**3GPP TSG-RAN WG4 Meeting #94-e R4-2002301**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.1.4

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

**Title:** Email discussion summary for RAN4#94e\_#47\_NR\_unlic\_RRM\_Core\_Part\_2

**Document for:** Information

# Introduction

This document is the email discussion summary for RAN4#94e\_#47\_NR\_unlic\_RRM\_Core\_Part\_2 with the following topics covered

* Topic 1: Interruptions due to operation in non-NR-U serving cells (AI 8.1.4.7)
* Topic 2: Active BWP switching (AI 8.1.4.8)
* Topic 3: RLM and link recovery procedures (AI 8.1.4.9)
* Topic 4: Timing (AI 8.1.4.13)

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: Interruptions (AI 8.1.4.7)

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

## Companies’ contributions summary

*Moderator: Only one CR is submitted in this agenda item. Directly go to 1.3.2*

## Open issues summary

*Moderator: Only one CR is submitted in this agenda item. Directly go to 1.3.2*

## Companies views’ collection for 1st round

### Open issues

*Moderator: Only one CR is submitted in this agenda item. Directly go to 1.3.2*

### 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** |
| R4-2001395 | Qualcomm: we’re ok with this CR.  |
|  |
|  |

## 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**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### 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**  |
| R4-2001395 | Agreeable |

## Discussion on 2nd round (if applicable)

*Moderator: no open issues*

## Summary on 2nd round (if applicable)

*Moderator: no open issues*

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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: Active BWP switching (AI 8.1.4.8)

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2001560**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001560.zip) | Huawei, HiSilicon | **Observation 1:** The BWP switching triggered by UL LBT on PCell or PSCell is important to help UE recover from the consistent LBT quickly.**Observation 2:** The performance of BWP switching delay triggered by UL LBT should be guaranteed.**Observation 3:** The consistent UL LBT failure recovery is configured per BWP.Proposal 1: Define the corresponding requirement for the BWP switching triggered by consistent UL LBT failure.**Proposal 2:** If RAN4 decided to define the BWP switching requirements, there are some issues should be discussed in the following meetings.1. Whether the choosing of the target BWP will impact the BWP switching requirement2. Whether to reuse the current BWP switching requirement (DCI-based, timer-based or RRC-based) |
| [**R4-2001848**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001848.zip) | Ericsson | **Observation # 1**: Upon consistent UL LBT failures on SpCell the UE triggers the UL BWP switching if configured with RACH resources on that cell.**Proposal # 1:** Specify UL BWP switching delay and interruption requirements upon detecting consistent UL LBT failures on SpCell provided that the UE is configured with RACH resources on that cell.**Proposal # 2:** The existing requirements defined for DCI-based or timer-based UL BWP switching are reused for defining the UL BWP switching requirements upon detecting consistent UL LBT failures on SpCell. |

## 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: Requirement for UL BWP switch triggered by consistent UL LBT failures on SpCell

**Issue 2-1-1: Whether to introduce UL BWP switch requirements (delay and interruption) triggered by consistent UL LBT failures**

* Proposals
	+ Option 1: YES (Huawei, Ericsson)
* Recommended WF
	+ Collect comments from more companies in the 1st round discussion.

**Issue 2-1-2: If the conclusion of Issue 1-2 is YES, what are the delay and interruption requirements?**

* Proposals
	+ Option 1: Follow DCI and timer-based BWP switch (Ericsson)
	+ Option 2: FFS (Huawei)
* Recommended WF
	+ More discussions are needed.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1-1: Whether to introduce UL BWP switch requirements (delay and interruption) triggered by consistent UL LBT failures**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1. |
| Huawei | Option 1 |
| ZTE | Option 1 |
| MTK | option 1. |
| Nokia | Option 1 |
| Intel | We support option 1. |
| Ericsson | Option 1 |

**Issue 2-1-2: If the conclusion of Issue 1-2 is YES, what are the delay and interruption requirements?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1. |
| Huawei  | Option 1 is fine |
| ZTE | Option 1 to reuse timer and DCI based BWP switching delay requirements |
| MTK | We support option 2, in order to FFS other possible scenarios. |
| Nokia | We support option 1, to reuse the requirements for DCI and timer-based active BWP switch. |
| Intel | Support option 2. The current requirements of DCI may be different with NR-U using scenario (e.g. only FR1). More discussion is needed.  |
| Ericsson | Option 1 |

### 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.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2001849**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001849.zip) |  Qualcomm: Editorial comment: shouldn’t the title include “A” suffix consistent with all other NR-U specific clauses?Technical comments: the condition to trigger switching to another BWP is timer expires AND counter exceeds the limit; meaning it reflects the “rate” of UL LBT failure UE experiences. The current TP in this CR mentions timer expires OR counter exceeds the limitSwitching delay should not be from slot#n to PUSCH; it should be from slot#n to PRACH.The CR text should also be add UE capability to support this optional feature.  |
| Huawei: Considering there is still some remaining issues and whether to introduce the requirements has not been fully discussed. CRs should be handled in the second round and focus on the remaining issues according to the guidelines. It is suggested to capture the agreements during the meeting in the section editor’s CR according to the work split when introducing new sections for NR-U for the first time. |
| MTK: the section title should be aligned with RAN2 wording. The current title “8.6.4 BWP switch delay under CCA failures” could be ambiguous, because there are other BWP switch under CCA failure but not triggered by consistent UL LBT failure. |
| Nokia: We cannot agree to this CR, because there are no sufficient agreements yet. Apart from that, we need to be consistent with the terminology across the specification (CCA instead of LBT failure). We also believe that RAN4 should only refer to RAN2 procedure, instead of detailing it, so removing the conditions in which the UE detects the UL LBT failure. |
| Ericsson: if the concern is the title then we could change it for example to “8.6.4 BWP switch delay under consistent UL LBT failures”. |
| [**R4-2001850**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001850.zip) |  Qualcomm: We suggest using the same terminology for consistent UL LBT failure as in RAN2 spec with clear reference to the related TS (and clause). |
|  Ericsson: Ok, we can give references to TS 38.331 and TS 38.321. |
|  |

## 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 2-1-1** | **Whether to introduce UL BWP switch requirements (delay and interruption) triggered by consistent UL LBT failures***Status:* All companies agrees Option 1 to introduce the requirement*Tentative agreements:* Introduce UL BWP switch requirements (delay and interruption) triggered by consistent UL LBT failures Candidate options:*Recommendations for 2nd round:* work on **Issue 2-1-2** |
| **Issue 2-1-2** | **If the conclusion of Issue 1-2 is YES, what are the delay and interruption requirements?***Status:* * Option 1 is supported by 5 companies (QC, HW, ZTE, Nokia, E///).
* Option 2 is supported by 2 companies (~~HW,~~ MTK, Intel)

*Tentative agreements:* *Recommendations for 2nd round:* Further discuss if Option 1 can be agreed in the 2nd round. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [**R4-2001849**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001849.zip) | *Status:* Editorial comments, technical comment as well as concerns on the mutuality of this topic were received from companies*Recommendations for 2nd round:***Postpone** the CR to the next meeting. Work on agreements in the aspect like session title, triggering condition, ending condition, UE capability, whether to just refer to RAN2 procedure instead of detailing |
| [**R4-2001850**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001850.zip) | *Status:* Only editorial comments were received. Moderator suggests to treat this CR in one package with R4-2001849 for spec consistency.*Recommendations for 2nd round:***Postpone** the CR to the next meeting together with R4-2001849. |

## Discussion on 2nd round (if applicable)

### Open issue

|  |  |
| --- | --- |
| **Issue 2-1-2** | **If the conclusion of Issue 1-2 is YES, what are the delay and interruption requirements?*** Option 1: Follow DCI and timer-based BWP switch
* Option 2: FFS

*Status:* * Option 1 is supported by 5 companies (QC, HW, ZTE, Nokia, E///).
* Option 2 is supported by 2 companies (~~HW,~~ MTK, Intel)

*Tentative agreements:* *Recommendations for 2nd round:* Further discuss if Option 1 can be agreed in the 2nd round. |
| **Company** | **2nd round comment** |
| Ericsson | Support option 1 |
| MTK | We support option 2 to FFS other possible scenarios. NR-U scenarios would not perfectly match with DCI and timer-based BWP switch. More clarification is needed, e.g. the starting timing due to UL LBT failure is unknown to network. Not sure network how to leverage this requirement, so we need more time to check. |

### CRs/TPs

## Summary on 2nd round (if applicable)

* **Issue 2-1-2** remains open after 2nd round discussion. Options are captured in WF R4-2002335

|  |  |
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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002284 revised to🡪R4-2002335 | *Status:* No objection received till March 5th.*Recommendation:* AgreeableNote: R4-2002335 covers all open issues in this document |

# Topic #3: RLM (AI 8.1.4.9)

*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** |
| [**R4-2000050**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000050.zip) | ZTE Corporation | 1. The previous agreements on extension of RLM evaluations periods are based on counting the number of missed SSB or DRS occasions.

**Proposal 1**: UE shall monitor all SSBs regardless of QCL information.**Proposal 2**: The OOS evaluation period shall be extended based on unavailable SSBs (Lout). |
| [**R4-2000929**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000929.zip) | MediaTek inc. | **Observation 1**: It is not practical to rely on UE detection for the presence of SSB to extend the measurement/evaluation period under low SNR condition. The mis-detection rate would be >10% when the SNR<-5dB.**Observation 2:** Advanced UEs could send out OOS indications earlier than the entire OOS evaluation period.**Proposal 1**: As minimum requirement, the OOS evaluation period is scaled by a fixed factor of N (N > 1), and it should allow UE to indicate OOS indicate earlier than the entire of OOS evaluation period.**Proposal 2**: Not to specify limit the acceptable period of consecutive LBT failures for INS evaluation.**Observation 3**: UE would not know whether the CSI-RS is available or not.**Proposal 3**: For CSI-RS measurements, UE is only required to measure those CSI-RS in COT where UE already decode the CG-PDCCH successfully.**Proposal 4**: For CSI-RS based INS evaluation, UE is only required to measure those CSI-RS in COT where UE already decode the CG-PDCCH successfully. The evaluation period is extended if the corresponding CG-PDCCH is not decoded successfully.**Proposal 5**: For CSI-RS based OOS evaluation, the evaluation period is scaled by a fixed factor of N (N > 1).**Observation 4**: For single cell scenario, the mis-detection rate for the presence of SSB will be >50% at SNR<-10 dB and will be <10% at SNR > -5dB. |
| [**R4-2000987**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000987.zip) | OPPO | ***Proposal 1:*** *For SSB based and CSI-RS based RLM, extend evaluation duration of RLM in-sync with the following Lin,max RS samples:** + *Lin,max = [7] for Max(TDRX,TDRS)≤40 where TDRX=0 for non-DRX*
	+ *Lin,max = [5] for 40<Max(TDRX,TDRS)≤320*
	+ *Lin,max = [3] for TDRX>320*

***Proposal 2:*** *For RLM in-sync, there is no need to define additional restriction due to consecutive DL LBT failures when longer DRX cycles > 640.****Proposal 3:*** *Define TEvaluate\_out\_DRS for NR-U with fixed scaling factor for different configuration:** + *For no DRX, N1=2*
	+ *For DRX cycle≤320, N2 =2*
	+ *For DRX cycle>320, N3 =1.5.*
 |
| [**R4-2001360**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001360.zip) | Ericsson | **Proposal 1:** Set the SSB based BFD evaluation period for NR-U as follows:

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| --- | --- |
| Configuration | TEvaluate\_BFD\_SSB (ms)  |
| no DRX | max(50, ceil((5+LBFD)\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(50, ceil(1.5\*(5+LBFD)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil((5+LBFD)\*P)\*TDRX |
| Note 1: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length.Note 2: LBFD is the number of SSBs not available at the UE during TEvaluate\_BFD\_SSB where LBFD ≤ LBFD\_max.Note 3: LBFD\_max=7 for Max(TDRX, TSSB) ≤ 40ms where TDRX=0 for no DRX, LBFD\_max=5 for 40ms < Max(TDRX, TSSB) ≤ 320ms, and LBFD\_max =3 for TDRX > 320ms. |

**Proposal 2:** If LBFD > LBFD,max, UE behaviour is the same as if the radio link quality is below Qout\_LR.**Proposal 3:** RAN4 defines the CSI-RS based beam failure detection requirements considering the LBT failure. **Proposal 4:** Set the CSI-RS based BFD evaluation period considering LBT failure as follows:

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms)  |
| no DRX | max(50, ceil((MBFD+LBFD)\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(50, ceil(1.5\*(MBFD+LBFD)\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil((MBFD+LBFD)\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS in the set . TDRX is the DRX cycle length.Note 2: LBFD is the number of CSI-RSs not available at the UE during TEvaluate\_BFD\_CSI-RS where LBFD ≤ LBFD\_max.Note 3: LBFD\_max=Ceil(1.4 x MBFD) for Max(TDRX, TCSI-RS) ≤ 40ms where TDRX=0 for no DRX, LBFD\_max=MBFD for 40ms < Max(TDRX, TCSI-RS) ≤ 320ms, and LBFD\_max =Ceil(0.6 x MBFD) for TDRX > 320ms. |

MBFD is the number of CSI-RSs and set MBFD=10 if the CSI-RS resource(s) in set $\overbar{q}\_{0}$ used for BFD is transmitted with Density = 3.**Proposal 5:** Set the SSB based CBD evaluation period for NR-U as follows:

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_CBD (ms)  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, ceil((3+LCBD)\*P) \* TSSB) |
| DRX cycle > 320ms | ceil((3+LCBD) \*P) \* TDRX |
| Note 1: TDRS is the periodicity of DRS in the set . TDRX is the DRX cycle length.Note 2: LCBD is the number of SSBs not available at the UE during TEvaluate\_CBD\_SSB where LCBD ≤ LCBD\_max.Note 3: LCBD,max=7 for Max(TDRX,TSSB) ≤ 40ms where TDRX=0 for non-DRX, LCBD\_max=5 for 40ms < Max(TDRX, TSSB) ≤ 320ms, and LCBD\_max=3 for TDRX > 320ms. |

**Proposal 6:** If LCBD > LCBD,max, UE should skip the new beam selection process. **Proposal 7:** RAN4 introduce CSI-RS based candidate beam detection requirements considering the LBT failure.**Proposal 8:** Set the CSI-RS based CBD evaluation period considering LBT failure as follows:

|  |  |
| --- | --- |
| Configuration | TEvaluate\_CBD\_CSI-RS (ms)  |
| no DRX, DRX cycle ≤ 320ms | max(25, ceil((MCBD+LCBD)\*P)\*TCSI-RS) |
| DRX cycle > 320ms | ceil((MCBD+LCBD)\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS in the set  $\overbar{q}\_{1}$. TDRX is the DRX cycle length.Note 2: LCBD is the number of CSI-RSs not available at the UE during TEvaluate\_CBD\_CSI-RS where LCBD ≤ LCBD\_max.Note 3: LCBD\_max= MCBD for Max(TDRX, TCSI-RS) ≤ 40ms where TDRX=0 for no DRX, LCBD\_max=Ceil(1.6 x MCBD) for 40ms < Max(TDRX, TCSI-RS) ≤ 320ms, and LCBD\_max =Ceil(2.3 x MCBD) for TDRX > 320ms. |

MCBD is the number of CSI-RSs and set MBFD=3 if the CSI-RS resource(s) in set $\overbar{q}\_{1}$ used for CBD is transmitted with Density = 3. |
| [**R4-2001439**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001439.zip) | Nokia, Nokia Shanghai Bell | **Observation 1**: The SINR in unlicensed spectrum is likely to be higher than in licensed spectrum, however, it is not possible to guarantee that this will always be the case.**Proposal 1**: In the RLM test cases in NR-U, use the same SINR side conditions defined for NR Rel-15.**Observation 2**: There is no consensus in whether the UE can distinguish missing RLM-RS (due to LBT failure) from RLM-RS received with low SINR, therefore it cannot be assumed in the RAN4 requirements.Therefore, it is proposed to follow what it indicated in [2][3]:**Proposal 2**: Extend the SSB based RLM OOS evaluation period by a fixed factor in comparison to the maximum IS evaluation period. **Proposal 3**: Define the SSB based RLM OOS evaluation period based on a fixed extension as follows:Table 1: Evaluation period TEvaluate\_out\_SSB for NR-U

|  |  |
| --- | --- |
| Configuration | TEvaluate\_out\_SSB (ms)  |
| no DRX | max(200,ceil((10+L)\*P)\*TSSB) |
| DRX cycle≤320 | max(200,ceil(1.5\*(10+L)\*P)\*max(TDRX,TSSB)) |
| DRX cycle>320 | ceil((10+L)\*P)\*TDRX |
| Note 1: TDRS is the periodicity of DRS configured for RLM. TDRX is the DRX cycle length.Note 2: L = 14 for max(TSSB, TDRX)≤ 40, L = 10 for 40 <Max(TDRX,TSSB)≤320 and L = 6 for TDRX>320 |

**Observation 3**: With the extensions agreed in last RAN4 meeting and considering that the known cell requirements were extended to 8s, there is no need to define any additional criterion to limit the number of consecutive LBT failures during the evaluation period.**Observation 4**: If the UE monitors only one SSB from the set of SSBs that are QCLed with each other, it might wrongly estimate that an LBT failure occurred, in case the SSB is sent in a candidate position other than the one the UE is monitoring.**Observation 5**: If the formulation of the requirement is kept like suggested in option 1, *UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other*, the network has no guarantee that the UEs are monitoring the further SSB candidate positions, in case of LBT failure in the beginning of the DRS Transmission window. Proposal 4: UE is required to monitor SSBs from the set of SSBs that are QCLed with each other within the set of configured RLM-RS resources, until it detects an SSB during this SMTC during RLM or link recovery procedures Proposal 5: Adopt the same approach for the extension of the OOS evaluation period for CSI-RS based RLM as in SSB based RLM, and define the in-sync evaluation period as:

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_in\_CSI-RS (ms)**  |
| no DRX | Max(100, Ceil((Min­+Lin-CSI-RS)×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(100, Ceil(1.5×(Min­+Lin-CSI-RS)×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil((Min­+Lin-CSI-RS)×P) × TDRX |
| NOTE 1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length.NOTE 2: Lin-CSI-RS is the number of CSI-RS not available at the UE during **TEvaluate\_in\_CSI-RS**, and Lin-CSI-RS < Lin-CSI-RS\_maxNOTE 3: Lin-CSI-RS\_max = TBD for max(TDRX, TCSI-RS)≤ 40, where TDRX = 0 for non-DRX, Lin-CSI-RS\_max = TBD for 40<max(TDRX, TCSI-RS)≤ 320 and Lin-CSI-RS\_max = TDB for TDRX > 320. |

Proposal 6: Adopt the same approach for the extension of the OOS evaluation period for CSI-RS based RLM as the proposed for SSB based RLM, and define the extension of the out-of-sync evaluation period based on a fixed number of samples as follows:

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_out\_CSI-RS (ms)**  |
| no DRX | Max(200, Ceil((Mout­+Lout-CSI-RS)×P) × TCSI-RS) |
| DRX ≤ 320ms | Max(200, Ceil(1.5×(Mout­+Lout-CSI-RS)×P)× Max(TDRX, TCSI-RS)) |
| DRX > 320ms | Ceil((Mout­+Lout-CSI-RS)×P) × TDRX |
| NOTE 1: TCSI-RS is the periodicity of the CSI-RS resource configured for RLM. The requirements in this table apply for TCSI-RS equal to 5 ms, 10ms, 20 ms or 40 ms. TDRX is the DRX cycle length.NOTE 2: Lout-CSI-RS = TBD for max(TDRX, TCSI-RS)≤ 40, where TDRX = 0 for non-DRX, Lout-CSI-RS= TBD for 40<max(TDRX, TCSI-RS)≤ 320 and Lout-CSI-RS= TDB for TDRX > 320. |

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| [**R4-2001561**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001561.zip) | Huawei, HiSilicon | **Observation 1**: UE is not able to identify whether the low SNR results is due to LBT failure without additional assistant information.**Observation 2**: If UE could decode the DCI successfully, the measured SSB located within the COT duration can be treated as available RLM-RS even in the low SNR case.**Observation 3**: UE could only distinguish partial RLM-RSs for RLM by the COT information. **Proposal 1**: The measurement period should be extended based on the RLM-RSs that cannot be treated as available ones.**Proposal 2**: The RLM-RS that that cannot be treated as available ones should be scaled by a fixed factors to extend the evaluation period, which is based on the option 1.**Proposal 3**: For the Link recovery procedures (BFD), the same method should be adopted as RLM OOS. |
| [**R4-2001933**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001933.zip) | Ericsson | SSB-based RLM in-sync:* ***Proposal 1****: To address the consecutively missing SSBs issue:*
	+ *A note or clarification is added in the RLM requirements that the RLM requirements apply provided any two closest SSB occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), with a reference to the place in TS 38.133 where this is defined.*
	+ *No additional requirement is specified on consecutively missing SSBs.*
* ***Proposal 2****: RAN4 should follow RAN1 agreements; there is no such mechanism for SSB-based RLM in RAN1, and UE is expected to perform RLM based on SSBs regardless of the COT information availability.*

CSI-RS based RLM in-sync:* ***Proposal 3****: The evaluation period for CSI-RS based RLM in-sync is specified as shown in Table 1.*
* ***Proposal 4****: The Lin,CSI-RS,max values are as follows:*

*Lin,CSI-RS,max = [14] for Max(TDRX,TCSI-RS)≤40 where TDRX=0 for non-DRX**Lin,CSI-RS,max = [10] for 40<Max(TDRX,TCSI-RS)≤320**Lin,CSI-RS,max = [6] for TDRX>320** ***Proposal 5****: UE behaviour when Lin,CSI-RS,max is exceeded: the same as for SSB-based RLM in-sync.*

SSB based RLM out-of-sync:* ***Proposal 6****: RLM out-of-sync requirements are specified based on Option 2, i.e., evaluation period depends on Lout (Lout ≤ Lout,max), where Lout is the number of SSBs not available at the UE during TEvaluate\_out\_SSB.*
* ***Proposal 7****: Consider designing RLM test cases for NR-U at higher SINR levels, which justified by at least the following observations:*
	+ ***Observation 1****: NR-U system is generally characterized by much higher SINRs (Es/Iot) than LTE, due to the CCA mechanism which effectively enables a dynamic time reuse among the closest interferers in the network.*
	+ ***Observation 2****: RLM test cases in MFA were also designed at higher SINR levels.*
* ***Proposal 8****: Lout,max values are as follows:*
	+ *Lout,max = 14 for Max(TDRX,TSSB)≤40 where TDRX=0 for non-DRX*
	+ *Lout,max = 10 for 40<Max(TDRX,TSSB)≤320*
	+ *Lout,max = 6 for TDRX>320*

***Proposal 9****: Upon exceeding Lout,max for one RLM-RS resource the UE behaviour is the same as if the radio link quality for this RLM-RS resource were below Qout* |
| [**R4-2002130**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002130.zip) | Qualcomm | **Observation 1**: Mandating a NR-U UE to always monitor all candidate SSB positions during measurement phase results in increased power consumption compared to a R15 UE. In addition, in many deployments such as Industrial IoT or FBE, the rate of CCA failure is quite low. **Observation 2**: If UE cannot distinguish whether signal is available for RLM OOS, adoption of option 2 may lead to following two different scenarios.* In the first scenario, network does not transmit due to LBT failure, but UE mistakenly assumes that the link quality is poor. In this scenario, UE generates an OOS indication although the link quality was good.
* In the second scenario, link quality is poor, but UE mistakenly assumes that network could not transmit due to LBT failure. In this scenario, UE waits for a longer period to generate an OOS indication.
* Option 1 solves the issue of the first scenario.

**Observation 3**: In FBE mode of operation, UE can reliably establish availability of the channel, and hence RLM-RS, for fixed frame periods (FFP) as indicated in SIB-1.**Observation 4**: UE can’t properly evaluate the link quality if the transmit power of RLM-RS does not remain the same across different SMTC windows.**Observation 5**: The requirements of CSI-RS based RLM can be defined using those of SSB based RLM. **Proposal 1**: UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other.**Proposal 2**: Select option 2 in FBE networks and option 1 in LBE networks, i.e.,* OOS evaluation period is scaled by a fixed factor of N in LBE networks and
* OOS evaluation period is based on Lout in FBE networks, where Lout ≤Lout,max is the number of SSBs not available at the UE during TEvaluate\_out\_SSB

**Proposal 3**: UE expects gNB to transmit RLM-RS with same transmit power across different SMTC windows.**Proposal 4**: RAN4 deprioritizes defining requirements for CSI-RS based RLM in Rel-16 NR-U networks. |

## Open issues summary

*Moderator: The whole scope of this agenda covers*

1. ***SSB based RLM (INS/OOS)****,*
2. *CSI-RS based RLM (INS/OOS),*
3. *SSB based BFD,*
4. *CSI-RS based BFD,*
5. *SSB based CBD,*
6. *CSI-RS based CBD*

*The plan is to first make progress on* ***1)*** *as much as possible in the 1st round. The conclusion in* ***1)*** *can be easily re-used to other cases with some adjustments.*

### Sub-topic 3-1: General UE behavior for SSB-based RLM

*Moderator: Similar issue may also be discussed in other agenda such as measurement capability. Decision consistency across different agendas should be maintained.*

Agreement from last meeting

|  |
| --- |
| * Option 1:
	+ UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other
* Option 2:
	+ UE is required to monitor all SSBs from the set of SSBs that are QCLed with each other
* Option 3:
	+ UE is required to monitor all SSBs regardless of QCL assumptions
 |

**Issue 3-1-1: The set of SSB that UE is required to monitor**

* Proposals
	+ Option 1: UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other (Qualcomm, MTK)
	+ Option 2: UE is required to monitor SSBs from the set of SSBs that are QCLed with each other within the set of configured RLM-RS resources, until it detects an SSB during this SMTC during RLM or link recovery procedures (Nokia)
	+ Option 3: UE shall monitor all SSBs regardless of QCL information (ZTE)
* Recommended WF
	+ More discussions are needed. Consistency across different agendas should be maintained.

**Issue 3-1-2: Whether UE can expect gNB to transmit RLM-RS with same transmit power across different occasions**

* Proposals
	+ Option 1: Yes (Qualcomm)
* Recommended WF
	+ More discussions are needed, since this is the 1st time discussion in RAN4.

### Sub-topic 3-2: SSB-based RLM INS

Agreement from last meeting

|  |
| --- |
| * FFS whether and how to take into account COT and LBT failures in the RLM requirements
* Lin,max
	+ Option 1:
		- Lin,max = [7] for Max(TDRX,TSSB)≤40 where TDRX=0 for non-DRX
		- Lin,max = [5] for 40<Max(TDRX,TSSB)≤320
		- Lin,max = [3] for TDRX>320
* FFS whether for longer DRX cycles > 640, an additional criterion applies, to limit the acceptable period of consecutive LBT failures to [X] seconds
 |

**Issue 3-2-1: Whether and how to take into account COT and LBT failures in the RLM requirements**

* Proposals
	+ Option 1: No, following RAN1 agreement (Ericsson)
	+ Option 2: Yes (Huawei)
* Recommended WF
	+ More discussions are needed.

**Issue 3-2-2: Conclude the values for Lin,max.**

* Proposals
	+ Option 1: (OPPO)
		- Lin,max = 7 for Max(TDRX,TDRS)≤40 where TDRX =0 for non-DRX
		- Lin,max = 5 for 40<Max(TDRX,TDRS)≤320
		- Lin,max = 3 for TDRX >320
* Recommended WF
	+ Agree on Option 1.

**Issue 3-2-3: Whether to specify additional requirement due to consecutively missing SSBs**

* Proposals
	+ Option 1: No (MTK)
	+ Option 2: No for the case DRX cycles > 640 (OPPO)
	+ Option 3: No with a note or clarification is added in the RLM requirements that the RLM requirements apply provided any two closest SSB occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), with a reference to the place in TS 38.133 where this is defined (Ericsson)
* Recommended WF
	+ Discuss if above 3 options can be merged into one, e.g., whether to have DRX limitation and whether to capture an additional note.

### Sub-topic 3-3: SSB-based RLM OOS

Agreement from last meeting

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| --- |
| * Extend the out-of-sync evaluation period
	+ Option 1: Out-of-sync evaluation period is scaled by a fixed factor of N (N > 1)
	+ Option 2: Same as for other measurements (out-of-sync evaluation is based on Lout, where Lout ≤Lout,max is the number of SSBs not available at the UE during TEvaluate\_out\_SSB)
		- FFS if UE can distinguish whether signal is available for RLM out-of-sync
 |

**Issue 3-3-1: Whether to consider a higher SINR level for OOS**

* Proposals
	+ Option 1: No (Nokia)
	+ Option 2: Yes (Ericsson)
* Recommended WF
	+ More discussions are needed.

**Issue 3-3-2: Whether to scale the OOS evaluation period based on the number of unavailable SSB**

* Proposals
	+ Option 1: No. Out-of-sync evaluation period is scaled by a fixed factor of N (MTK, OPPO, Nokia)
	+ Option 1a: No, Out-of-sync evaluation period excluding the available SSB is scaled by a fixed factor of N (Huawei)
	+ Option 2: Yes. OOS evaluation is based on Lout, where Lout ≤Lout,max is the number of SSBs not available at the UE during TEvaluate\_out\_SSB (ZTE, Ericsson)
	+ Option 3: Select option 2 in FBE networks and option 1 in LBE networks (Qualcomm)
* Recommended WF
	+ More discussions are needed. Note that the conclusion of **Issue 3-3-1** may need to be considered together. If consensus can be reached in the 1st round, further discuss the exact requirements in 2nd round.

### Sub-topic 3-4: CSI-RS based RLM (INS/OOS)

**Issue 3-4-1: How to handle CSI-RS based RLM**

* Proposals
	+ Option 1: UE is only required to measure CSI-RS in COT where UE already decoded the CG-PDCCH successfully. (MTK)
	+ Option 2: Adapt the same approach for the extension of the INS and OOS evaluation periods for CSI-RS based RLM as in SSB based RLM (Nokia, Ericsson)
	+ Option 3: RAN4 deprioritizes defining requirements for CSI-RS based RLM in Rel-16 NR-U networks. (Qualcomm)
* Recommended WF
	+ More discussions are needed. If consensus can be reached in the 1st round, further discuss the exact requirements in 2nd round. Note that the conclusion of **Topic 3-2** and **Topic 3-3** will have the impact on the decision here.

### Sub-topic 3-5: Beam failure detection

**Issue 3-5-1: How to handle BFD**

* Proposals
	+ Option 1: Adapt the same approach for RLM OOS. (Huawei, Ericsson)
* Recommended WF
	+ Suggest to postpone the discussion for BFD to 2nd round, because the conclusion in RLM could be re-used here with some adjustments.

### Sub-topic 3-6: Candidate Beam detection

**Issue 3-6-1: How to handle CBD**

* Proposals
	+ Option 1: Adapt the same approach for RLM. (Ericsson)
* Recommended WF
	+ Suggest to postpone the discussion for CBD to 2nd round, because the conclusion in RLM could be re-used here with some adjustments.

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1-1: The set of SSB that UE is required to monitor**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1 and note that the phrase in option 2 “…until it detects an SSB during this SMTC during RLM or link recovery procedures” does not really alleviate the UE processing burden. It is not possible for UE to do an “early exit” of monitoring QCL’ed SSB upon detecting the first one since the distance between them can be quite small (e.g, for Q = 1) and the outcome of SSB detection may not become available soon enough.Some further comments on Ericsson’s comments below: In FR1 range, beamforming is actually less likely. So the most likely scenario is that gNB sends one beam with a Q factor. In the most extreme case, UE will have to monitor all 20 positions. In the example shown by Ericsson, it will mean monitoring 4 possible positions. So we don’t understand how option 3 is even in the list of options. Comment to ZTE’s comment: RAN4 should defines minimum requirements for all Q values.  |
| Huawei | We support Option 1.  |
| ZTE | We understand that in some cases it’s desirable to alleviate the burden on UE, thus we can compromise on Option 2. Option 1 is not desired because this would mean that the enhancements agreed in RAN1 would be meaningless. To Qualcomm’s comments, there’re cases with a larger Q and that won’t be a problem. |
| MTK | We support option 1. Note that even in Rel-15, UE is not required to monitor all SSBs of a cell. |
| OPPO | We support option 1. |
| Nokia | Option 2. This issue is directly related to the enhancement proposed by RAN1 to cope with the DL LBT failure when sending SSBs. If the UEs are required in LBE mode to monitor only one QCLed SSB (option 1), there is no reason for the gNB to attempt to send the QCLed SSBs in other candidate positions if the first candidate position is blocked by CCA failure, hence the enhancement brought by “beam-cycling” would be lost. According to RAN1#99 Agreement:*From a UE’s perspective, the number of transmitted SSBs within a DRS transmission window is not larger than Q.* Additionally, it is important to highlight that the extension of all measurement /evaluation periods at least in Nokia’s perspective (R4-1914177 and R4-1914178 ) were defined based on the assumption that this enhancement proposed by RAN1 would create additional opportunities for transmitting SSBs within an SMTC in case of LBT failure. Furthermore, the network can configure the duration of the “DRS transmission window” (per Ran1 #98b agreement) and consequently reduce the burden at the UE for monitoring multiple QCLed beams. RAN1 agreement only states that the maximum window size is 5ms,  |
| Ericsson | UE shall monitor all configured SSBs, regardless of the QCL information.Further, “at least one SSB” should not be used in the requirements for several reasons. There is a RAN1 agreement:

|  |
| --- |
| Agreement:From a UE’s perspective, the number of transmitted SSBs within a DRS transmission window is not larger than Q. |

So, gNB transmits Q SSBs on Q beams (in most typical implementation), which means it’s not very likely for the UE to receive more than one QCLed SSBs.The same applies for measurements and RLM.Furthermore, if we say “at least one”, then the UE may start monitoring the wrong SSB which may then be not transmitted and the DRS transmission window may then be dynamically shifted to adapt to LBT failures and the other SSBs will be transmitted instead. The “at least one” is thus also limiting the NW flexibility to shift the transmission window while adapting to LBT, which is one of the most important RAN1 NR-U features. For example if Q=4 and there are no QCL SSBs and as we also know there are 20 possible positions where it is possible to transmit SSBs then NW can transmit bursts like:1,2,3,4,x,x,x,x,x,x,x,x,x,x,x,x,x,xX,2,3,4,1,x,x,x,x,x,x,x,x,x,x,x,x,xX,x,3,4,1,2,x,x,x,x,x,x,x,x,x,x,x,xX,x,x,4,1,2,3,x,x,x,x,x,x,x,x,x,x,xX,x,x,x,1,2,3,4,x,x,x,x,x,x,x,x,x,x……X,x,x,x,x,x,x,x,x,x,x,x,x,x,1,2,3,4(x=no transmission)And this changes dynamically between bursts – so for instance if measuring gNB beam #2, in this example, there are 5 possible positions beam 2 can come, and each burst it might be a different one that actually happens.Even if the UE does receive some QCL’d SSBs  (eg the actual transmission represents …x,x,x,1,1,2,2,x,x,x…), the UE has no knowledge that they are QCL’d, only the BS or BS designer knows that. |

**Issue 3-1-2: Whether UE can expect gNB to transmit RLM-RS with same transmit power across different occasions**

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| --- | --- |
| **Company** | **Comments** |
| MTK | Support option 1, with further clarification that power per RE is consistent.  |
| Nokia | We need further discussion. We cannot support option 1, since RAN1 is still discussing it. For example, in RAN1 #99 there was an agreement regarding CSI-RS measurements, and there is an FFS. We suggest postponing this discussion until further discussion in RAN1: *Agreement:**A UE shall not average CSI-RS measurements for channel estimation across different transmission bursts from the UE's perspective.**FFS: Potential issues due to AGC* |
| Intel | Support option 1 |
| Ericsson | Do not agree. Why do we need to have such an explicit statement for RLM? And why the network would have it different?  |
| Qualcomm | The reason this clarification is needed is exactly because of the agreement that Nokia pasted above. If UE shall not average CSI-RS measurements for channel estimation across different transmission bursts, then how can it evaluate the SNR across a long evaluation period for RLM? If gNB configures a 40 MHz BW CSI-RS RLM-RS for UE and in the first burst, it transmits with power P, and in the second burst, LBT hits one of the subbands, does gNB puts all its Tx power on the other 20 MHz meaning SNR will be boosted by 3 dB? Or not? If it’s the former, then how can UE reliably perform RLM?  |

**Issue 3-2-1: Whether and how to take into account COT and LBT failures in the RLM requirements**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | While we agree that the support for GC-PDCCH carrying COT-SI is an optional UE feature and may not even be supported from NW side, it is noted that at least in FBE systems, the determination of beginning and end of a COT is not dependent on GC-PDCCH support. In other words, in an FBE system, UE can take into account COT (as indicated in SI) in determining LBT failure. Whether RAN4 decides to have a separate set of requirements for FBE vs. LBE is a separate discussion. |
| Huawei | Option 2 doesn’t means only the RS located in COT will be used. The COT information can help UE to determine partial RSs is available especially for OOS case since it is difficulty for UE to distinguish whether the RS is an available one. |
| MTK | We support option 1 for SSB based RLM INS.  |
| OPPO | We support option 1. |
| Nokia | We support option 1. However, we are open to further discuss whether RAN4 should have different requirements for FBE, since this is a new topic. So we propose to include an FFS in the agreement, if we agree on option 1 this meeting. |
| Intel  | Support option 1 |
| Ericsson | We support option 1. |

**Issue 3-2-2: Conclude the values for Lin,max.**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree to the WF. |
| OPPO | We agree on option 1. |
| Nokia | We agree to the WF |
| Ericsson | Support option 1. Although to us, it was already agreed in RAN4#93 as the only option:*For RLM in-sync:** *FFS whether and how to take into account COT and LBT failures in the RLM requirements*
* *Lin,max*
	+ *Option 1:*

*Lin,max = [7] for Max(TDRX,TSSB)≤40 where TDRX=0 for non-DRX**Lin,max = [5] for 40<Max(TDRX,TSSB)≤320**Lin,max = [3] for TDRX>320**FFS whether for longer DRX cycles > 640, an additional criterion applies, to limit the acceptable period of consecutive LBT failures to [X] seconds* |

**Issue 3-2-3: Whether to specify additional requirement consecutively missing SSBs**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We prefer option 1 but have no strong objection to option 3. |
| Huawei | Option 1 |
| MTK | We support option 1. Not sure the note is necessary and what would be the impact on RLM without this note? |
| OPPO | Compromise on option 1. |
| Nokia | Option 1, but no objection to option 3. |
| Ericsson | Could compromise to option 1 |

**Issue 3-3-1: Whether to consider a higher SINR level for OOS**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1. There is no guarantee that in unlicensed spectrum, UE consistently experiences higher SNR. Field data from LTE LAA deployments do not support this hypothesis.  |
| Huawei | Option 1 |
| MTK | We support option 1. SINR could be low in some scenarios. |
| OPPO | Option 1. |
| Nokia | Option 1 |
| Intel  | Option 1. Generally OOS will be triggered by lower SINR/RSRP.  |
| Ericsson | We have not even discussed test cases, what/how we are going to test, and the test set up in general. For example, testing whether the UE goes out-of-sync at very low SINR, with LBT, may be not so interesting, but testing that the UE does not go out-of sync at higher SINR due to LBT is more practical. |

**Issue 3-3-2: Whether to scale the OOS evaluation period based on the number of unavailable SSB**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | If RAN4 decides not to define two sets of requirements for FBE and LBE, then the requirements should account the worst case scenario which is LBE, in this case. We can compromise to option 1 but disagree with option 2. |
| Huawei | The most controversial point is whether UE could distinguish the unavailable SSB in low SNR conditions. The major concern for the Option 1 the fixed extended period may lead to long evaluating period. Our proposal is a compromise between Option 1 and Option 2, which is not clearly summarized. When the COT is supported, some RLM-RS locate within the COT can be regarded as available ones. When scale the evaluation period by the fixed scalar, these available RS may be excluded. For the extreme case, all RLM-RS for OOS are all within the received COT, there is no need to extend the period. If COT are not supported or not received, the period should be scaled by a fixed factor.We add the compromised solution under Issue 3-3-2 as Option 1a. |
| MTK | We support option 1. For option 3, it’s not clear about the technical reason to apply different rules for FBE and LBE. |
| OPPO | Option 1. Regarding it is still not clear if UE can distinguish whether signal is available for RLM out-of-sync in poor channel condition, we prefer to consider the worst case that all SSB samples(available and unavailable) are taken into account for extension. Besides, we propose to consider different scaling factor for different DRX configuration. |
| Nokia  | The issue mentioned by Qualcomm is new and was not discussed in previous RAN4 meetings. Therefore, we can agree with Option 1, and maybe include an FFS whether different requirements can be defined for FBE networks. Then companies can bring their views in the next meeting. |
| Intel | Support Option 1. As we stated before, we can investigate the feasibility of detection of LBT failure firstly. Some approaches were proposed (e.g. GC-PDCCH detection). But according to our understanding, it is quite challenging to succeed the reliable LBT failure detection under deep fading, in which RLM OOS can be triggered.  |
| Ericsson | Disagree with option 1, it’s not feasible to decide on any fixed scaling factor. Furthermore, with option 1:* RLM becomes either unreliable (too low scaling factor) and the out-of-sync may be triggered when the UE is well in-sync just unlikely got affected by one-two LBTs, or
* RLM becomes overpessimistic (too long delays before UE realizes it is in out-of-sync),
* Having different scaling factors for different DRX does not solve the above issues.
 |

**Issue 3-4-1: How to handle CSI-RS based RLM**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We cannot support option 1. As explained earlier, support of GC-PDCCH for COT-SI is optional from both UE and gNB side. Option 2 makes sense if RAN4 decides to proceed with CSI-RS-based RLM specification.  |
| Huawei | We cannot support Option 1. The COT can assist to distinguish the RS states, but should not limit the CSI-RS for RLM only within the COT. |
| ZTE | Support Option 2. |
| MTK | RAN4 can focus on SSB RLM first. However, extend the period depending on the LBT failure is not preferable, since CSI-RS was not designed for detection and thus the number of DL LBT failure is unknown at UE.  |
| OPPO | Support Option 3. |
| Nokia | Option 2.  |
| Intel | Support Option 3.  |
| Ericsson | Option 2 |

**Issue 3-5-1: How to handle BFD**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree with WF.  |
| Huawei | We agree with WF |
| MTK | We agree with WF to postpone the discussion in 2nd round. |
| OPPO | Similar view as above. |
| Nokia | Agree with WF |
| Ericsson | Agree with the WF |

**Issue 3-6-1: How to handle CBD**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree with WF.  |
| MTK | We agree with WF to postpone the discussion in 2nd round. |
| OPPO | Similar view as above. |
| Nokia | Agree with WF |
| Ericsson | Agree with the WF |

### 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** |
| [**R4-2001934**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001934.zip) | Huawei: We cannot agree with this CR now since there is still a lot remaining issues. We suggest to focus on the issues for the first round. |
| ZTE: I guess Qualcomm is looking at another CR. Back to this CR, considering a lot of TBD and content not yet agreed, we propose to postpone this one until more details are worked out. |
| MTK: We cannot agree with this CR now , since some related open issue discussion are still ongoing, e.g. how to handle SSB based OOS and CSI-RS based RLM. |
| Nokia: we cannot agree to this CR, there are too many open issues. |

## 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 3-1-1** | **The set of SSB that UE is required to monitor***Status:** Option 1 is supported by 4 companies (QC, HW, MTK, OPPO)
* Option 2 is supported by 2 companies (ZTE, Nokia)
* Option 3 is supported by 2 companies (ZTE, E///)

*Tentative agreements:* No*Recommendations for 2nd round:* * Continue discussion in 2nd round.
* Not sure if E/// is OK to compromise to Option 2 to reduce the number of options on the table?
 |
| **Issue 3-1-2** | **Whether UE can expect gNB to transmit RLM-RS with same transmit power across different occasions***Status:* Option 1 is supported by (QC, MTK, Intel), disagreed by 2 companies (Nokia, E///). Nokia mentioned that RAN1 may have some related discussion in parallel. *Tentative agreements:* No*Recommendations for 2nd round:* Continue discussion, considering RAN1’s further agreements if any. |
| **Issue 3-2-1** | **Whether and how to take into account COT and LBT failures in the RLM requirements***Status:** Option 1 is supported by 5 companies (E///, MTK, OPPO, Nokia, Intel)
* Option 2 is supported by 1 company (HW)

QC and Nokia mentioned whether to have different requirements for FBE and LBE.*Tentative agreements:* No*Recommendations for 2nd round:* * Check if HW can compromise to Option 1.
* FFS whether the decision is applicable to both FBE and LBE or only one of them
 |
| **Issue 3-2-2** | **Conclude the values for Lin,max***Status:* All companies confirmed the 3 *Lin,max* values for different DRX cycles and SSB periodicities. The square brackets can be removed.*Tentative agreements:* For RLM in-sync*Lin,max = 7 for Max(TDRX,TSSB)≤40 where TDRX=0 for non-DRX**Lin,max = 5 for 40<Max(TDRX,TSSB)≤320**Lin,max = 3 for TDRX>320**Recommendations for 2nd round:* No |
| **Issue 3-2-3** | **Whether to specify additional requirement due to consecutively missing SSBs***Status:* All companies can agree on Option 1*Tentative agreements:* No additional requirements for consecutively missing SSBs due to SSB-based RLM INS*Recommendations for 2nd round:* No |
| **Issue 3-3-1** | **Whether to consider a higher SINR level for OOS***Status:** Option 1 is supported by 6 companies (Nokia, QC, HW, MTK, OPPO, Intel)
* Option 2 is supported by 1 company (E///)

*Tentative agreements:* No*Recommendations for 2nd round:* * Continue discussion between Option 1 (do not consider higher SINR level for OOS) and Option 2 (consider higher SINR level for OOS)
 |
| **Issue 3-3-2** | **Whether to scale the OOS evaluation period based on the number of unavailable SSB***Status:** Option 1 is supported by companies (MTK, OPPO, Nokia, [QC])
* Option 1a is supported by companies (HW)
* Option 2 is supported by companies (ZTE, E///)
* Option 3 is supported by companies (QC)

Whether to consider Option 1a is related to the conclusion of **Issue 3-2-1**.QC and Nokia mentioned whether to have different requirements for FBE and LBE.*Tentative agreements:* No*Recommendations for 2nd round:* * Continue discussion in the 2nd round
* FFS whether the decision is applicable to both FBE and LBE or only one of them
 |
| **Issue 3-4-1** | **How to handle CSI-RS based RLM***Status:** Option 1 is supported by 1 companies (MTK)
* Option 2 is supported by 3 companies (Nokia, E///, ZTE)
* Option 3 is supported by 4 companies (QC, MTK, OPPO, Intel)

*Tentative agreements:* No*Recommendations for 2nd round:* Continue discussion between Option 2 (follow SSB) and Option 3 (deprioritize). |
| **Issue 3-5-1** | **How to handle BFD***Status:* All companies agreed to postpone the discussion to 2nd round. But since the RLM requirements are not yet concluded, moderator suggests to further postpone BFD discussion to next meeting and focus on RLM in this meeting*Tentative agreements:* No*Recommendations for 2nd round:* Check if companies are fine to further postpone BFD discussion to next meeting and focus on RLM in this meeting |
| **Issue 3-6-1** | **How to handle CBD***Status:* All companies agreed to postpone the discussion to 2nd round. But since the RLM requirements are not yet concluded, moderator suggests to further postpone CBD discussion to next meeting and focus on RLM in this meeting*Tentative agreements:* No*Recommendations for 2nd round:* Check if companies are fine to further postpone CBD discussion to next meeting and focus on RLM in this meeting |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| [**R4-2001934**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001934.zip) | *Status:* Four companies suggest to postpone the CR to the next meeting, since there are still many open issues in RLM*Recommendations for 2nd round:* Postpone the CR to next meeting. |

## Discussion on 2nd round (if applicable)

### Open issues

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|  | **Status summary**  |
| **Issue 3-1-1** | **The set of SSB that UE is required to monitor*** Option 1: UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other
* Option 2: UE is required to monitor SSBs from the set of SSBs that are QCLed with each other within the set of configured RLM-RS resources, until it detects an SSB during this SMTC during RLM or link recovery procedures
* Option 3: UE shall monitor all SSBs configured for RLM, regardless of QCL information

*Status:** Option 1 is supported by 4 companies (QC, HW, MTK, OPPO)
* Option 2 is supported by 2 companies (ZTE, Nokia)
* Option 3 is supported by 2 companies (ZTE, E///)

*Tentative agreements:* No*Recommendations for 2nd round:* * Continue discussion in 2nd round.
* Not sure if E/// is OK to compromise to Option 2 to reduce the number of options on the table?
 |
| **Company** | **2nd round comment** |
| Qualcomm | Proponents of option 3 should clarify what it means. For example, if SSB index 0 is configured to be RLM-RS with Q = 8 and SCS=30 kHz, is UE supposed to monitor all 20 SSB position indices? Or only SSB indices 0, 8, 16? If the former, why does UE need to monitor every SSB position index? If the later, then how is option 2 different from option 3? |
| Nokia | We maintain our view, and support Option 2. As mentioned before, beam cycling is one of the most important features of NR-U to overcome the LBT failure.  |
| ZTE | Support Option 2. |
| Ericsson | Support option 3. Options 1 and 2 do not seem to be aligned with RAN1 discussions. We disagree with the QCL condition, e.g., since the BS may be able to transmit SSBs with different indexes at different transmission opportunities. Furthermore, SMTC is mentioned but for RLM in the serving cell we look at configured SSBs not SMTC. Also, in option 2, which SSBs from the set – one, some, or all?In our view, the UE needs to monitor/continuously evaluate *all* configured SSBs at their candidate locations, even after one of the SSB has been determined within the burst, since that SSB may or may not be transmitted by the gNB at the next transmission occasion. |
| MTK | We support option 1. Note that even in Rel-15, UE is not required to monitor all SSBs of a cell. On question on option 3 about “SSBs configured”. SSB is configured via SSB index, and the SSB with the same index could be transmitted on multiple QCLed positions. As a result, ignoring the QCL information, how does UE know which positions are QCLed? And it will require UE to monitor all 20 possible positions. |

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| **Issue 3-1-2** | **Whether UE can expect gNB to transmit RLM-RS with same transmit power across different occasions*** Option 1: Yes

*Status:* Option 1 is supported by (QC, MTK, Intel), disagreed by 2 companies (Nokia, E///). Nokia mentioned that RAN1 may have some related discussion in parallel. *Tentative agreements:* No*Recommendations for 2nd round:* Continue discussion, considering RAN1’s further agreements if any. |
| **Company** | **2nd round comment** |
| Qualcomm | We’re not aware of any RAN1 agreement in the past week on this subject. How is UE supposed to handle varying transmit power across different SMTC occasions for the purpose of RLM? If UE is not allowed to filter across SMTC occasions for Channel estimation, why is RLM different?  |
| Nokia | The agreement that we mentioned was from last meeting. We are not aware of any agreements this meeting, however, there was still an FFS point in RAN1 discussion. That’s why we suggested to postpone this discussion. |
| Ericsson | See no need in this restriction, it is not specific for RLM, and need to further check RAN1 agreements as well. |
| MTK | RAN1 agreement is just for CSI-RS, not for SSB, so SSB can have the same transmit power across different occasions. For CSI-RS RLM, if UE is not allowed to average, then the performance is not reliable. |

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| **Issue 3-2-1** | **Whether and how to take into account COT to count LBT failures in the RLM requirements*** Option 1: No, following RAN1 agreement
* Option 2: Yes

*Status:** Option 1 is supported by 5 companies (E///, MTK, OPPO, Nokia, Intel)
* Option 2 is supported by 1 company (HW)

QC and Nokia mentioned whether to have different requirements for FBE and LBE.*Tentative agreements:* No*Recommendations for 2nd round:* * Check if HW can compromise to Option 1.
* FFS whether the decision is applicable to both FBE and LBE or only one of them
 |
| **Company** | **2nd round comment** |
| Qualcomm | In FBE, COT is aligned with every even radio frame boundary with fixed frame periods from the set of {1, 2, 2.5, 4, 5, 10}ms. So without having to rely on GC-PDCCH, UE can establish the validity of a COT in FBE. In addition, FBE or LBT support is a UE capability. So in our view, RAN4 should discuss whether the RLM requirements should be different for FBE vs. LBE and if so, how. |
| Huawei | Actually, we don’t have strong views about using COT information in RLM. It results from the issue that whether the UE can distinguish the dropped SSB for OOS monitoring, which has lasted for several meetings. We thinks it is impossible to require the UE to distinguish at extreme low SNR. The COT information may be used in some cases, where the RS located within the decoded COT can be regarded as available even in very low SNR. This may reduce the too long delay by the extension the evaluation period by a fixed scalars, which is the major concern of opposing companies.For FBE and LBE, though the frame structure is fixed in FBE, UE still cannot tell whether the COT is occupied by gNB successfully as there is no indications like COT information in DCI 2\_0. So it is still a problem for UE to distinguish the dropped SSB. And supporting companies should further clarify that why these two cases should be discussed in RLM only. |
| Nokia | We also do not have a strong view about different requirements for LBE and FBE. We supported the view from Qualcomm because we would like to hear views from other companies and discuss whether this would be something to be considered by RAN4. Concerning the original issue, we still support Option 1. And if the FFS is not agreeable, we are OK with removing it.  |
| Ericsson | Actually the formulation is a bit ambiguous, is it about COT being used to count LBT failures or is it about relaying on COT and/or counting LBT failures? If the corrected formulation is what was meant, then we support option 1 – the RLM requirements shall not relay on COT information availability, at least because this information may not be always available, regardless of LBE/FBE. |
| MTK | Unclear why UE can establish the validity of a COT in FBE. If LBT is needed, then there is no difference between LBE and FBE. The SSB could be still missed due to DL LBT failure in one radio frame.  |
| Huawei | More comments.As mentioned by Ericsson. If the formulation means that whether the RLM requirement should rely on COT information. Our answer is No, because the acquisition of the information cannot be guaranteed.But the COT information can provided additional assistance, which mean it can be considered. |

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| **Issue 3-2-3** | **Whether to specify additional requirement due to consecutively missing SSBs*** Option 1: No
* Option 2: No for the case DRX cycles > 640
* Option 3: No with a note or clarification is added in the RLM requirements that the RLM requirements apply provided any two closest SSB occasions available at the UE for the measurement shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), with a reference to the place in TS 38.133 where this is defined

*Status:* All companies can agree on Option 1*Tentative agreements:* No additional requirements for consecutively missing SSBs due to SSB-based RLM INS*Recommendations for 2nd round:* No |
| **Company** | **2nd round comment** |
| Moderator | Assume no further discussion is needed.  |
| Company A |  |
| Company B |  |

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| **Issue 3-3-1** | **Whether to consider a higher SINR level for OOS*** Option 1: No
* Option 2: Yes

*Status:** Option 1 is supported by 6 companies (Nokia, QC, HW, MTK, OPPO, Intel)
* Option 2 is supported by 1 company (E///)

*Tentative agreements:* No*Recommendations for 2nd round:* * ~~Continue discussion between Option 1 (do not consider higher SINR level for OOS) and Option 2 (consider higher SINR level for OOS)~~
* Continue the SINR discussion together with the relevant test cases
 |
| **Company** | **2nd round comment** |
| Moderator | Apologize for mis-undersanding Ericsson’s Proposal 7 in R4-2001933. The recommendation for 2nd round is revised. Please companies check again. |
| Qualcomm | We do not support option 2 as it cannot be guaranteed. Moreover, raising the SINR just for RLM test cases does not seem logical. If NR-U hypothetically experiences higher SINR, then many other RRM and demod test cases may have to be revised accordingly. |
| Ericsson | The SINRs are for test cases. Test cases have not yet been discussed. How can we decide on SINRs if we do not know what and how we are going to test, etc. Postpone the discussion until the test case set up is clear, which is the performance part. |
| MTK | This can be discussed in performance part discussion. |

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| **Issue 3-3-2** | **Whether to extend the OOS evaluation period based on the number of unavailable SSB*** Option 1: No. Out-of-sync evaluation period is scaled by a fixed factor of N
* Option 1a: No, Out-of-sync evaluation period excluding the available SSB is scaled by a fixed factor of N
* Option 2: Yes. OOS evaluation is based on Lout, where Lout ≤Lout,max is the number of SSBs not available at the UE during TEvaluate\_out\_SSB
* Option 3: Select option 2 in FBE networks and option 1 in LBE networks

*Status:** Option 1 is supported by companies (MTK, OPPO, Nokia, [QC])
* Option 1a is supported by companies (HW)
* Option 2 is supported by companies (ZTE, E///)
* Option 3 is supported by companies (QC)

Whether to consider Option 1a is related to the conclusion of **Issue 3-2-1**.QC and Nokia mentioned whether to have different requirements for FBE and LBE.*Tentative agreements:* No*Recommendations for 2nd round:* * Continue discussion in the 2nd round
* FFS whether the decision is applicable to both FBE and LBE or only one of them
 |
| **Company** | **2nd round comment** |
| Qualcomm | We can also compromise on option 1. We’d like to mention that option 1 is the option that was adopted in Multi-Fire (See TS 36.133 of MFA). In addition, the INS and OOS evaluation periods are long enough that instantaneous LBT failure does not cause instability issues as one company suggests. Furthermore, even the current RLM settings are not optimal so the expectation that RAN4 arrives at an optimal setting is unreasonable.  |
| Huawei | As mentioned in the comment for the Issue 3-2-1, we think option1a is a compromised solution between option 1 and option 2. The evaluation period should be extended by scaling the samples that cannot be determined whether available by a fixed scalar. Anyway option 2 is unacceptable as it is a too strict requirement to UE ability. |
| Nokia | Still option 1. As in topic 3-2-1, we support the FFS, but if it is not agreeable, we are also fine in removing it.  |
| ZTE | At this stage we still prefer Option 2, but we suggest to come back next meeting since there are several options left to be further studied. |
| Ericsson | Option 2. With option 1, it’s not about evaluation period length but it is about LBT failures and measuring on the noise which may result in that, e.g., being in in-sync conditions a UE is reporting out-of-sync. What would be the scaling to compensate for 1 LBT failure? Then, with the increased evaluation period, the number of LBT failures will also increase in average during the evaluation period, e.g., what is the difference between non-scaled evaluation period T and N LBT failures during T when UE is sampling everything and scaling by K with K\*N LBT failures during K\*T?FFS is perhaps Ok here.In Multi-Fire (See TS 36.133 of MFA) the evaluation period was extended accounting for available and non-available signals (and the UE is able to differentiate those); the requirements were not based on option 1 in our view. |
| MTK | Option 1. Option 1a is based on COT, which is subject to the topic 3-2-1. Not clear about the concern on extended period will lead to OOS reporting in INS condition, since OOS evaluation period is longer than the INS evaluation period. With option 2, the performance is unreliable in low SNR condition. |

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| **Issue 3-4-1** | **How to handle CSI-RS based RLM*** Option 1: UE is only required to measure CSI-RS in COT where UE already decoded the CG-PDCCH successfully.
* Option 2: Adapt the same approach for the extension of the INS and OOS evaluation periods for CSI-RS based RLM as in SSB based RLM
* Option 3: RAN4 deprioritizes defining requirements for CSI-RS based RLM in Rel-16 NR-U networks.

*Status:** Option 1 is supported by 1 companies (MTK)
* Option 2 is supported by 3 companies (Nokia, E///, ZTE)
* Option 3 is supported by 4 companies (QC, MTK, OPPO, Intel)

*Tentative agreements:* No*Recommendations for 2nd round:* Continue discussion between Option 2 (follow SSB) and Option 3 (deprioritize). |
| **Company** | **2nd round comment** |
| Qualcomm | Besides technical reasons that CSI-RS has a less reliable detection mechanism compared to SSB, we don’t think RAN4 will have the time to cover this issue in this release.  |
| Nokia | Option 2. IS evaluation is done in higher SINR, so would it be a problem for the UEs to detect missing CSI-RS during the evaluation period? Additionally, if the OOS evaluation period is scaled by a fixed factor, we see no problem in reusing this approach for CSI-RS as well.  |
| ZTE | Support Option 2, but as this topic is deprioritized, maybe we should focus on other topics during this meeting and come back next meeting. |
| Ericsson | Option 2. If we define requirements for SSB-based RLM, then it’s not a big issue to define for CSI-RS based RLM, like we did in Rel-15. |
| MTK | Option 3. Extend the period depending on the LBT failure is not reliable for CSI-RS measurement, which was not designed for detection. |

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| **Issue 3-5-1** | **How to handle BFD*** Option 1: Adapt the same approach for RLM OOS.

*Status:* All companies agreed to postpone the discussion to 2nd round. But since the RLM requirements are not yet concluded, moderator suggests to further postpone BFD discussion to next meeting and focus on RLM in this meeting*Tentative agreements:* No*Recommendations for 2nd round:* Check if companies are fine to further postpone BFD discussion to next meeting and focus on RLM in this meeting |
| **Company** | **2nd round comment** |
| Qualcomm | The recommendation from moderator is reasonable to us. |
| Nokia | We agree to postpone the discussions.  |
| ZTE | Can agree with recommendation from moderator. |
| Ericsson | Ok |
| MTK | Agree with the recommendation |

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| **Issue 3-6-1** | **How to handle CBD*** Option 1: Adapt the same approach for RLM.

*Status:* All companies agreed to postpone the discussion to 2nd round. But since the RLM requirements are not yet concluded, moderator suggests to further postpone CBD discussion to next meeting and focus on RLM in this meeting*Tentative agreements:* No*Recommendations for 2nd round:* Check if companies are fine to further postpone CBD discussion to next meeting and focus on RLM in this meeting |
| **Company** | **2nd round comment** |
| Qualcomm | The recommendation from moderator is reasonable to us. |
| Nokia | We agree to postpone the discussions.  |
| ZTE | Can agree with recommendation from moderator. |
| Ericsson | Ok |
| MTK | Agree with the recommendation |

### CRs/TPs

## Summary on 2nd round (if applicable)

* **Issue 3-1-1** remains open after 2nd round discussion. Options are captured in WF R4-2002335
* **Issue 3-1-2** remains open after 2nd round discussion. Options are captured in WF R4-2002335
* **Issue 3-2-1** is **concluded**. All companies agree with Option 1. Conclusion is captured in WF R4-2002335
* **Issue 3-3-1** is **postponed** to performance part
* **Issue 3-3-2** remains open after 2nd round discussion. Options are captured in WF R4-2002335
* **Issue 3-4-1** remains open after 2nd round discussion. Options are captured in WF R4-2002335
* **Issue 3-5-1** is **postponed** to the next meeting. Issue captured in WF R4-2002335
* **Issue 3-6-1** is **postponed** to the next meeting. Issue captured in WF R4-2002335

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002284 revised to🡪R4-2002335 | *Status:* No objection received till March 5th.*Recommendation:* AgreeableNote: R4-2002335 covers all open issues in this document |

# Topic #4: Timing (AI 8.1.4.13)

*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** |
| [**R4-2000046**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000046.zip) | ZTE Corporation | Proposal 1: The UE is allowed to transmit if the UE meets the existing (Rel-15) UL Tx timing requirements (even if no SSB is available during the last 160 ms), otherwise the UE can take any activated SCell with SSB available at the UE within this CG as the new reference cell. If the UE doesn’t choose a new timing reference cell, it shall not transmit in uplink.**Observation 1:** Applying one-shot timing adjustment introduces a new error, which can’t be corrected by gradual timing adjustment later on.Proposal 2: Further study how to adjust timing after changing timing reference cell.Proposal 3: When the UE is using a SCell as timing reference cell and the SCell gets deactivated, the UE shall use the Spcell as timing reference cell. |
| [**R4-2000933**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000933.zip) | MediaTek inc. | **Observation 1**: To identify a new detectable intra frequency cell, SSB index detection is not required if deriveSSB-IndexFromCell is enabled. And, it is assumed that deriveSSB-IndexFromCell is always enabled for FR1 TDD and FR2.**Observation 2**: Currently, the current operating band for NR-U is FR1 TDD.**Proposal 1**: For NR-U operating band, deriveSSB-IndexFromCell should always be enabled, and SSB index detection is not required to identify a new detectable intra frequency cell.**Observation 3**: To identify the first detectable cell on one inter frequency, if UE is indicated to report SSB based RRM measurement result with the associated SSB index, PBCH reading is not required but DMRS descrambling is still required, provided Q value is signaled by higher layers.**Proposal 2**: For interfrequency cell identification, if UE is not indicated to report SSB based RRM measurement result with the associated SSB, SSB index detection is not required; if UE is indicated to report SSB based RRM measurement result with the associated SSB, SSB index detection of 3 samples is assumed, provided Q is signalled by higher layers. |
| [**R4-2000934**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000934.zip) | MediaTek inc. | **Observation 1**: By applying one shot timing adjustment when SCell is taken as timing reference, it will over-compensate at PCell UL reception.**Proposal 1**: The one shot timing adjustment is not applied for the case that UE takes an activated SCell as the new timing reference cell. Gradual UL timing adjustment is assumed.  |
| [**R4-2001711**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001711.zip) | Ericsson | **Proposal**: There is no need to apply any one shot adjustment when timing reference cell need to be changed due to LBT failure. |
| [**R4-2002131**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002131.zip) | Qualcomm | **Observation 1**: In NR-U networks, the available SSB within the new reference cell may not be QCLed with the SSB that the UE was tracking in the previous reference cell. The timing difference between these two SSBs can be high.**Proposal 1**: RAN4 does not decide one shot UL timing adjustment procedures for Rel-16 NR-U networks before this issue gets resolved for Rel-15. |

## Open issues summary

Agreement in last meeting

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| * Scenario B and C: if the current reference cell (i.e. PCell in Scenairo C or PSCell in Scenario B) is unavailable to UE after certain number of DL SSB detection attempts, then the UE can take any activated SCell with SSB available at the UE within this CG as the new reference cell
* FFS: The UE applies one shot timing adjustment
 |

### Sub-topic 4-1: One-shot timing adjustment

**Issue 4-1-1: Whether to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts**

* Proposals
	+ Option 1: No (ZTE, MTK, Ericsson)
	+ Option 2: FFS, e.g., collocated/non-collocated scenarios or pending on Rel-15 discussion (Qualcomm)
* Recommended WF
	+ Waiting for the conclusion of Rel-15 discussion first.

### Sub-topic 4-2: Applicability of deriveSSB-IndexFromCell on unlicensed band

*Moderator: The requirements for deriveSSB-IndexFromCell belong to timing section, while it may impact to the L3 measurement requirements.*

**Issue 4-1-2: Whether deriveSSB-IndexFromCell should always be enabled on unlicensed band**

* Proposals
	+ Option 1: Yes (MTK)
* Recommended WF
	+ More discussions are needed, since this is the 1st time discussion in RAN4.

## Companies views’ collection for 1st round

### Open issues

**Issue 4-1-1: Whether to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts**

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| **Company** | **Comments** |
| Qualcomm | We can support option 1.  |
| Huawei | Option 1 |
| ZTE | Our proposal was not correctly captured. We don’t think one-shot timing adjustment will be useful under any cases, so we support Option 1. (I also move ZTE to the list of companies supporting Option 1) We suggested to further study the effectiveness of gradual timing adjustment under different cases since there might be a residue error which can’t be corrected with gradual timing adjustment. |
| MTK | We support option 1. No need to wait for the conclusion in R15. |
| Nokia | We support Option 1.  |
| Ericsson | We support Option 1 |

**Issue 4-1-2: Whether deriveSSB-IndexFromCell should always be enabled on unlicensed band**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Asynchronous operation in NR-U is possible so *deriveSSB-IndexFromSCell* does not have to be always enabled.  |
| MTK | Support option 1. It can be observed that the NR-U is operated in TDD band (n46), where *deriveSSB-IndexFromCell*should be enabled, according to the following RAN1#93 agreement: Agreements:* For RRM, UE may assume that in TDD bands, the half radio frame boundaries of the cells in the same frequency layer are aligned.
* When useServingCellTimingForSync is set to TRUE for measurements, it means the following:
	+ For intra-frequency measurements, UE may use the serving cell timing to derive the SSB index of neighbor cells in the same frequency layer.
* For inter-frequency measurements, UE may use timing of any detected cell in the target frequency layer to derive the SSB index of neighbor cells of the target frequency layer
	+ Note: cells in different frequency layer are not assumed to be half radio frame aligned.
	+ UE may assume that in TDD bands useServingCellTimingForSync is assumed to be set to TRUE
 |
| Nokia:  | Despite band n46 being a TDD band, operation in this band differs from TDD bands in licensed spectrum. We don’t believe that *deriveSSB-IndexFromSCell* should always be enabled. This restriction is not necessary, since asynchronous operation in NR-U is possible. The agreement cited by MTK refer to NR Rel-15, TDD in licensed spectrum, and should not automatically apply for band n46. |
| Ericsson | Agree with Qualcomm, at least to support asynchronous operation the presence of *deriveSSB-IndexFromSCell* cannot be mandated. |

### 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.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2001710**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001710.zip) | 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.*

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|  | **Status summary**  |
| **Issue 4-1-1** | **Whether to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts***Status:* * All companies agree not to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts.
* ZTE would like to further study the effectiveness of gradual timing adjustment

*Tentative agreements:* * One shot timing adjustment is not allowed when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts.

*Recommendations for 2nd round:* FFS if there is any issue for gradual timing adjustment |
| **Issue 4-1-2** | **Whether deriveSSB-IndexFromCell should always be enabled on unlicensed band***Status:* 3 companies disagree with the proposal *Tentative agreements:* No*Recommendations for 2nd round:* Check if MTK is OK to compromise that *deriveSSB-IndexFromSCell* is not mandatory in NR-U. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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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)

### Open issues

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| **Issue 4-1-2** | **Whether deriveSSB-IndexFromCell should always be enabled on unlicensed band*** Option 1: Yes

*Status:* 3 companies disagree with the proposal *Tentative agreements:* No*Recommendations for 2nd round:* Check if MTK is OK to compromise that *deriveSSB-IndexFromSCell* is not mandatory in NR-U. |
| **Company** | **2nd round comment** |
| MTK | We are OK that *deriveSSB-IndexFromSCell* is not mandatory in NR-U. |
| Company B |  |

### CRs/TPs

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| **CR/TP number** | **Comments collection** |
| [**R4-2001710**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001710.zip) | Ericsson**Issue 4-1-1**Since all companies agree that, “there is no need to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts.”, we do not see any problem in agreeing/endorsing Ericsson CR R4-2001710.Note that, RRM session chair’s note also captures this: **Topic #4: Timing**Issue 4-1-1: Whether to allow one shot timing adjustment when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attemptsAgreement: One shot timing adjustment is not allowed when UE changes its DL timing reference cell to any activated SCell if SpCell is unavailable to UE for a certain number of DL SSB detection attempts.So, our proposal is to agree/endorse CR in R4-2001710. |
| Qualcomm: we cannot yet agree to this CR. What is the definition of “at least one SSB available” in the CR?. Let’s say that UE is using SSB#0 for time tracking on PCell and then SSB#0 goes missing on PCell but SSB#8 becomes available and Q factor is also 8. Is UE supposed to switch? CR should specifically discuss the availability or unavailability of the SSB that UE uses for time tracking.  |
| Huawei:We share the same concern as Qualcomm. The UE behavior is not clear yet. The issues of the definition of available SSB should be considered together among related topics for NR-U. |
| ZTE:Agree with Qualcomm on the wording problem. If the time left in this meeting is adequate, can Ericsson revise the CR and we’ll check again? Or to come back next meeting.  |
| MTK: same concern on the wording, and it is related to the Issue 3-1-1.  |

## Summary on 2nd round (if applicable)

* **Issue 4-1-2**:is **concluded**. All companies agree not to mandate deriveSSB-IndexFromCell on NR-U carrier. Conclusion is captured in WF R4-2002335

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002284 revised to🡪R4-2002335 | *Status:* No objection received till March 5th.*Recommendation:* AgreeableNote: R4-2002335 covers all open issues in this document |
| **[R4-2001710](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001710.zip)** | **Postpone** to next meeting |