RS types for relaxation shall be further studied and decided in RAN4.1. How to determine relaxation factor?

Option 1: to simplify UE implementation, define the fixed value for all conditions. Option 2: allow for different values for different conditions.Option 2 is preferred. If option 2 is chosen, the different value of relaxation factor should be determined based on simulation assuming different conditions of:1. RLM-RS
2. UE speed
3. DRX cycle (no DRX/short/long)
4. Periodicity of SSB or CSI-RS resource
5. N (RX beam for FR2)
6. P (scale factor with consideration of overlap with measurement gap and/or SMTC window)

Proposal #3: For different pairs of IS/OOS BLER values, whether to use the same value of relaxation factor. RAN4 needs to study on it.  |
| [**R4-2014534**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014534.zip) | vivo, MediaTek | *Moderator’s note: assumptions for system level simulation and for power consumption are proposed in this Tdoc.* |
| [**R4-2014535**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014535.zip) | vivo | Observation 1 : when PDCCH WUS is configured, RLM/BFD measurement take a great portion of the total power consumption.Observation 2: To optimise the case where data packet arrives with interval of around 100ms to 200ms, relaxation of RLM/BFD may further achieve power saving gain on top of R16 power saving techniques. If PDCCH WUS is configured and relaxing RLM-RS measurement from 1x to 5x,15 ~ 27% additional gain can be achievedObservation 3: By default, RLM/BFD RSs are different from the RSs that used for RRM, and UE is required to perform unnecessary measurement and filtering on these RSs for RLM/BFD.Observation 4: If UE movement is less than 3km/h, initial results based on the given evaluation assumption show that there is room for RLM relaxation.**Proposal 1: Based on system level evaluations, it is feasible to relax RLM/BFD at least in FR1 if the following conditions are met:*** **The measured SINR is above one additional threshold (e.g. SINR > 2dB), and**
* **The low mobility criterion is met.**

**Proposal 2: R16 criterion for low mobility can be considered as a reference.****Proposal 3: The RSs for RLM/BFD, especially the periodicity/bandwidth of these RSs and the relation to RSs for RRM, need careful consideration in R17 RLM/BFD relaxation.** |
| [**R4-2014654**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014654.zip) | Xiaomi | **Observation 1: The periodicity measurement for RLM/BFD is an important factor on UE power consuming.** **Proposal 1: Low mobility scenario and at-cell-center scenario could be considered as two possible scenarios for RLM/BFD measurement relaxation.****Proposal 2: The relaxation mechanism defined in Rel-16 NR Power saving can be considered as starting point for Rel-17 RLM/BFD measurement relaxation.****Proposal 3: Reducing the number of candidate beams when UE fulfilled relaxed criteria can be a feasible way to reduce power consuming.** |
| [**R4-2014797**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014797.zip) | OPPO | **Proposal 1: Consider relaxation of evaluation period for UE measurements for RLM and/or BFD in Rel17 power saving enhancement.****Proposal 2: Evaluate the scaling factor of RLM/BFD measurement relaxation based on UE speed and SINR level in RAN4.** |
| [**R4-2015199**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015199.zip) | Nokia Solutions & Networks (I) | 1. The achievable UE power saving and system performance impact may be studied by assuming extended evaluation period for RLM and BFD for low mobility UE with short DRX periodicity/cycle.
2. Rel-15 requirements already allow relaxation by the factor 1.5 for RLM and BFD with DRX cycle ≤ 320ms.
3. Study the UE power saving gain *and* system impact by defining a set of relaxation factors to be studied for SSB and CSI-RS based RLM and BFD evaluation period.
4. It should be clarified in the simulation assumptions, whether the relaxation factors to be studied are to be added *on top* of the current 1.5 relaxation factor for RLM and BFD, or to *replace* the factor 1.5.
5. There might be a delay in RLF triggering or initiation of the beam recovery process in case of relaxed RLM/BFD measurements.
6. Study the impact of longer RLM/BFD evaluation period compared to the Rel-15 evaluation period taking into account the following evaluation metrics:
* **UE power saving gain from relaxed RLM measurement requirements**
* **UE power saving gain from relaxed BFD measurement requirements**
* **System impact from increased latency in RLF triggering (for RLM)**
* **System impact from increased latency in beam failure detection and the initiation of beam recovery procedure (for BFD)**
1. In UE connected mode, the UE is performing RRM measurements on at least the serving cell in addition to RLM and BFD measurements, which may have an impact on the power saving gain of RLM/BFD measurement relaxation.
2. Include RLM, BFD and RRM measurements in the evaluation of UE power saving impact due to relaxation of RLM/BFD measurements.
3. Use VoIP traffic model as in TR 38.840 with the parameters listed in Table 1 to simulate the traffic in the UE power saving evaluation.
4. RAN4 should also discuss how to take into account the following in the simulation study: CSI-reporting, WUS, scheduling assumptions and TTI bundling.
5. Use the power consumption model from TR 38.840 for power saving evaluations.
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| [**R4-2015485**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015485.zip) | Huawei, HiSilicon | *Moderator’s note: This Tdoc mentioned as follows,* In summary, at the study phase of the WI, we need to align the parameters, model and metrics to valuate UE power saving gain. The cases in Figure 1 and Figure 2 are provided as an example. Other configuration like L1-RSPR, L3 measurement is suggested to be considered as well. |
| [**R4-2016150**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016150.zip) | Ericsson | * **Proposal #1:** RAN4 to discuss and agree on one of the following options:
	+ Option 1: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by the network.
	+ Option 2: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by the UE.
	+ Option 3: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by both the network and UE.
* **Proposal #2:** The UE while performing relaxed RLM upon detecting certain number of out-of-sync indications or upon triggering T310 reverts to the normal RLM operation (i.e. without relaxation). .
* **Proposal #3:** The UE while performing relaxed BM upon beam failure detection reverts to the normal BM operation (i.e. without relaxation).
* **Proposal #4:** RAN4 to further discuss use of a scaling factor for defining the relaxed RLM/BM evaluation period and indication intervals.
* **Proposal #5:** RAN4 to further discuss the relaxation of BM when not all serving cells in intra-band CA/DC meets relaxation criteria.
* **Proposal #6:** RAN4 to discuss the impact of RLM/BM relaxation on PDCCH monitoring.
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## 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 2-1 Evaluation assumption and factors

**Issue 2-1-1: Evaluation assumption for system level simulation**

* Background:
	+ System level simulation assumptions for mobility impact analysis from RLM/BFD relaxation is proposed. (R4-2014534)
* Proposals
	+ Option 1: RAN4 to approve the system level assumption proposed in section 2 in R4-2014534 (Vivo, MTK)
* Recommended WF:
	+ Companies’ views will be collected in 1st round discussion.
	+ Responsible company could revise evaluation assumption for 2nd round discussion, based on views collected in 1st round.
	+ Strive to approve the evaluation assumption in this meeting.

**Issue 2-1-2: Evaluation assumption for power consumption**

* Background:
	+ Evaluation assumption for power consumption model is proposed. (R4-2014534, R4-2015199, R4-2014367).
* Proposals
	+ Option 1:
		- RAN4 to study the relaxation method based on UE power saving gain with the setting in TR38.840 and LS R1-2007419 (MTK Proposal 4)
		- RAN4 to approve the evaluation assumption proposed in section 3 in R4-2014534 (Vivo/ MTK)
	+ Option 1a:
		- Use VoIP traffic model as in TR 38.840 with the parameters listed in Table 1 to simulate the traffic in the UE power saving evaluation. (Nokia Proposal 4)
		- Use the power consumption model from TR 38.840 for power saving evaluations. (Nokia Proposal 5)
* Recommended WF:
	+ Companies’ views will be collected in 1st round discussion.
	+ Responsible company could revise evaluation assumption for 2nd round discussion, based on views collected in 1st round.
	+ Strive to approve the evaluation assumption in this meeting.

**Issue 2-1-3: From configuration perspective, factors to be studied and evaluated for RLM/BFD relaxation**

* Background:
	+ Companies proposed factors, from configuration perspective, to be studied and evaluated for RLM/BFD measurements relaxation. (R4-2014219 Apple, R4-2014428 CATT, R4-2014534 vivo).
* Proposals:
	+ Option 1: DRX cycle (no DRX/short/long) (CATT Proposal 2, Apple Proposal 1)
	+ Option 2: RS configurations, including
		- 2a: RLM/BFD-RS types (CATT Proposal 2)
		- 2b: Periodicity of SSB or CSI-RS resource (CATT Proposal 2, Vivo Proposal 3)
		- 2c: BW of RLM/BFD-RS types (Vivo Proposal 3)
		- 2d: the relation to RSs for RRM (Vivo Proposal 3)
	+ Option 3: N factor (# of RX beams for FR2) (CATT Proposal 2)
	+ Option 4: P (scale factor with consideration of overlap with measurement gap and/or SMTC window) (CATT Proposal 2)
	+ Option 5: different pairs of IS/OOS BLER values (CATT Proposal 3)
* Recommended WF:
	+ Trying to down select with ≤ [3] factors for evaluation setting, to control system-level simulation load. Companies are encouraged to provide views on the factors.

**Issue 2-1-4: From channel perspective, factors to be studied and evaluated for RLM/BFD relaxation**

* Background:
	+ Companies proposed factors, from channel perspective, to be studied and evaluated for RLM/BFD measurements relaxation. (R4-2014367 MTK, R4-2014428 CATT, R4-2014797 OPPO).
* Proposals:
	+ Option 1: Serving cell's SINR level (Oppo Proposal 2, MTK Proposal 7)
	+ Option 2: UE mobility (CATT Proposal 2, Oppo Proposal 2, MTK Proposal 7)
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views.

### Sub-topic 2-2 Evaluation metrics

**Issue 2-2-1: Evaluation metrics, power saving aspects**

* Background:
	+ It is also mentioned the UE is performing RRM measurements on at least the serving cell in addition to RLM and BFD measurements, which may have an impact on the power saving gain of RLM/BFD measurement relaxation. (Proposal 3 in R4-2015199, Nokia).
* Proposals:
	+ Option 1: Include RRM (at least mobility, RLM and BM) measurements in the evaluation of UE power saving impact due to relaxation of RLM/BFD measurements. (Nokia Proposal 3)
* Recommended WF:
	+ Is Option 1 agreeable?

**Issue 2-2-2: Evaluation metrics, system impact aspects**

* Background:
	+ To study the system impact of relaxed RLM/BFD measurement, companies proposed evaluation metrics. (R4-2015199, R4-2014367, R4-2016150).
* Proposals:
	+ Option 1: RAN4 to apply delta SINR as one of the performance statistic to evaluate the RLM/BFD performance impact, where delta SINR is the difference between the averaged SINR sampled with Rel-15 baseline UE behavior and Rel-17 relaxed UE behavior (MTK Proposal 5)
		- RAN4 to determine the confidence level applied in the evaluation of delta SINR (MTK Proposal 6)
	+ Option 2: Study the system impact of relaxed RLM/BFD measurements, taking in to account the following evaluation metrics: (2nd part of Nokia Proposal 2)
		- increased latency in RLF triggering (for RLM)
		- increased latency in beam failure detection and the initiation of beam recovery procedure (for BFD)
	+ Option 3: RAN4 to discuss the impact of RLM/BM relaxation on PDCCH monitoring. (Ericsson Proposal 6)
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views. Note that the options are not necessary to be mutually exclusive.

### Sub-topic 2-3 Relaxation Methodology

**Issue 2-3-1: Scheme of RLM/BFD measurements relaxation**

* Background:
	+ Companies proposed schemes for relaxing RLM/BFD measurements. (R4-2014367 MTK, R4-2014428 CATT, R4-2014534 vivo, R4-2014654 Xiaomi, R4-2014797 OPPO, R4-2016150 Ericsson).
* Proposals:
	+ Option 1: Extending evaluation period of RLM/BFD measurement (CATT Proposal 1; OPPO Proposal 1; MTK Proposal 1; Xiaomi Proposal 2; Nokia Proposal 1)
	+ Option 1a: RAN4 to further discuss use of a scaling factor for defining the relaxed RLM/BM evaluation period and indication intervals. (Ericsson Proposal 4)
	+ Option 2: Reducing the number of candidate beams when UE fulfilled relaxed criteria can be a feasible way to reduce power consuming. (Xiaomi Proposal 3)
* Recommended WF:
	+ Is Option 1 agreeable?

**Issue 2-3-2: Criteria which the UE is allowed to relax the RLM/BM requirements**

* Background:
	+ Companies proposed criteria which the UE is allowed to relax the RLM/BM requirements. (R4-2014219 Apple, R4-2014534 vivo, R4-2014654 Xiaomi).
* Proposals:
	+ Option 1: UE mobility
		- 1a: Low mobility criteria, e.g. R16 RRM relaxation criterion can be used as a starting point. (Apple Proposal 1, Vivo Proposal 2, Xiaomi Proposal 1)
	+ Option 2: Serving cell’s quality (e.g. RSRP, SINR)
		- 2a: at-cell-center criteria, e.g. R16 RRM relaxation criterion can be used as a starting point. (Apple Proposal 1, Xiaomi Proposal 1)
		- 2b: the measured SINR is above one additional threshold (e.g. SINR > 2dB). (Vivo Proposal 1).
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views. Note that the options are not necessary to be mutually exclusive.

**Issue 2-3-3: Network or UE to determine if the criteria for relaxation is fulfilled**

* Background:
	+ Companies proposed to discuss the criteria which the UE is allowed to relax the RLM/BM requirements is determined by the network and/or UE. (Proposal 1 in R4-2016150 Ericsson).
* Proposals:
	+ Option 1: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by the network.
	+ Option 2: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by the UE.
	+ Option 3: Low mobility scenario under which the UE is allowed to relax the RLM/BM requirements is determined by both the network and UE.
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views.

### Sub-topic 2-4 Other Aspects

**Issue 2-4-1: Reverting to the normal RLM operation**

* Background:
	+ Companies proposed reverting to the normal RLM operation (i.e. without relaxation) upon detecting certain number of out-of-sync indications or upon triggering T310. (Proposal 2 in R4-2016150 Ericsson)
* Proposals:
	+ Option 1: The UE while performing relaxed RLM upon detecting certain number of out-of-sync indications or upon triggering T310 reverts to the normal RLM operation (i.e. without relaxation).
* Recommended WF:
	+ Agree on Option 1.

**Issue 2-4-2: Reverting to the normal BM operation**

* Background:
	+ Companies proposed reverting to the normal BM operation (i.e. without relaxation) upon beam failure detection. (Proposal 3 in R4-2016150 Ericsson)
* Proposals:
	+ Option 1: The UE while performing relaxed BM upon beam failure detection reverts to the normal BM operation (i.e. without relaxation).
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views.

**Issue 2-4-3: Relaxation of BM when not all serving cells in intra-band CA/DC meets relaxation criteria**

* Background:
	+ Companies proposed to discuss the relaxation of BM when not all serving cells in intra-band CA/DC meets relaxation criteria. (Proposal 5 in R4-2016150 Ericsson)
* Proposals:
	+ Option 1: RAN4 to further discuss the relaxation of BM when not all serving cells in intra-band CA/DC meets relaxation criteria.
* Recommended WF:
	+ Need more discussion, companies are encouraged to provide views.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1-1: Evaluation assumption for system level simulation**

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| **Company** | **Comments** |
| vivo | Support to approve evaluation assumptions on mobility impact analysis in R4-2014534. |
| CATT | We think it is a little early to approve the evaluation assumptions in this meeting. For R4-2014534, many simulation conditions are not decided. For example: In the following issues, we need to conclude which factors affect the power saving gain. And it requires simulation for multiple parameter sets, With/without WUS signal is an important condition to fair comparison.  |
| Ericsson | The purpose of the system simulation is not clear. Will the simulation be performed to derive delta SINR for different scaling factors? If the idea is to check the delta SINR between Rel-15 ideal SINR and relaxed SINR, then this can also be done in link simulations by setting several SNR levels and channel conditions.  |
| OPPO | Agree to further collect and revise evaluation assumption in this meeting. |
| Xiaomi | We think we need more discussion on the detailed simulation assumption. As RLM/BFD-RS resources can be SSBs and CSI-RSs, the different sets should also be taken into consideration. |
| Huawei | Need to know the motivation of SL simulation. In our understanding, how relaxation impacts system level performance high depends on the applied method. |
| MTK | Agree on this simulation assumption. Reply to CATT: this is the simulation assumption of SLS evaluation for RLM/BFD performance impact, not for the power saving gain evaluation.Reply to Ericsson and Huawei: The simulation is performed to derive delta SINR under different scaling factors and UE speed. To evaluate the RLM/BFD performance impact, it is very important to simulate the variation of SINR when UE is moving. LLS can’t do such kind of simulation, so we think that SLS assumption is very important. |
| Nokia | RRM measurements on at least serving cell should be included in the simulation study. Otherwise the study doesn’t give a realistic picture of possible UE power saving gain. We also think it is important to include UL transmissions to get a complete and realistic view of what kind of UE power saving gain can be achieved by relaxing RLM/BFD. Simulation assumptions should also include the relaxation cases to be studied. |
| vivo2 | Reply to Nokia:This is for mobility impact analysis, not for power saving gain. In our view it is the periodicity of RLM/BFD measurement that would impact the mobility. Therefore, we do not think RRM measurement need to be considered in the system level evaluations and so does the UL transmission. |
| Ericsson2 | Thanks to MTK for clarification on simulation objective to derive delta SINR under different scaling factors and UE speed. But then as we commented earlier there is no need to do complex system simulations. Only link simulations are enough. In the link simulation SINR measured under different scaling factors can be derived and compared with legacy SINR. RAN4 should agree on list of scaling factors for link simulations.  |
| Apple | More discussion is needed for SLS.  |

**Issue 2-1-2: Evaluation assumption for power consumption**

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| **Company** | **Comments** |
| vivo | Support option 1. We are also fine to include VoIP traffic model. Regarding Table 1 in option 1a, we have couples of comments. Firstly we are not sure whether it is a typical case that UE is configured with maximal number of RLM or BFD RS that it supports according to 38.213, and we suggest other configurations are not precluded. Moreover, it is also suggested to provide details on the VoIP model and corresponding scheduling assumption. |
| CATT | Use power consumption model in 38.840 as the start point. |
| Ericsson | In our view first RAN4 should discuss the possible criteria and then determine suitable scaling factor which lead to UE power saving but also do not degrade system performance. At that stage system simulation will be more useful, so it is a bit early to agree on the power consumption model.  |
| OPPO | Support the power consumption model in 38.840 as baseline. |
| Huawei | Agree with CATT and OPPO. |
| MTK | Support option 1. We can also include the VoIP traffic model. |
| Nokia | In Option 1 (R4-2014534), FTP traffic model is used, but the proposed DRX parameters do not seem to match with the RAN1 assumptions in TR 38.840, where DRX cycle = 160/320 ms and Inactivity timer = 100/80 ms depending on the packet size and mean inter-arrival time, and 10/8 ms ON duration for FR1 and 4/2 ms for FR2 depending on DRX cycle. We propose to use VoIP traffic model for DL and UL, because it has 40 ms DRX cycle with 10 ms inactivity timer and 4/2 ms (FR1/FR2) ON duration in the RAN1 assumptions in TR 38.840. We think simulations should be done for both FR1 and FR2, which is why slot length should not be fixed, but should depend on the FR.It should also be clarified whether to simulate SSB and/or CSI-RS based RLM and/or BFD, and to define the relevant parameters (e.g. RS period).Also, as commented in issue 2-1-1, UL transmissions should be taken into account by adding e.g. assumption on the UE transmit power and UL-DL slot pattern. |
| Vivo2 | Replying to Ericsson:The motivation to agree on a common power consumption model is to achieve RAN4 common understanding on whether there is power saving gain regarding different relaxation approach. Replying to Nokia:Firstly, it is clearly stated in the WID that this relaxation will focus on short DRX cycles, and therefore it is assumed both FTP model and DRX 40ms. Why do you think FTP model has to be configured with 160/320 ms DRX cycles? This is also one typical deployment scenario in our understanding.Then we are fine to consider both FR1 and FR2 in the evaluation assumptions. Regarding whether SSB or CSI-RS is configured, we think both options are not precluded. Regarding UL transmission in our view the occurrence of such transmission is rare and we suggest not to consider UL transmission for simplicity.Replying to CATT, OPPO and Huawei,We agree to take 38.840 as baseline, but also need to identify what is additional set of evaluation assumption for this RLM/BFD relaxation. |
| Apple | Support using 38.840 as baseline  |

**Issue 2-1-3: From configuration perspective, factors to be studied and evaluated for RLM/BFD relaxation**

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| **Company** | **Comments** |
| vivo | In our understanding, different factors should be considered for mobility impact and power saving gain.For mobility impact analysis:1. DRX cycles needs to be considered, and according to WID we suggest to consider 40ms.2. RLM/BFD-RS types needs NOT to be considered. For simplicity we can easily use SSB for evaluation.3. Periodicity of SSB resources needs NOT to be considered, as the DRX cycle length is longer than the periodicity.4. BW of SSB resources needs NOT to be considered.5. The relation to RSs for RRM need NOT to be considered.6. N factor (# of RX beams for FR2) needs to be considered for mobility impact analysis.7. P factor needs NOT to be considered, since DRX cycle should be longer than RS periodicity.8. For IS/OOS BLER pairs, at least if option 1 in 2-2-2 is adopted, we do not see the need to consider this.For power saving gain analysis:1. DRX cycles needs to be considered, and according to WID we suggest to consider 40ms.2. RLM/BFD-RS types needs to be considered. We suggest to also consider CSI-RS for power saving gain analysis.3. Periodicity of SSB or CSI-RS resource needs to be considered.4. BW of RLM/BFD-RS needs to be considered, and more power consumption is expected if RS BW is large.5. The relation to RRM-RS can be considered, since it would be important to judge whether it is in low mobility state based on this RS. 6. N factor need NOT to be considered.7. P factor need NOT to be considered.8. Different pairs of IS/OOS BLER values need not to be considered for power saving gain analysis. |
| CATT | Too many factors affect the performance. If only [X] factors will be selected, We suggest considering for FR1 and FR2 separately. |
| Ericsson | These issues are not related to simulations but needs to be investigated/considered for RLM/BFD relaxation? We are fine to look at them but no need to include them in simulation. This needs to be clarified. |
| Xiaomi | We prefer to prioritize Option 1 and Option 3.The consideration in Option 4 has been discussed and reflected in current specification, and we think there is no need to discuss. |
| Huawei | Besides the options listed we’d like to add more factors which is essential: 2e:relation to RS for other L1 measurementFor both FR1 and FR2, the L1-RSRP measurement can be configured. UE can perform SSB based L1-RSRP and SSB based RLM at the same time in FR1. In this WI if SSB based RLM is relaxed, while L1-RSRP measurement is still performed, power saving needs to be evaluated.2f: WUS is applied or not |
| MTK | Option 1: DRX cycle  2 setting can be applied (20ms, 40ms)Option 2: RS configurations, including • 2a: RLM/BFD-RS types (CATT Proposal 2)The RS type will not impact the evaluation results of ideal ∆SINR; however, the RLM/BFD has different evaluation time (sample number as shown in below table) and that would impact the evaluation results of ideal ∆SINR. So we prefer to evaluate ∆SINR with corresponding 5, 10, and 20 samples.

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|  | RLM | BFD |
| SSB-based | 10 samples | 5 samples |
| CSI-RS-based | 20 samples | 10 samples |

• 2b: Periodicity of SSB or CSI-RS resource (CATT Proposal 2, Vivo Proposal 3)The requirement take maximum of periodicity and DRX cycle max(DRX, periodicity), Assuming DRX is 20ms/40ms. We think that there is no need to consider periodicity.• 2c: BW of RLM/BFD-RS types (Vivo Proposal 3)Fixed BW should be applies:For SSB, the BW is fixed For CSI-RS, core part now is specified based on 24 PRB with density of 3.• 2d: the relation to RSs for RRM (Vivo Proposal 3) Clarify is needed. Does it means Klayer1 or TCI indication?[vivo] As clarified above, this is only considered in the power saving gain analysis.o Option 3: N factor (# of RX beams for FR2) (CATT Proposal 2) To simplify the evaluation. We prefer to apply SSB-based RLM/BFD N=8 in FR2 CSI-RS-based RLM/BFD N=1 in FR2o Option 4: P (scale factor with consideration of overlap with measurement gap and/or SMTC window) (CATT Proposal 2) If needed, we can set some values to be considered (e.g. 1 or 2 in FR1, 6 in FR2 ?)o Option 5: different pairs of IS/OOS BLER values (CATT Proposal 3) Prefer to use only 1 setting |
| Nokia | It is a bit unclear to us what is the purpose of this proposal related to the simulation assumptions. We have proposed simulation parameters in our contribution, but are also open to discuss other options to be included. |
| Vivo2 | Replying to Ericsson.As we commented above, we need to differentiate what is for mobility impact analysis and what is for power saving gain analysis. Agree with Ericsson that not all factors are considered in mobility impact analysis. |
| Apple  | Option 1, option 2 at least for periodicity. BW of RS is not modelled in 38.840. OK to include option 3 and 4. Do not think we should discuss option 5.  |

**Issue 2-1-4: From channel perspective, factors to be studied and evaluated for RLM/BFD relaxation**

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| **Company** | **Comments** |
| vivo | From channel perspective, 1. The UE speed would be a key factor.2. Based on evaluation results in R4-2014535, the spatial correlation of shadow fading would also play important role in the mobility impact.3. Interference modeling for SSB is important and has to be considered in SINR calculation. |
| CATT | Prefer option 2.  |
| Ericsson | It seems these proposals assume certain metric e.g. SINR, as the criterion for relaxation. We are open to further discuss but in this meeting we should collect ideas on potential criteria that can trigger the RLM/BM relaxation and further investigate with more details until next meeting. |
| MTK | Both 2 options are potential criteria to be further discussed. We should evaluate both of them.Reply to Ericsson: Delta SINR is the performance metric to evaluate the RLM/BFD performance impact, not criterion for relaxing RLM/BFD. Without evaluation provided, it is hard for companies to determine the useful criteria. |
| Nokia | We lean towards option 2, but are open for discussion. |
| Apple | option 1 and 2. |

**Issue 2-2-1: Evaluation metrics, power saving aspects**

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| **Company** | **Comments** |
| vivo | We are fine to include RRM measurements in the evaluation. However, companies are also encouraged to provide power saving gain results in case RRM measurements are not considered. In this case serving cell mobility can be also obtained by measuring the same RS that used for RLM/BFD. |
| Ericsson | We are ok to check the impact of RLM/BFD on RRM. But neighbour cell relaxation is not part of the WI. RLM/BFD is done on serving cell and in short DRX, so even if there is some RRM relaxation the impact on mobility should not be very significant.  |
| Xiaomi | Support not to include RRM measurements. We should focus on discussion the RLM/BM measurements correspond to the WID and the RRM measurements are not in the scope.  |
| Huawei | Support option1, and other L1 measurement is considered as well. |
| MTK | Based on WID the evaluation should focus on RLM/BFD. However, we are opened to discuss whether RRM relaxation can be included. If it is agreeable, companies can choose their own setting for L3 measurement relaxation (UE implementation) |
| Nokia | First, we would like to clarify our proposal: The purpose is not to study relaxation of RRM measurements, which is not part of this WI. We are proposing to include RRM measurements in the simulation study while studying relaxed RLM/BFD measurements, because without taking RRM measurements into account, the study is not realistic. In RRC CONNECTED mode, the UE is performing RRM measurements at least on the serving cell and this may have an impact on the UE power saving gain that can be achieved by relaxing RLM/BFD measurements. Rel-15 RRM measurement requirements should be used as a baseline, because Rel-16 UE power saving RRM relaxation was only for IDLE/Inactive mode, and this WI is for CONNECTED mode. |
| Apple | Focus on RLM/BM  |

**Issue 2-2-2: Evaluation metrics, system impact aspects**

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| **Company** | **Comments** |
| vivo | We support option 1.In Rel. 15, delta SINR is already used for performance metric of RLM. The metrics in option 2 and option 3 can be regarded as outcome of delta SINR, and it is related to many other aspects, such as RLM parameters configuration and PDCCH decoding. It is not preferred for this analysis. |
| CATT | We think it is a little early to approve the evaluation assumptions in this meeting.  |
| Ericsson | Option 1: there is an assumption that SINR is criterion for relaxing RLM/BFD. It is better to first agree on criterion, possible approaches for relaxation (e.g. scaling factors etc) before doing the studies for checking system impact.Option 2: This kind of system simulations to check impact of increased latency in RLF and beam failure recovery etc, should be done once we have agreed on basic issues e.g. criteria, relaxation mechanism etc.Option 3: If UE has to monitor PDCCH like in legacy while applying relaxed RLM/BFD then UE receiver will have to be active more often (same as in legacy). So the UE may have to monitor PDCCH less often when doing relaxed RLM/BFD. This needs further investigation from UE power consumption point of view. But PDCCH monitoring does not have to be part of any system simulations. |
| Huawei | System impact depends on the concrete relaxation methods. It is early to do this work. |
| MTK | Support option 1. Delta SINR is the performance metric to evaluate the RLM/BFD performance impact, not criterion for relaxing RLM/BFD. Without evaluation provided, it is hard for companies to determine the useful criteria.For option 2: We assume this latency impact can be controlled by determining the confidence level of delta SINR in option 1. It can be already covered within option 1.For option 3: Our understanding is that PDCCH monitoring will not be relaxed (conducting on DRX on duration), even though RLM/BFD measurement is relaxed (conducting on RS). So we do not have to study the impact on PDCCH monitoring. |
| Nokia | At least Option 2 should be included to see the impact of relaxation to the whole system. It should be studied how long times the UE spends in outage due to delayed triggering of RLF/BF. Option 1: We would wish for some clarification on this metric. To us delta SINR seems like UE’s internal evaluation, which would be used for defining whether the UE can enter the relaxed mode, but we don’t really see how this would be used to evaluate the performance of relaxation. Option3: We do not completely understand how PDCCH monitoring would be impacted. |
| Vivo2 | Replying to Ericsson and Huawei,In our understanding, this WI should first agree on the feasibility of RLM/BFD relaxation. Only by ensuring the feasibility we can further discuss what is the detailed solution. In our view the TU is quite limited to justify such feasibility and our preference is to approve the evaluation assumption in this meeting. |

**Issue 2-3-1: Scheme of RLM/BFD measurements relaxation**

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| **Company** | **Comments** |
| vivo | We support option 1. |
| CATT | Support option 1.  |
| Ericsson | Options 1 and 1a are similar except that 1a also includes indication internal. In our view without relaxing indication interval there won’t be enough power saving gain. Companies need to investigate this further. Option 2: In our view candidate beams should not be relaxed because this may lead to coverage loss. So we support option 1a.  |
| OPPO | Support option 1. |
| Xiaomi | Support Option 1.For Option 1a, we would like to ask Ericsson to make a clarification about why relaxing indication interval can have power saving gain. |
| Huawei | We are thinking if the method of reducing the sample number is another direction. |
| MTK | Agree with Ericsson’s view. We can agree 1a. |
| Nokia | Option 1, but if companies see a possible benefit, it is also ok to study other options.  |
| Apple | All schemes needs to be further discussed. |

**Issue 2-3-2: Criteria which the UE is allowed to relax the RLM/BM requirements**

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| **Company** | **Comments** |
| vivo | Both option 1 and option 2 should be considered based on our analysis in R4-2014535. |
| Ericsson | The relaxation is allowed under low mobility and in short DRX according to the WI objectives. So on high level option 1 is ok. However these exact criteria are used in idle mode, where the criterion is cell specific and UE has to determine if it meets criterion based on measurement. But these idle mode criteria are not suitable for connected mode because each UE can be treated individually by the network. So RAN4 need to investigate how ‘low mobility’ is determined for applying RLM/BFD relaxation.  |
| OPPO | Support Option 1 and 2 |
| Xiaomi | We think both options make sense and we need further study. |
| Huawei | Both Different UE velocity and SINR condition can be evaluated in the simulation work. And then based on the observations from simulation results, we can further discuss the criteria. |
| MTK | Support option 1a and 2b.For 2a: at-cell-center criteria is applied on RSRP/RSRQ; however, RLM/BFD measurement is applied on SINR. We don’t think R16 RRM relaxation criterion can be used. |
| Nokia | Option 1, low mobility is already mentioned in the WID, so this should be used. Other options can be discussed. |
| Apple  | Option 1 and 2 |

**Issue 2-3-3: Network or UE to determine if the criteria for relaxation is fulfilled**

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| **Company** | **Comments** |
| vivo | Support option 1.In our understanding, the scope of the WID mainly includes network controlled relaxation mechanism for RLM/BFD. Based on current RAN4 spec, it is expected that UE is not allowed to relax RLM/BFD if network does not provide indication on the condition that can relax. |
| CATT | Support option 1.  |
| Ericsson | We also support option 1 and open for option 3. But our understanding of option 1 is that this is purely NW approach. It means NW evaluates the criterion (e.g. UE is in low mobility) and configures the UE accordingly. Then UE does not need to do any further evaluation rather apply relaxation. It is up to the NW how it determines whether the UE can apply relaxed RLM/BFD e.g. at high SINR based on CQI reports etc. It may also consider other factors. For example, NW may not allow relaxation even at higher SINR if there is enough traffic to schedule etc.  |
| OPPO | Support option 1. |
| Xiaomi | This issue could refer to the relaxation mechanism in Rel-16, Network determine the criteria for relaxation. |
| Huawei | This is the first meeting for the topic, it is too rush to agree on this.In R16 power saving, the scaling factor is fixed and no network signaling. This issue needs to be further discussed after the candidate solutions are clear. |
| MTK | Support option 2. Network can only obtain the estimated SINR from UE. Besides, Network also does not know how much power the UE has left, and cannot identify how urgent the UE needs to save power. If RAN4 agree particular maximum scaling factor that UE can apply under given UE speed and SINR, UE can maintain its own power saving method in an efficient way.  |
| Nokia | This issue needs to be discussed, but we think making agreements in this meeting might be too early. |
| Ericsson2 | Some clarification on different options:In option 1: UE does not need to check any criteria to apply the relaxation; rather NW can tell UE that from now UE can relax RLM/BFD. Agree with MTK that NW does not know whether UE needs to save power or not. When NW allows then it is still up to UE to apply relaxed RLM/BM. This option is analogous to DRX.In option 2: Criteria and thresholds for evaluation of the criteria can be pre-defined/fixed in the standard. UE evaluates and apply relaxation when criteria are met. But there will be higher layer signaling to disable any RLM/BFD relaxation. In option 3: There can be different variants. But one example is that criteria can be predefined while thresholds for evaluation of the criteria can be configured by the NW. |

**Issue 2-4-1: Reverting to the normal RLM operation**

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| **Company** | **Comments** |
| vivo | We are fine with the proposal. Anyway maybe RAN1/RAN2 is a better place for this discussion. Prefer to further discuss this issue in WI phase. |
| CATT | Option 1 is acceptable.  |
| Ericsson | Support the WF. UE should not continue applying RLM relaxation if there is certain no. of OOS, start of RLF timer etc. In our view this is primarily RAN4 issue since OOS detection is very much related to RAN4 requirements. |
| OPPO | Option 1 is fine. |
| Xiaomi | We think there is no need to define this requirement. Through reasonable relaxation criterion design and measurement relaxation, the UE can hardly detect link failure after entering power saving mode. When UE cannot meet the relaxation criterion, UE have to revert to normal operation. |
| Huawei | This is the first meeting for the topic, it is too rush to agree on this. |
| MTK | It is reasonable, UE will back to no DRX mode if any of above condition is fulfilled |
| Nokia | This seems like a reasonable approach, but the details and robustness of the revert and making sure this happens in a timely manner should be evaluated carefully before making agreements. |

**Issue 2-4-2: Reverting to the normal BM operation**

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| **Company** | **Comments** |
| vivo | We are fine with the proposal. Anyway maybe RAN1/RAN2 is a better place for this discussion. Prefer to further discuss this issue in WI phase.On the other hand, it is noted that only BFD is in the scope. |
| CATT | Option 1 is acceptable. |
| Ericsson | We support option 1. This is to make sure the candidate beam detection is not delayed if there is beam failure when the BM is relaxed. In our view this is primarily RAN4 issue since this is strongly related to BFD requirements which is RAN4 domain.Agree with Vivo that it should be BFD not BM in general as per WI objective. So perhaps BM should be replaced by BFD e.g.“The UE while performing relaxed BFD upon beam failure detection reverts to the normal BFD operation”. |
| OPPO | Option 1 is fine. |
| Xiaomi | We think there is no need to define this requirement. Through reasonable relaxation criterion design and measurement relaxation, the UE can hardly detect beam failure after entering power saving mode. When UE cannot meet the relaxation criterion, UE have to revert to normal operation. |
| Huawei | This is the first meeting for the topic, it is too rush to agree on this. |
| MTK | We have concern on option 1. BFD's original behavior is entering CBD when UE counts Oout for N samples. It would too sensitive if N=1 and it might be useless because SINR is high for relaxed BFD. |
| Nokia | This seems like a reasonable approach, but the details and robustness of the revert and making sure this happens in a timely manner should be evaluated carefully before making agreements. |

**Issue 2-4-3: Relaxation of BM when not all serving cells in intra-band CA/DC meets relaxation criteria**

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| **Company** | **Comments** |
| vivo | In our view this needs further study in future meetings. |
| CATT | Option 1 is acceptable. Need further study. |
| Ericsson | We support option 1 so companies can further study. Typically, the UE has common RF front end for intra-band CA/DC. If BFD is relaxed on one serving cell but not on the other serving cells in intra-band case then impact on power saving needs some investigation. |
| OPPO | Agree with the recommended WF and need more discussion. |
| Xiaomi | We support to relax all the SpCell and SCell(s) if the BM relaxation criteria is met only for one serving cell in intra-band CA/DC.From our perspective, for intra-band CA/DC, the multiple carriers are in the same band and are most probably co-location, which means there would be little difference between RS-RSRPs. In this case, we think the relaxation of BM could be the same. |
| Huawei | Option 1 is acceptable and need further study. |
| MTK | More discussion is needed. We can only relax the BFD on serving cell where the relaxed criteria is fulfilled. |
| Nokia | We are ok to discuss this case, but maybe too early make agreements. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary**  |
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*Recommendations on WF/LS assignment*

Moderator: this WF is to capture all agreements and remaining open issues of this Email thread

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
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### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
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## Discussion on 2nd round (if applicable)

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| Company A |  |
| Company B |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
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