**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

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

**Agenda item:** 8.1.4.7, 8.1.4.8, 8.1.4.9, 8.1.4.13

**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 |  |
|  |
|  |

## 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.*

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

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

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

|  |  |  |
| --- | --- | --- |
| **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. |
|  |  |
|  |  |

**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. |
|  |  |
|  |  |

### 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** |
| [**R4-2001849**](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.  |
| Company B |
|  |
| [**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). |
| 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.*

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

*Suggestion 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 provided recommendation on CRs/TPs Status update suggestion*

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

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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 #3: RLM (AI 8.1.4.9)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **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:

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

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
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**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. |
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**Issue 3-2-2: Conclude the values for Lin,max.**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree to the WF. |
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**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. |
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**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.  |
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**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. |
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**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.  |
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**Issue 3-5-1: How to handle BFD**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree with WF.  |
|  |  |
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**Issue 3-6-1: How to handle CBD**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We agree with 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) |  Qualcomm: not sure why this CR which are updates to clauses 1-3 in General section is listed here under RLM topic. As a technical comment on this CR, we note that the band classification NR\_TDD\_FR1\_I for n46 is not yet agreed in the RF room and still being debated. |
| 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.*

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

*Suggestion 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 provided recommendation on CRs/TPs Status update suggestion*

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

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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 #4: Timing (AI 8.1.4.13)

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **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 (MTK, Ericsson)
	+ Option 2: FFS, e.g., collocated/non-collocated scenarios or pending on Rel-15 discussion (ZTE, 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**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We can 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.  |
|  |  |
|  |  |

### 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.*

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

*Suggestion 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 provided recommendation on CRs/TPs Status update suggestion*

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

## Discussion on 2nd round (if applicable)

## 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*

|  |  |
| --- | --- |
| **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”* |