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

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

**Agenda item:** 8.1.4.10, 8.1.4.11, 8.1.4.12

**Source: Moderator (**Nokia, Nokia Shanghai Bell)

**Title:** Email discussion summary for RAN4#94e\_#48\_NR\_unlic\_RRM\_Core\_Part\_3

**Document for:** Information

# Introduction

## Background and Scope

This is the document for the email discussion of the following items under the NR-U RRM agenda:

1. 8.1.4.10 – Measurement requirements
2. 8.1.4.11 – Measurement accuracy
3. 8.1.4.12 – Measurement capability and reporting criteria

The division of topics was done based on the WF from the previous meeting, which is captured in R4-1915777. The topics in this email discussion are:

Topic #1: L1-RSRP measurements

Topic #2: SFTD measurements

Topic #3: UL LBT failure during measurement reporting

Topic #4: PBCH payload reading at SSB Index Detection

Topic #5: RSSI and Channel Occupancy measurements

Topic #6: Measurement and Monitoring QCL-ed SSBs

Topic #7: Remaining issues in intra-frequency and inter-frequency measurements

Topic #8: Measurement capability and reporting criteria

## Email discussion guidelines

In addition to following the RAN4#94 E-meeting Arrangements and Guidelines V1.1” of which some important passages are reproduced below, we would request the companies participating in RAN4#94e\_#48\_NR\_unlic\_RRM\_Core\_Part\_3, to follow the additional guidelines outlined here:

* Deadline for 1st round email discussion is **Wednesday 5pm UTC Feb. 26**.
* Deadline for 2nd round email discussion is **Thursday 5pm UTC Mar. 5**.
* Emails sent and company views uploaded after the deadline will not be taken into account for the summary of the respective round.
* The preferred method of commenting is to add/update your company’s view directly in this email summary document (use change marks if appropriate) and upload it to the RAN4#94e\_#48\_NR\_unlic\_RRM\_Core\_Part\_3 draft folder, using a new revision counter.
	+ Please account for possibly updated base document versions, before uploading your updates.
	+ At the end of the file name, add your company identifier and the date. For example, “NOK\_2402” for Nokia updates on February, 24th.
	+ Draft folder: <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%2348_NR_unlic_RRM_Core_Part_3>
	+ Comments received by email will be merged into the summary document by the moderator on a best effort basis.
* If no company shows their concern on a particular issue until the deadline, the related contents will be considered stable.

In the shared draft of the “RAN4#94 E-meeting Arrangements and Guidelines V1.1”, available on the reflector and ultimately uploaded as [R4-2000001], the RAN4 Chair and Vicechairs have given the following guidance and the email discussion procedures and timeline:

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| * **Week before the E-meeting (Feb. 17 - 21)**
	+ Monday (Feb. 17): email discussion moderators will be announced by session chairs (aligned template will be provided and used)
	+ Tuesday – Friday (Feb. 18-21): moderators prepare summary materials for email discussion
		- Moderators shall identify key open issues, summarize proposals and recommend topics/questions to be handled via email discussions
* **E-meeting (Feb. 24 – Mar. 6)**
	+ Stage 0: Session chairs announce the set of email threads (no later than Monday 8am UTC, Feb. 24)
	+ Stage 1: Moderators trigger email discussion (Monday Feb. 24)
	+ Stage 2: Companies provide comments for the 1st round (Feb. 24 – Wednesday 5pm UTC Feb. 26)
	+ Stage 3: Moderators summarize the status and possible proposals, recommending what decisions can be made for 1st round. A formal t-doc will be used (Thursday 5pm UTC, Feb. 27)
	+ Stage 4: After receiving the summary from moderators, session chair may approve documents, make agreements or assign new CRs, WFs, LSs, etc. Then, session chair announces 2nd round discussion with tdoc status update (no later than Monday 8am UTC, March 2)
	+ Stage 5: Companies provide comments for 2nd round and moderators provide second round summary (Monday Mar. 2 – Thursday 5pm UTC Mar. 5)
		- Note: Formal version of stable tdocs shall be uploaded to the Inbox (except Cat A CRs) before Stage 6
	+ Stage 6: Session Chair announces conclusions (no later than 5pm UTC, March 6)
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Furthermore, useful notes/tips on the email discussion were provided:

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| * Delegates are strongly encouraged to provide comments/concerns asap
	+ Silence within a reasonable timeframe means no objection
* It is strongly encouraged that each company/delegate consolidate their comments/views and send them out in one email for each email thread
* Each email thread needs to use a clear and consistent thread title for easy tracking (the title for each thread is to be announced)
	+ - * E.g., if not done appropriately, after a while an email thread may become something like:
				+ RE: xxxx
				+ RE: RE: xxxx
				+ 回复:RE: xxxx
				+ [External] RE: xxxx
				+ Etc.

which makes it very hard to track. PLEASE fix it to RE: xxxx!  |

Please be also advised to follow the requests by MCC on the email reflector on the logistics of this e-meeting:

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| * It is important to refrain from sending attachments [on the reflector] because they slow down the delivery of emails and thereby, they have an adverse impact on the already ongoing e-meetings. Draft documents can be shared by creating subfolders to Inbox/Drafts folder.
* there is now a facility on RAN4#94-e Inbox and Inbox/Drafts folders on the public server to allow you to upload your documents using a web browser\*.
	+ Open your browser and navigate to RAN4#94-e Inbox folder,
	+ <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox>
	+ or Inbox/Drafts folder,
	+ <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts>
	+ Click the green button to log in using your EOL account.
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# Topic #1: L1-RSRP measurements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000718 | Qualcomm | Proposal 1. If higher layer parameter *timeRestrictionForChannelMeasurement* is configured, L1-RSRP becomes a time-critical measurement and no extension due to DL CCA failure should be allowed so L1,max = 0 and UE reports “not valid” measurements if the reference signal is not available.Observation 1. RAN1 specifications in terms of allocating periodic UL resources for periodic/semi-persistent reporting and retransmission of PUSCH provide the coverage needed to define UE behavior in the event of UL CCA failure. Moreover, RAN2 procedure for persistent UL LBT failure mechanism already enforces a maximum extension on reporting delay.Proposal 2. L1-RSRP reporting delay reuses R15 reporting delay. Extension of delay due to UL CCA failure, and its maximum value, is determined by RAN1/2 specifications. More specifically, 1. For aperiodic reporting using PUSCH, UL CCA failure is treated as NACK and PUSCH retransmission is scheduled by gNB. Maximum extension is determined by HARQ operation specified in clause 5.4.2 of TS 38.321
2. For periodic reporting using PUCCH and in the event of UL CCA failure, UE attempts retransmission of the report in the next occasion if new measurement is not available in time. Otherwise, it will transmit the new measurement in the next occasion.
3. Semi-persistent reporting using PUCCH is the same as periodic reporting using PUCCH. Moreover,
	1. If UE cannot transmit HARQ-ACK on MAC-CE activation due to UL CCA failure, UE continues to be in its previous state, i.e., it should not start L1-RSRP measurement and reporting
	2. If UE cannot transmit HARQ-ACK on MAC-CE deactivation due to UL CCA failure, UE continues to be in its previous state, i.e., it should measure and report L1-RSRP until it successfully transmits HARQ-ACK
4. Semi-persistent reporting using PUSCH is the same as aperiodic reporting using PUSCH with each report on PUSCH independently going through retransmission attempts as determined by HARQ operation

*Note: the other proposals of this document where copied under the appropriate topics.*  |
| [R4-2001361](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2001361.zip) | Ericsson | Proposal 1: Set the SSB based L1-RSRP evaluation period for NR-U as follows:

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| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms)  |
| non-DRX | max(TReport, ceil((M+L1)\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil((M+L1)\*P)\*TDRX |
| Note 1: TSSB is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise L1 is the number of SSBs not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB where L1 ≤ L1max.Note 3: L1,max=7 for Max(TDRX,TSSB) ≤ 40ms where TDRX=0 for non-DRX, L1,max=5 for 40ms < Max(TDRX, TSSB) ≤ 320ms, and L1,max=3 for TDRX > 320ms. |

Proposal 2: Set the CSI-RS based L1-RSRP evaluation period for NR-U as follows:

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_CSI-RS(ms)  |
| non-DRX | max(TReport, ceil((M+L1)\*P)\*TCSI-RS) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TCSI-RS)) |
| DRX cycle > 320ms | ceil((M+L1)\*P)\*TDRX |
| Note 1: TCSI-RS is the periodicity of CSI-RS configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise L1 is the number of CSI-RSs not available at the UE during TL1-RSRP\_Measurement\_Period\_CSI-RS where L1 ≤ L1,max.Note 3: L1,max=7 for Max(TDRX,TCSI-RS) ≤ 40ms where TDRX=0 for non-DRX, L1,max=5 for 40ms < Max(TDRX, TCSI-RS) ≤ 320ms, and L1,max=3 for TDRX > 320ms. |

Proposal 3: For periodic and aperiodic L1-RSRP reporting, the L1-RSRP reporting delay reuses the Rel-15 reporting delay. Proposal 4: For semi-persistent CSI reporting, L1-RSRP reporting delay for the last CSI is extended to account for UL LBT failures resulting in UE being not being able to transmit, provided the UL resources are configured. FFS how to extend the delay. Proposal 5: For semi-persistent CSI reporting with PUCCH, if UE cannot transmit HARQ-ACK on the MAC CE activation due to the UL LBT failure, UE should not start the L1-RSRP measurement and reporting. Proposal 6: For semi-persistent CSI reporting with PUCCH, if UE cannot transmit HARQ-ACK on the MAC CE deactivation due to the UL LBT failures, UE continues the L1-RSRP measurement and delay the L1-RSRP reporting. If UE does not receive deactivation command during the delay period, UE restart to transmit L1-RSRP reporting. FFS how to extend the delay. |
| R4-2001443 | Nokia, Nokia Shanghai Bell | Observation1: For periodic L1-RSRP reporting, the reporting delay reuses Rel15 reporting delay. Observation2: For aperiodic L1-RSRP reporting, the reporting delay can reuse Rel15 reporting delay. Observation3: For semi-persistent reporting using PUCCH, the reporting delay reuses Rel15 reporting delay. Observation4: For semi-persistent reporting using PUSCH, the reporting delay reuses Rel15 reporting delay. Proposal: It is proposed to reuse Rel15 reporting delay for L1-RSRP measurement in NR-U.  |

## Open issues summary

The list of open issues in this topic are:

1. Value of L1,max when timeRestrictionForChannelMeasurement is configured
2. Periodic and aperiodic L1-RSRP reporting delay
3. Semi-persistent L1-RSRP CSI reporting delay
4. Semi-persistent CSI reporting with PUCCH
5. CSI-RS based L1-RSRP measurement period

### Value of L1,max when timeRestrictionForChannelMeasurement is configured

*L1,max is the maximum number of DL LBT failures during the L1-RSRP measurement. Way forward from last RAN4 meeting:*

* *L1,max:*
	+ - *L1,max=7 for Max(TDRX,TSSB) ≤ 40 where TDRX=0 for non-DRX*
		- *L1,max=5 for 40 < Max(TDRX, TSSB) ≤ 320*
		- *L1,max=3 for TDRX > 320*

**Issue 1-1: Value of L1,max when timeRestrictionForChannelMeasurement is configured**

* Proposals
	+ (R4-2000718- Qualcomm, R4-2001361 Ericsson ): L1,max = 0 when timeRestrictionForChannelMeasurement is configured
* Recommended WF
	+ Agree on:
		- L1,max = 0 when **timeRestrictionForChannelMeasurement** is configured and update table as

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms)  |
| non-DRX | max(TReport, ceil((M+L1)\*P)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*(M+L1)\*P)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil((M+L1)\*P)\*TDRX |
| Note 1: TSSB is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.Note 2: L1=0 if higher layer parameter timeRestrictionForChannelMeasurement is configured. Otherwise L1 is the number of SSBs not available at the UE during TL1-RSRP\_Measurement\_Period\_SSB where L1 ≤ L1max.Note 3: L1,max=7 for Max(TDRX,TSSB) ≤ 40ms where TDRX=0 for non-DRX, L1,max=5 for 40ms < Max(TDRX, TSSB) ≤ 320ms, and L1,max=3 for TDRX > 320ms. |

### Periodic and aperiodic L1-RSRP reporting delay

In the last RAN4 meeting, the effect of UL LBT failure during the measurement reporting was discussed. The following was captured in the way forward:

* For periodic and aperiodic L1-RSRP reporting, the L1-RSRP reporting delay reuses the Rel-15 reporting delay
	1. Option 1: reuses the Rel-15 reporting delay
	2. Option 2: is extended to account UL LBT failure (e.g., similar to semi-persistent)

**Issue 1-2: Periodic and aperiodic L1-RSRP reporting delay**

* Proposals
	+ Option 1 (R4-2001361, Ericsson, R4-2000718 Qualcomm, R4-2001443 Nokia, Nokia Shanghai Bell) : Periodic and aperiodic L1-RSRP reporting reuses Rel-15 reporting delay.
* Recommended WF
	+ Periodic and aperiodic L1-RSRP reporting delay reuses Rel-15 reporting delay

### Semi-persistent CSI reporting, L1-RSRP reporting delay

*In the last RAN4 meeting, the effect of UL LBT failure during the measurement reporting was discussed. The following was captured in the way forward (R4-1915777):*

* *For semi-persistent CSI reporting, L1-RSRP reporting delay for the last CSI is extended to account for UL LBT failures resulting in UE being not being able to transmit*
	1. *FFS how to extend the delay, where the maximum extension is*
		+ - *Option 1: determined by RAN1/RAN2 specifications*
			- *Option 2: is pre-defined*

**Issue 1-3: Semi-persistent L1-RSRP reporting delay**

* Proposals
	+ Option 1 (R4-2001361, Ericsson):
		- Extend the delay, how to extend the delay is FFS.
	+ Option 2 (R4-2000718 Qualcomm, R4-2001443 Nokia, Nokia Shanghai Bell) : L1-RSRP reporting reuses Rel-15 reporting delay.
* Recommended WF
	+ No consensus in the proposals. More discussion is needed. Companies, please provide your views and advantages/disadvantages in Option 1 and Option 2.

### Semi-persistent CSI reporting with PUCCH

In the last RAN4 meeting, the effect of UL LBT failure during the measurement reporting was discussed. The following was captured in the way forward:

* *FFS: For semi-persistent CSI reporting with PUCCH,*
	1. *if UE cannot transmit HARQ-ACK on the MAC CE activation due to UL LBT failures, UE should not start the L1-RSRP measurement and reporting*
	2. *if UE cannot transmit HARQ-ACK on the MAC CE deactivation due to UL LBT failures, UE continues the L1-RSRP measurement and delay the L1-RSRP reporting. If UE does not receive deactivation command during the delay period, UE restart to transmit L1-RSRP. FFS how to extend the delay*

**Issue 1-4: Semi-persistent CSI reporting with PUCCH**

* Proposals
	+ Option 1 (R4-2001361, Ericsson ): For semi-persistent CSI reporting with PUCCH:
		- Extend the delay. How to extend the delay is FFS.
	+ Option 2 (R4-2001443 Nokia, Nokia Shanghai Bell and R4-2000718, Qualcomm ) :
		- Reuse Rel1-15 reporting delay
* Recommended WF
	+ Reuse the Rel-15 reporting delay

### CSI-RS based L1-RSRP measurement period

In the last RAN4 meeting, there was an agreement on the maximum number of LBT failures during the L1-RSRP procedure.

**Issue 1-5: CSI-RS based L1-RSRP measurement period**

* Proposals
* (Ericsson, R4-2001361)
	+ Extend the measurement period for CSI-RS based L1-RSRP, as it was extended for SSB based L1-RSRP.
	+ Reuse the same values of L1,max as agreed for SSB based L1-RSRP measurement.
* Recommended WF
	+ The issue was not discussed previously in RAN4. Companies, please provide your comments on the proposal above.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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 #2: SFTD measurements

## Companies’ contributions summary

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| [R4-2000042](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000042.zip) | ZTE Corporation | **Proposal 1: Upon exceeding Tmeasure\_SFTD\_LBT\_max, the UE shall stop cell search for a certain period of time and then resume SFTD measurement.****Proposal 2: Tmeasure\_SFTD\_LBT\_max = 6 × Tmeasure\_SFTD1.**Observation 1: The impact of the unknown search pattern is already considered in the requirements for Tmeasure\_SFTD1, and potential LBT failures severe that problem. |
| [R4-2000044](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000044.zip) | ZTE Corporation | withdrawn  |
| [R4-2000931](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000931.zip) | MediaTek inc. | Observation 1: For EN-DC SFTD measurement in NR-U, the maximum scaling on measurement period is ranged from 1.6 to 2.4.Observation 2: The maximum scaling for inter-RAT and EN-DC SFTD can be similar, in order to cope with similar level of LBT failure probability.**Proposal 1: For inter-RAT SFTD measurement, k is 2 as the maximum scaling. UE shall not report the SFTD measurement when it exceeds the maximum extended measurement period.****Proposal 2:** **For the reporting delay of inter-RAT SFTD measurement, X and Y are not necessary to be specified.** |
| [R4-2002086](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2002086.zip) | Ericsson | **Proposal 1:**  **For testing of inter-RAT SFTD measurement delay under CCA, the test system shall guarantee that at some point in the test there is a time period of duration 2 × Tmeasure\_SFTD1 – 1 × SMTC period during which SSBs are transmitted consecutively. Provided that such period is starting T1 ms into the SFTD measurement, the UE shall be capable of determining SFTD within a physical layer measurement period Tmeasure\_SFTD\_CCA = T1 + 2 × Tmeasure\_SFTD1 – 1 × SMTC period.**The following proposal is made with respect to k:**Proposal 2: Upon expiry of Tmeasure\_SFTD\_LBT\_max = [10]× Tmeasure\_SFTD1** **the UE abandons the inter-RAT SFTD measurement.**  |

## Open issues summary

### UE behaviour when exceeding Tmeasure\_SFTD\_LBT\_max

*Background from last RAN4 meeting (R4-1915777):*

* *UE behavior upon exceeding Tmeasure\_SFTD\_LBT\_max: UE shall stop the search*
	1. *FFS whether UE abandons the measurement*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: UE behaviour when exceeding** **Tmeasure\_SFTD\_LBT\_max**

* Proposals
	+ Option 1 (R4-2002086 - Ericsson): The UE abandons the inter-RAT SFTD measurement
	+ Option 2 ([R4-2000042](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000042.zip) - ZTE): stop cell search for a certain period of time and then resume SFTD measurement
	+ Option 3 (R4-2000931 - MediaTek) UE shall not report the SFTD measurement when it exceeds the maximum extended measurement period.
* Recommended WF
	+ There is no consensus in the proposals above. Companies, please provide your views on the options above.

### Maximum number of LBT failures allowed during procedure

*Background from last RAN4 meeting:*

* + *FFS:* *Tmeasure\_SFTD\_LBT\_max = k× Tmeasure\_SFTD1, k=TBD≤10*

**Issue 2-2: Maximum number of LBT failures allowed during procedure**

* Proposals
	+ Option 1 (ZTE [R4-2000042](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000042.zip)): k = 6
	+ Option 2: (MediaTek R4-2000931): k =2
	+ Option 3: (Ericsson R4-2002086): k = 10.
* Recommended WF
	+ Companies, please provide your views on the 3 options above. A compromise would be to define k = 6.

### Inter-RAT SFTD measurements reporting delay

*Background from last RAN4 meeting:*

* *Reporting delay: based on that the UE shall be capable of reporting SFTD at earliest upon having received the SFTD measurement configuration, and at latest X ms after the start of a period with Y consecutively available SSBs. Values of X and Y depend on the configuration in use and are FFS.*
	1. *Rel-15 side conditions apply*

**Issue 2-3: Inter-RAT SFTD measurements reporting delay**

* Proposals
	+ Option 1 (R4-2000931 MediaTek): For the reporting delay of inter-RAT SFTD measurement, X and Y are not necessary to be specified.
	+ Option 2 ([R4-2002086](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2002086.zip) Ericsson): For testing of inter-RAT SFTD measurement delay under CCA, the test system shall guarantee that at some point in the test there is a time period of duration 2 × Tmeasure\_SFTD1 – 1 × SMTC period during which SSBs are transmitted consecutively. Provided that such period is starting T1 ms into the SFTD measurement, the UE shall be capable of determining SFTD within a physical layer measurement period Tmeasure\_SFTD\_CCA = T1 + 2 × Tmeasure\_SFTD1 – 1 × SMTC period
* Recommended WF
	+ There is no consensus in the proposals, more discussion is needed. Companies, please provide your views/advantages/disadvantages on Option 1 and Option 2.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |
| ZTE | 2-4: We have withdrawn LS [R4-2000044](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000044.zip) before meeting and suggest to skip this sub topic entirely to save time for the group. The sub topic of 2-4 is deleted from the original version using change marks since we don’t intend to bring this to RAN4 anymore.2-2: As discussed in our paper, we think k=10 is a bit too large. However k=2 seems a bit insufficient. |

### 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** |
| R4-2000041 | Company A |
| Company B |
|  |
| R4-2000043 | ZTE: We will create a new sub-clause for NR-U dedicated requirements. Modifications in R4-2002087 which are agreed during the meeting will be merged into this one. I need a revision number for this CR. |
| Company B |
|  |
| R4-2002087 | ZTE: After offline discussion with Ericsson, modifications in this CR which are agreed during the meeting will be merged into R4-2000043 as agreed by Ericsson. |
|  |  |

## 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 #3: UL LBT failure during measurement reporting

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000718 | Qualcomm | Proposal 3. For even-triggered reporting, UE shall abandon the measurement report when the extension UL exceeds UL,max\_ref, where UL,max\_ref is clearly defined by RAN1/2 specification and is determined by the max number of HARQ retransmission attempts and their UL resource allocation. RAN4 should not specify a pre-defined value UL,max\_ref. Observation 2. The time when new measurement results become available cannot play a role in defining the max extension value. Ongoing PUSCH retransmissions will occur regardless of when the next reporting occasion or new measure results appear. This is the existing procedure in RAN1/2.Proposal 4. The maximum value of UE measurement reporting delay extension in (event-triggered) periodic reporting is UL,max = min (UL,max\_ref, Treport)where Treport is the length of one measurement report period and UL,max\_ref is defined in RAN1/2 specification for even-triggered reporting (Proposal 3). |
| R4-2001441 | Nokia, Nokia Shanghai Bell | 1. RAN4 has agreed that the TSSB\_measurement\_period\_intra and TSSB\_measurement\_period\_inter will be extended to consider the DL LBT failure. Therefore, by adjusting the references in the specification, to TSSB\_measurement\_period\_intra\_CCA and TSSB\_measurement\_period\_inter\_CCA, the effect of DL LBT failure will also be considered in the reporting delay.

The event triggered reporting delay excludes a delay caused by no UL resources being available for the UE to send the measurement report on. The following needs to be considered when discussing the UE abandoning a measurement report due to UL LBT failure:1. The uplink transmissions are scheduled by the gNB.
2. At the UE, the measurement report data is mapped in a transport block (TB)
3. If a TB is not correctly received at the gNB due to either LBT failure or poor channel conditions, the gNB will schedule other opportunities for the UE retransmissions.
4. After a measurement report is mapped in a TB, it is not possible for the UE to drop selectively the data that carries the measurement report without affecting the TB.
5. Other specifications have procedures to control the TB retransmissions.

It seems not to be necessary that RAN4 specifies a maximum period for UL LBT failure, either to include it in the reporting delay, since the retransmission procedures are specified in RAN1/RAN2 specs.1. If there is a need to capture the UL LBT failure in the event triggered reporting delay, or event-triggered periodic reporting delay for NR-U, modify the definition of the delay to clarify that it also excludes a delay caused by no UL resources being available for UE, for example due to CCA failure.
2. For periodic reporting delay, RAN4 to adopt the same approach as in Rel-15 NR periodic reporting delay.
 |
| R4-2001935 | Ericsson | * Proposal 1: For event triggered reporting, the measurement reporting delay due to UL LBT failures is extended by =min(UL, UL,max), where
	+ UL is the time period from the time of the first reporting attempt failed due to UL CCA failure until the time of the successful reporting attempt,
	+  UL,max is the time period from the time of the first reporting attempt failed due to UL CCA failure until the time when the UE detects consistent UL LBT failure and the corresponding RAN2 procedure is triggered [TS 38.321].
	+ No extension for UL channel access category 1, i.e., =0.
* Proposal 2: For periodic and event-triggered periodic measurement reporting, the UE measurement reporting delay due to UL LBT failures is extended by =min(UL, UL,max, Treporting), where
	+  UL is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time of the successful reporting attempt,
	+  UL,max is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time when the UE detects consistent UL LBT failure and the corresponding RAN2 procedure is triggered [TS 38.321],
	+ Treporting is the measurement reporting interval.
	+ No extension for UL channel access category 1, i.e., =0*.*
 |
| R4-2001562 | Huawei, HiSilicon | Observation 1: The measurement report message will be submitted to lower layers for transmission upon the measurement report is generated. The message is invisible for upper layers, and it is infeasible to delete the message according to a specific time limits.Observation 2: The consistent UL LBT failure recovery will handle the UL LBT when the measurement report cannot be transmitted.Proposal 1: There is no need to define new time limits and the corresponding UE behavior for measurement reporting in RAN4. |

## Open issues summary

### UE behaviour in case of successive UL LBT failures during event-triggered reporting

*In the last RAN4 meeting, the following was agreed:*

*Event triggered reporting:*

* + 1. *FFS: UE shall abandon the measurement report when the extension UL, i.e., the time period from the time of the first reporting attempt failed due to UL CCA failure until the time of the successful reporting attempt, exceeds UL,max*
		2. *The extension is*
			- *Option 1: determined by RAN1/RAN2 specifications*
			- *Option 2: a pre-defined value*
	1. *measurement reporting delay can be further extended to account for DL LBT failures, in the same way as in the measurement period requirements*

**Issue 3-1: UE behaviour in case of successive UL LBT failures during event-triggered reporting**

* Proposals
	+ Option 1 (Nokia R4-2001441, Huawei, HiSilicon R4-2001562):
		- It is not feasible to delete the message according to a specific time limits and UL,max is already captured in existing RAN1/RAN2 specifications. Hence, RAN4 should not specify new UE behaviour in case of successive UL LBT failures during reporting.
	+ Option 2 (Qualcomm R4-2000718, Ericsson R4-2001441)
		- RAN4 should capture UE behaviour in case of successive UL LBT failures during reporting and
			* Option 2a (Qualcomm R4-2000718): UE will abandon the measurement report, and UL,max is determinedbased on the HARQ retransmission attempts
			* Option 2b (Ericsson R4-2001441): UL,max is determinedbased on the consistent LBT failure procedure
		- RAN4 should not specify UL,max. as RAN1/RAN2
* Recommended WF
	+ RAN4 should not specify a pre-defined value of UL,max .
	+ FFS: whether new behaviour is needed:
		- Option 1: UE abandons the measurement report when reaching the maximum number of HARQ retransmission attempts
		- Option 2: UE abandons the measurement report when reaching the limit for the consistent UL LBT failure procedure.

### Reporting delay for (event-triggered) periodic reporting

Background is the same as in Section 3.2.1.

**Issue 3-2: Reporting delay for (event-triggered) periodic reporting**

* Proposals
	+ Option 1:
		- (Qualcomm R4-2000718) **UL,max = min (UL,max\_ref, Treport)**where Treport is the length of one measurement report period and UL,max\_ref is defined in RAN1/2 specification for even-triggered reporting.
	+ Option 2:
		- (Ericsson R4-2001935) For periodic and event-triggered periodic measurement reporting, the UE measurement reporting delay due to UL LBT failures is extended by =min(UL, UL,max, Treporting), where
			*  UL is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time of the successful reporting attempt,
			*  UL,max is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time when the UE detects consistent UL LBT failure and the corresponding RAN2 procedure is triggered [TS 38.321],
			* Treporting is the measurement reporting interval.
		- No extension for UL channel access category 1, i.e., =0
	+ Option 3
		- (Nokia R4-2001441): For periodic reporting delay, adopt the same definition as in Rel-15.
* Recommended WF
	+ - No consensus among options. Delegates, please provide comments for options 1, 2 and 3 above.

### Reporting delay for event-triggered reporting

Background is the same as in Section 3.2.1.

**Issue 3-3: Reporting delay for event-triggered reporting**

* Proposals
	+ Option 1:
		- (Qualcomm R4-2000718) For even-triggered reporting, UE shall abandon the measurement report when the extension UL exceeds UL,max\_ref, where UL,max\_ref is clearly defined by RAN1/2 specification and is determined by the max number of HARQ retransmission attempts and their UL resource allocation. RAN4 should not specify a pre-defined value UL,max\_ref
	+ Option 2:
		- (Ericsson R4-2001935) For event-triggered measurement reporting, the UE measurement reporting delay due to UL LBT failures is extended by **=min(UL, UL,max,**), where
			*  UL is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time of the successful reporting attempt,
			*  UL,max is the time period from the time of the failed periodic reporting occasion due to UL CCA failure until the time when the UE detects consistent UL LBT failure and the corresponding RAN2 procedure is triggered [TS 38.321],
			* No extension for UL channel access category 1, i.e., =0
	+ Option 3
		- (Nokia R4-2001441): It seems not to be necessary that RAN4 specifies a maximum period for UL LBT failure, either to include it in the reporting delay, since the retransmission procedures are specified in RAN1/RAN2 specs. If there is a need to, clarify the definition of the delay. Including that the measurement reporting delay excludes a delay which is caused by no UL resources available due to CCA failures for UE to send the measurement report.
* Recommended WF
	+ - No consensus among options. Delegates, please provide comments for options 1, 2 and 3 above, considering.
			* If the delay should be extended, or just include a clarification in the definition of the delay.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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: PBCH payload reading at SSB Index Detection

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2000718](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2000718.zip) | Qualcomm | Observation 5. Time period for time index detection in FR1 already accounts for PBCH decoding and no further budget for NR-U is needed other than those accounting for DL CCA failure.  |
| [R4-2001437](file:///C%3A%5C%5CUsers%5C%5Cportelal%5C%5CDocuments%5C%5C000-NR_unlic-CORE%5C%5C3GPP%20RAN4%2094%20Athens%5C%5CDocs%5C%5CR4-2001437.zip) | Nokia, Nokia Shanghai Bell | 1. In NR-U, the SSB index can be fully identified by using the PBCH DMRS sequence index.

For recovering the candidate SSB index, RAN1 defined a new mechanism which, in addition to the DMRS sequence index, also uses bits from the PBCH payload. This mechanism is similar to what is originally used in Rel-15 FR2 for identifying the SSB index. However, it should be clarified that for NR-U, this mechanism is used for serving cell timing determination within a frame, and not for the SSB index identification. In NR-U, the candidate SSB index can be identified by using the PBCH DMRS sequence index and bits from the PBCH payload.For the determination of the QCL relation between SSBs between beams sent within or across measurement windows, the UE is not required to decode the PBCH payload. In TS 38.133, the only requirements based on the SSB index acquisition period are related to SSB based RRM reporting. For the purpose of RRM measurements, only the SSB index is needed. The UE is not required to report the measurements based on the candidate SSB index. RAN4 has already discussed the SSB time index identification period, which was extended to account for LBT failures.1. RAN4 to confirm the agreements in RAN4 #93, and not specify any additional time for PBCH payload decoding during the SSB index identification
 |
|  |  |  |

## Open issues summary

### Additional time for PBCH payload reading for SSB index identification

*In the last RAN4 meeting, the following was agreed:*

* *FFS whether PBCH reading is required for SSB index identification in FR1 for NR-U*

**Issue 4-1: Defining a maximum value of UL LBT failures for event-triggered reporting**

* Proposals
	+ - The proposals from Qualcomm and Nokia are aligned.
* Recommended WF
	+ - There is no need to specify additional time for PBCH reading during SSB index identification in FR1 NR-U.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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 #5: RSSI and Channel Occupancy measurements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001929 | Ericsson | * Proposal 1: RSSI measurement report mapping in NR-U is the same as that for CLI-RSSI in NR (i.e., from -100 dBm to -25 dBm with 1 dBm resolution).
* Proposal 2: No need to define measurement report mapping for channel occupancy in NR-U.
* Proposal 3: Intra- and inter-frequency RSSI are defined according to Table 1.
* Proposal 4: Need for gaps for RSSI is agreed according to Table 1.

Table 1: intra-/inter-frequency definitions and need for gaps for RSSI and CO

|  |  |  |
| --- | --- | --- |
|  | Definition | Need for measurement gaps |
| Intra-frequency RSSI | * the bandwidth of the PRB set configured for RSSI measurement is within the bandwidth of at least one resource (e.g., CSI-RS resource, SSB, etc.) configured for a measurement on the serving cell, and
* the SCS of the active BWP in the serving cell and of the RSSI measurement are the same
 | not needed | The RSSI measurement is over the bandwidth which is fully within the active BWP of the UE |
| needed | The RSSI measurement is over the bandwidth which is not fully within the active BWP of the UE |
| Inter-frequency RSSI | if at least one of the two conditions above is not met | not needed | The RSSI measurement is over the bandwidth which is fully within the active BWP of the UE |
| needed | The RSSI measurement is over the bandwidth which is not fully within the active BWP of the UE |

* Proposal 5: The RSSI and CO measurement periods depend on:
	+ max(reportInterval, rmtc-Period) in non-DRX when measurement gaps are not required,
	+ max(reportInterval, rmtc-Period, DRX) in DRX when measurement gaps are not required, or
	+ max(reportInterval, rmtc-Period, MGRP and gap sharing) in DRX when measurement gaps are required.
* Proposal 6: Measurement reporting requirements are to be specified for periodic RSSI and CO reporting.
 |
| R4-2000720 | Qualcomm | Observation 1. Per RAN1/2 agreements, a measurement object configuration for RSSI/CO reporting can only cover a single subband of 20 MHz. RSSI/CO reporting for multiple subbands requires multiple and separate measurement objects.Proposal 1. RAN4 to define intra-frequency RSSI measurement to be the case when the RMTC configuration indicates that:* Reference subcarrier spacing is the same as serving cell SCS
* Measurement BW is contained within the active BWP of the serving cell

Inter-frequency RSSI measurement is defined when any of the above conditions is not satisfied. Observation 2. With the definition in Proposal 1, intra-frequency RSSI measurement can be performed without the need for measurement gap whereas inter-frequency RSSI measurement requires measurement gap. Table 10.x.x.x: RSSI measurement report mapping

|  |  |  |  |
| --- | --- | --- | --- |
| Reported value | Measured quantity value (L3 RSSI) | Measured quantity value (L1 RSSI) | Unit |
| RSSI\_0 | RSSI<-156 | Not valid | dBm/SCS |
| RSSI\_1 | -156≤ RSSI<-155 | Not valid | dBm/SCS |
| … | … | … | dBm/SCS |
| RSSI\_16 | -141≤ RSSI<-140 | RSSI<-140 | dBm/SCS |
| RSSI\_17 | -140≤ RSSI<-139 | -140≤RSSI<-139 | dBm/SCS |
| RSSI\_18 | -139≤ RSSI<-138 | -139≤ RSSI<-138 | dBm/SCS |
| … | … |  | … |
| RSSI\_111 | -46≤ RSSI<-45 | -46≤ RSSI<-45 | dBm/SCS |
| RSSI\_112 | -45≤ RSSI<-44 | -45≤ RSSI<-44 | dBm/SCS |
| RSSI\_113 | -44≤ RSSI<-43 | -44≤ RSSI | dBm/SCS |
| RSSI\_114 | -43≤ RSSI<-42 | Not valid | dBm/SCS |
| … | … | … | … |
| RSSI\_126 | -31≤ RSSI | Not valid | dBm/SCS |
| RSSI\_127  | Infinity (FFS) | Infinity (FFS) | dBm/SCS |

Observation 3. The advantages of Table 10.x.x.x for RSSI measurement report mapping are:* The RSSI reporting is normalized to the SCS used for measurement, the least common denominator, allowing flexibility for UE implementation to measure based on any value of *N* so long as accuracy requirements are met and with consistent interpretation of the value on NW and UE side.
* Improved accuracy of L3 filtering is provided in a similar fashion as in RSRP report mapping (note that LTE RSSI report mapping table in TS 36.133 does not differentiate the cases when L3 filtering is enabled or disabled)
* The full dynamic range that the 8-bit field (128 possible values) provides are employed (note that LTE RSSI report mapping table in TS 36.133 only uses 77 out of 128 possible values).

Proposal 2. RAN4 to adopt Table 10.x.x.x for RSSI measurement report mapping.Proposal 3. RAN4 does not need to define CO measurement report mapping table. Proposal 4. RMTC periodicity to be from the set of {40, 80, 160, 320, 640} ms exclusively. RMTC measurement duration to be from the set of {1, 14, 28, 42, 56, 70, 84, 140} in units of OFDM symbols with the limitation of max RTMC duration to be capped at 5ms (i.e., 84 and 140 symbols to be valid only for 30 kHz SCS). No new measurement gap pattern needed for RSSI measurement. Observation 4. Wideband operation in NR-U may necessitate the need for configuring multiple measurement objects spanning multiple subbands. Logically, it is expected of UE to measure and report different measurement objects serially. Proposal 5. Intra-frequency RSSI/CO measurement period corresponds to to Nintra-MO.max(*reportInterval*, *rmtc-Period*) when DRX is not used with Nintra-MO , *reportInterval*, and *rmtc-Period* defined as the number of intra-frequency measurement objects, configured reporting interval, and configured RMTC period. When DRX is used, the measurement period is Nintra-MO.max(*reportInterval*, *rmtc-Period, DRXcycle length*).Proposal 6. Inter-frequency RSSI/CO measurement period corresponds to Ninter-MO.max(*reportInterval*, *rmtc-Period, Nfreq*.*MGRP*) when DRX is not used where Ninter-MO is the number of inter-frequency measurement objects, and Nfreq is defined in clause 9.1.3 of TS 38.133. When DRX is used, the measurement reporting period is Ninter-MO.max(*reportInterval*, *rmtc-Period, Nfreq*.*MGRP, Nfreq*.*DRXcycle-length*).Proposal 7. RAN4 to define interruption requirements on SCells that are deactivated when RMTC or measurement cycles are long. LTE LAA requirements in clauses 7.8.2.11 and 7.8.2.12 of TS 36.133 can be used as a starting point.Proposal 8. When the UE performs intra-frequency RSSI/CO measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurements* The UE is not expected to transmit PUCCH/PUSCH/SRS on RSSI measurement symbols, and on 1 data symbol before each consecutive RSSI symbols and 1 data symbol after each consecutive RSSI symbols within RMTC window duration.

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols. |
| R4-2000719 | Qualcomm | Draft LS to RAN2 on RSSI measurement agreements. |
| R4-2000045 | ZTE | Proposal 1: Measurement accuracy requirements need to be defined in RAN4.Proposal 2: The UE can use less measurement bandwidth than the signaled bandwidth given that the measurement requirements are met.Proposal 3: The RSSI measurement report mapping defined in Table 9.1.18.5.1-1 in 36.133 can be used as a starting point for RSSI measurement report mapping for NR-U. The mapping shall be revisited after RAN4 finalizes on the measurement bandwidth. For forward compatibility, more reported values can be added and reserved. |
| R4-2000932 | MediaTek | Observation 1: For one ARFCN, the RSSI measurement is confined within a single LBT bandwidth. Thus, to report RSSI/CO measurement of multiple subbands, multiple MOs should be configured.Proposal1: The report for RSSI/CO measurement is per subband, for UE capable and configured with wideband operation with CCA. |

## Open issues summary

*In the last RAN4 meeting (R4-1915777), the following was agreed.*

* *RAN4 to define:*
	+ *intra-frequency (on PCC, PSCC, and SCC), inter-frequency, and inter-RAT measurement requirements for RSSI and channel occupancy*
	+ *FFS the exact definition of intra-/inter-frequency*
	+ *intra-frequency, inter-frequency, and inter-RAT measurement accuracy requirements for RSSI and channel occupancy*
	+ *measurement reporting mapping for RSSI*
	+ *FFS whether measurement report mapping is needed for channel occupancy, depending on its definition to be decided by other groups*
	+ *clarify measurement gap patterns applicability for RSSI and channel occupancy measurements:*
	+ *All Rel-15 measurement gap patterns applicable for FR1 measurements are also applicable for RSSI and channel occupancy measurements on carrier frequencies with CCA*
	+ *FFS: for gap-based measurements if RAN1 defines the measurement duration longer than 5 ms*

List of open issues:

* + - 1. Intra-frequency and Inter-frequency definition
			2. Measurement Gaps (depends on Issue 5-1:, deprioritize discussions)
			3. RSSI measurement report mapping
			4. Channel Occupancy measurement report mapping
			5. RSSI/CO measurement periods
			6. RSSI/CO measurement reporting requirements
			7. RMTC periodicity and RMTC measurement duration
			8. Interruption requirements
			9. Restrictions during RSSI measurements
			10. RSSI Measurement Bandwidth
			11. RSSI report normalization
			12. RSSI measurement accuracy
			13. Channel occupancy measurements
			14. LS to RAN2

###  Intra-frequency and Inter-frequency definition

**Issue 5-1: RSSI Intra-frequency and Inter-frequency definition**

Proposals:

* + (R4-2001929 Ericsson):

|  |  |
| --- | --- |
| Intra-frequency RSSI | * the bandwidth of the PRB set configured for RSSI measurement is within the bandwidth of at least one resource (e.g., CSI-RS resource, SSB, etc.) configured for a measurement on the serving cell, and
* the SCS of the active BWP in the serving cell and of the RSSI measurement are the same
 |
|
| Inter-frequency RSSI | if at least one of the two conditions above is not met |
|

* + (R4-2000720 Qualcomm )

RAN4 to define intra-frequency RSSI measurement to be the case when the RMTC configuration indicates that:

* Reference subcarrier spacing is the same as serving cell SCS
* Measurement BW is contained within the active BWP of the serving cell

Inter-frequency RSSI measurement is defined when any of the above conditions is not satisfied.

* Recommended WF
	+ - This is the first time the topic is discussed in RAN4. So more discussion is needed. Based on the proposals above, the following WF is proposed:
			* Intra-frequency RSSI measurements are defined when both conditions are satisfied:
				+ Condition 1: RMTC configured SCS is the same as the active BWP in the serving cell.
				+ FFS Condition 2:

Option 1: Measurement BW is contained within the active BWP of the serving cell

Option 2: Bandwidth of the PRB set configured for RSSI measurement is within the bandwidth of at least one resource configured for measurement on the serving cell.

* + - * Inter-frequency measurements are defined when at least one condition above is not satisfied.

### Measurement Gaps

**Issue 5-2: Need for measurement Gaps**

Proposals:

* + (R4-2001929 Ericsson):
		- Intra-frequency requires gaps when: The RSSI measurement is over the bandwidth which is not fully within the active BWP of the UE
		- Inter-frequency requires gaps when: The RSSI measurements is over the bandwidth which is not fully within the active BWP of the UE.
	+ (R4-2000720 Qualcomm )
		- Inter-frequency measurements require measurement gaps.
		- Intra-frequency measurements do not require measurement gaps.
		- No new measurement gap pattern needed for RSSI measurement.
* Recommended WF
	+ - This is the first time the topic is discussed in RAN4. Furthermore, the need or not for measurement gaps depends on the definition of intra and inter-frequency measurements. Therefore, it is proposed to deprioritize this discussion until there is an agreement for issue 5-1: the definition of RSSI intra and inter-frequency measurements.

###  RSSI measurement report mapping

**Issue 5-3: RSSI measurement report mapping**

Proposals:

* + Option 1:
		- (R4-2001929 Ericsson) RSSI measurement report mapping in NR-U is the same as that for CLI-RSSI in NR (i.e., from -100 dBm to -25 dBm with 1 dBm resolution).
		- (R4-2000045 ZTE) The RSSI measurement report mapping defined in Table 9.1.18.5.1-1 in 36.133 can be used as a starting point for RSSI measurement report mapping for NR-U. The mapping shall be revisited after RAN4 finalizes on the measurement bandwidth. For forward compatibility, more reported values can be added and reserved.
	+ Option 2: (R4-2000720 Qualcomm )
		- Define a new RSSI measurement report mapping, assuming that the RSSI measurement report is normalized to the SCS used for measurement.
* Recommended WF
	+ - There is no consensus in the proposals. Companies are advised to provide their views about :
			* Option 1: RSSI measurement report mapping is the same as for CLI-RSSI, i.e. from -100 dBm to -25 dBm with 1 dBm resolution.
				+ Note: this is equivalent to adopting the table in 9.1.18.5.1-1 in TS 36.133 as baseline
			* Option 2: Define a new measurement report mapping

### Channel Occupancy measurement report mapping

**Issue 5-4: Need to define a CO measurement report mapping**

Proposals:

* + Not define a measurement report mapping for CO (R4-2001929 Ericsson, R4-2000720 Qualcomm)
	+ Other options
* Recommended WF

This is the first time the issue is discussed in RAN4. Since there are no other options

* + - No measurement report mapping is defined for Channel Occupancy measurements in NR-U.

### RSSI/CO measurement periods

**Issue 5-5: RSSI/CO measurement periods**

Proposals:

* R4-2000720 Qualcomm:
	+ Observation 4. Wideband operation in NR-U may necessitate the need for configuring multiple measurement objects spanning multiple subbands. Logically, it is expected of UE to measure and report different measurement objects serially.
	+ Proposal 5. Intra-frequency RSSI/CO measurement period corresponds to to Nintra-MO.max(*reportInterval*, *rmtc-Period*) when DRX is not used with Nintra-MO , *reportInterval*, and *rmtc-Period* defined as the number of intra-frequency measurement objects, configured reporting interval, and configured RMTC period. When DRX is used, the measurement period is Nintra-MO.max(*reportInterval*, *rmtc-Period, DRXcycle length*).
	+ Proposal 6. Inter-frequency RSSI/CO measurement period corresponds to Ninter-MO.max(*reportInterval*, *rmtc-Period, Nfreq*.*MGRP*) when DRX is not used where Ninter-MO is the number of inter-frequency measurement objects, and Nfreq is defined in clause 9.1.3 of TS 38.133. When DRX is used, the measurement reporting period is Ninter-MO.max(*reportInterval*, *rmtc-Period, Nfreq*.*MGRP, Nfreq*.*DRXcycle-length*).
* (R4-2001929 Ericsson):
	+ Proposal 5: The RSSI and CO measurement periods depend on:
		- max(reportInterval, rmtc-Period) in non-DRX when measurement gaps are not required,
		- max(reportInterval, rmtc-Period, DRX) in DRX when measurement gaps are not required, or
		- max(reportInterval, rmtc-Period, MGRP and gap sharing) in DRX when measurement gaps are required.
* Recommended WF

 This is the first time the issue is discussed in RAN4. A tentative WF is:

* + - The RSSI and CO measurement periods depend on:
			* max(reportInterval, rmtc-Period) in non-DRX when measurement gaps are not required,
			* max(reportInterval, rmtc-Period, DRX) in DRX when measurement gaps are not required, or
			* max(reportInterval, rmtc-Period, MGRP and gap sharing) in DRX when measurement gaps are required.
		- FFS: for intra-frequency measurements:
			* In wideband operation, whether and how to consider the number of measurement objects (Nintra-MO) in the measurement period, in case there are multiple intra-frequency measurement objects configured.
		- FFS: for inter-frequency measurements:
			* Whether and how to consider the number of measurement reports (Ninter-MO) and Nfreq in the measurement period.

### RSSI/CO measurement reporting requirements

**Issue 5-6: RSSI/CO measurement reporting requirements**

Proposals:

* (R4-2001929 Ericsson):
	+ Proposal 6: Measurement reporting requirements are to be specified for periodic RSSI and CO reporting.
* Recommended WF
	+ Measurement reporting requirements are to be specified for periodic RSSI and CO.
		- Note: this agreement can be reviewed in case further agreements are made in RAN2.

### RMTC periodicity and RMTC measurement duration

**Issue 5-7: RMTC periodicity**

Proposals:

* R4-2000720 Qualcomm:
	+ Proposal 4. RMTC periodicity to be from the set of {40, 80, 160, 320, 640} ms exclusively. RMTC measurement duration to be from the set of {1, 14, 28, 42, 56, 70, 84, 140} in units of OFDM symbols with the limitation of max RTMC duration to be capped at 5ms (i.e., 84 and 140 symbols to be valid only for 30 kHz SCS).
* Recommended WF
	+ Only one proposal was presented. Companies, please provide your views on the proposal above.

### Interruption requirements

**Issue 5-8: Interruption requirements**

Proposals:

* R4-2000720 Qualcomm:
	+ RAN4 to define interruption requirements on SCells that are deactivated when RMTC or measurement cycles are long. LTE LAA requirements in clauses 7.8.2.11 and 7.8.2.12 of TS 36.133 can be used as a starting point.
* Recommended WF
	+ Only one proposal was presented. Companies, please provide your views on the proposal above.

### Restrictions during RSSI measurements

**Issue 5-9: Restrictions during RSSI measurements**

Proposals:

* R4-2000720 Qualcomm:
* Proposal 8. When the UE performs intra-frequency RSSI/CO measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurements
	+ The UE is not expected to transmit PUCCH/PUSCH/SRS on RSSI measurement symbols, and on 1 data symbol before each consecutive RSSI symbols and 1 data symbol after each consecutive RSSI symbols within RMTC window duration.
	+ When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.
* Recommended WF
	+ Only one proposal was presented. Companies, please provide your views on the proposal above. Note that it also depends on the definition of the intra or inter-frequency RSSI measurements.

### RSSI Measurement Bandwidth

**Issue 5-10: RSSI measurement bandwidth**

Proposals:

* R4-2000721 Qualcomm
	+ Proposal 1. RAN4 to define RSSI measurement accuracy requirements based on SSB BW.
* R4-20000045 ZTE:
	+ The UE can use less measurement bandwidth than the signaled bandwidth given that the measurement requirements are met.
* Others?
* Recommended WF
	+ Delegates, please provide your comments on the proposals above.

### RSSI report normalization

**Issue 5-11: RSSI reporting normalization**

Proposals:

* R4-2000719 Qualcomm:
	+ The RSSI reporting is normalized to the SCS used for measurement, the least common denominator, allowing flexibility for UE implementation to measure based on any value of N so long as accuracy requirements are met and with consistent interpretation of the value on NW and UE side
* Recommended WF
	+ From previous meetings, there was no consensus on this topic. Delegates, please provide your comments on the proposal above.

### RSSI measurement accuracy

**Issue 5-12: RSSI measurement accuracy**

Proposals:

* R4-2000721 Qualcomm:
	+ Proposal 2. RAN4 to define RSSI accuracy requirements based on 1-sumbol measurement duration with no L3 filtering.
* Recommended WF
	+ This topic was not discussed previously in RAN4. Delegates, please provide your comments on the proposal above.

### Channel occupancy measurements

**Issue 5-13: RSSI measurement accuracy**

Proposals:

* R4-2000721 Qualcomm:
	+ Proposal 3. UE shall be able to correctly evaluate the intra-frequency and inter-frequency CO provided that the following conditions are met:
		- All symbols during each RSSI measurement duration are available for RSSI sampling within the same reporting interval,
		- RSSI at the UE receiver meets the following conditions with respect to the configured channelOccupancyThreshold:
		- RSSI at the receiver is below channelOccupancyThreshold – ΔRSSI-intra for intra-frequency RSSI measurements and channelOccupancyThreshold – ΔRSSI-inter for inter-frequency RSSI measurements, or
		- RSSI at the receiver is above channelOccupancyThreshold + ΔRSSI-intra for intra-frequency RSSI measurements and channelOccupancyThreshold + ΔRSSI-inter for inter-frequency RSSI measurements
	+ Where ΔRSSI-intra and ΔRSSI-inter are intra-frequency and inter-frequency RSSI measurement accuracy requirements and whose values are FFS.
* Recommended WF
	+ Delegates, please provide your comments on the proposal above.

### LS to RAN2

**Issue 5-14: LS to RAN2**

Proposals:

* R4-2000719 Qualcomm:
	+ LS to RAN2 including the proposals on issues 5-3 and 5-7.
* Recommended WF
	+ This LS can only be discussed after the discussion of issues 5-3 and 5-7.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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 #6: Measurement and Monitoring QCL-ed SSBs

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-200930 | MediaTek Inc | Observation 2: For option 1, UE is required to monitor one SSB/candidate SBI for one SBI, and the Rel-15 UE measurement capability can be directly re-used.Observation 3: For option 2, UE may be required to monitor SSBs with up to 20 different candidate SBI per cell, which is much larger than the number of SBI per cell (i.e. up to 8). Observation 4: If UE is required to monitor on all SSBs with different candidate SBI, the UE measurement complexity will be boosted to 160 SSBs from 14 or 7 SSBs required in Rel.15.Observation 5: If UE is required to monitor on all SSBs from a set of QCL-ed SSB, the Rel-15 UE measurement capability should not be re-used for NR-U.Observation 6: For option 3, UE is required to monitor all SSBs with different candidate SBI of a cell.Proposal 1: For the requirements of RLM, IDLE mode measurement, and CONNECTED mode measurement, including intra-/inter-frequency measurement, UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other. Otherwise, the UE measurement capability in terms of candidate SBI is necessary to be introduced. |
| R4-c | Qualcomm | **Observation 4. Mandating a UE supporting operating in unlicensed spectrum 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.** **Proposal 6. A NOTE to be added in each of the tables in cell measurement clauses for NR-U (e.g., clause 9.2A.5.2 for intra-frequency) as in the following shown for example:****Table 9.2A.5.2-1: Measurement period for intrafrequency measurements without gaps**

|  |  |
| --- | --- |
| **Condition** | **T SSB\_measurement\_period\_intra**  |
| Max(TDRX,TSMTC)≤40 | max(200ms, ceil((5+Lmeas) x Kp) x max(SMTC period,DRX cycle))Note 1 x CSSFintra |
| 40<Max(TDRX,TSMTC)≤320 | max(200ms, ceil(1.5x (5+Lmeas) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| TDRX>320 | ceil((5+Lmeas) x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: Lmeas< Lmeas,max is the unavailable SMTC or DRX cycles during T SSB\_measurement\_period\_intra, where Lmeas,max=TBD.NOTE 3: Upon exceeding Lmeas,max over the corresponding period of time, the UE has to restart the corresponding procedure.NOTE 4: UE considers a SMTC occasion unavailable if the SSB index of the identified cell at the detected SSB position index is not available. |

 |
| R4-2001563  | Huawei, HiSilicon | **Proposal 1: The UE behavior of Option 1a shall be adopted. The UE behavior and benefits for measuring multiple SSBs should be further considered in the following meetings**  |
| R4-2000722 | Qualcomm | UE measurement capability for intra-frequency and inter-frequency measurements in NR-U are amended as in the following:**Intra-frequency requirements for FR1:**For each intra-frequency layer with CCA, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least: * 8 identified cells, and
* 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

NOTE: The above requirements apply assuming the detected SSB indices of identified cells remain available at their respective detected SSB position indices during layer 1 measurement period. **Inter-frequency requirements for FR1:**For each inter-frequency layer with CCA, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least: * 4 identified cells, and
* 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

NOTE: The above requirements apply assuming the detected SSB indices of identified cells remain available at their respective detected SSB position indices during layer 1 measurement period.  |
| R4-2001439 | Nokia (under 8.1.4.9 agenda item) | 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 |
| R4-2000050 | ZTE (under 8.1.4.9 agenda item) | Proposal 1: UE shall monitor all SSBs regardless of QCL information. |

## Open issues summary

Monitoring of QCLed SSB was discussed in RAN4-93 in the RLM agenda item. The following was agreed on the WF (R4-1915777)

RLM: QCL-ed SSBs

* 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

However, it is also necessary to discuss it in the measurement requirements.

### Definition of unavailable SMTC occasion

**Issue 6-1: Definition of unavailable SMTC occasion**

* Proposals
	+ Qualcomm: Proposal 6 UE considers a SMTC occasion unavailable if the SSB index of the identified cell at the detected SSB position index is not available
	+ Others?
* Recommended WF
	+ This topic needs to be further discussed. Delegates, please provide your views on the original options from the RLM way forward last meeting, and the proposal above.

### Number of QCLed SSBs the UE is required to monitor

**Issue 6-2: Number of QCLed beams UEs are required to monitor**

* Proposals
	+ MediaTek: Proposal 1: For the requirements of RLM, IDLE mode measurement, and CONNECTED mode measurement, including intra-/inter-frequency measurement, UE is required to monitor at least one SSB from the set of SSBs that are QCLed with each other.
	+ Huawei, HiSilicon: The UE behavior of Option 1a shall be adopted. The UE behavior and benefits for measuring multiple SSBs should be further considered in the following meetings.
	+ Others?
* Recommended WF
	+ This topic needs further discussion. There are different views submitted under the RLM agenda item.

### UE measurement capability for intra-frequency and inter-frequency measurements in NR-U

**Issue 6-3: UE measurement capability for intra-frequency and inter-frequency measurements in NR-U**

* Proposals
	+ Qualcomm (R4-2000722):
		- UE measurement capability for intra-frequency and inter-frequency measurements in NR-U are amended as in the following:

**Intra-frequency requirements for FR1:**

For each intra-frequency layer with CCA, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

* 8 identified cells, and
* 14 SSBs with different SSB index and/or PCI on the intra-frequency layer, where the number of SSBs in the serving cell (except for the SCell) is not smaller than the number of configured RLM-RS SSB resources.

NOTE: The above requirements apply assuming the detected SSB indices of identified cells remain available at their respective detected SSB position indices during layer 1 measurement period.

**Inter-frequency requirements for FR1:**

For each inter-frequency layer with CCA, during each layer 1 measurement period, the UE shall be capable of performing SS-RSRP, SS-RSRQ, and SS-SINR measurements for at least:

* 4 identified cells, and
* 7 SSBs with different SSB index and/or PCI on the inter-frequency layer.

NOTE: The above requirements apply assuming the detected SSB indices of identified cells remain available at their respective detected SSB position indices during layer 1 measurement period.

* Recommended WF
	+ This issue depends on the discussions above. Deprioritize the discussion until agreements on issues 6-1 and 6-2 are reached.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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 #7: Remaining issues in intra-frequency and inter-frequency measurements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000780 | Apple | *Proposal 1: Upon exceeding the maximum acceptable number of DL LBT failures* *UE would stop the PSS/SSS detection on the target unlicensed frequency layer, and UE would switch to another carrier for new PSS/SSS detection if this carrier is configured in the MOs.**Proposal 2: RAN4 shall allow UE to stop PSS/SSS detection if UE exceeds the maximum acceptable number of DL LBT failures for PSS/SSS detection on the target carrier and no other MOs are configured from network.**Proposal 3: In RRC\_CONNECTED mode, UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the serving cell for at least X consecutive number of SSB bursts not available at the UE, where the value of X is TBD.* |
| R4-2000718 | Qualcomm | Observation 3. In the identification stage, UE cannot reliably decide on the presence or absence of an SSB based on a single sample (SMTC occasion). If it could, then R15 requirements would have used one sample for the identification stage.Proposal 5. A NOTE to be added in each of the tables in cell identification clauses for NR-U (e.g., clause 9.2A.5.1 for intra-frequency) as in the following shown for example:Table 9.2A.5.1-1: Time period for PSS/SSS detection

|  |  |
| --- | --- |
| Condition | TPSS/SSS\_sync\_intra |
| Max(TDRX,TSMTC)≤40 | max( 600ms, ceil((5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle))Note 1 x CSSFintra |
| 40<Max(TDRX,TSMTC)≤320 | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| TDRX>320 | ceil((5+LPSS/SSS) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: LPSS/SSS< LPSS/SSS,max is the unavailable SMTC or DRX cycles during TPSS/SSS\_sync\_intra, where LPSS/SSS,max=TBD.NOTE 3: At least one SSB index in the same SSB position index shall be detectable, as specified in clause 9.2A.2, in the time period for PSS/SSS detection. |
| Proposal 7. After *N* unsuccessful measurement attempts due to exceeding the max number of unavailable SMTC occasions, UE should restart from the detection stage again. Value of *N* can be further discussed in RAN4. Proposal 8. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRP or SS-SINR measurement * The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols scheduled to be measured, and on 1 data symbol before each consecutive SSB symbols scheduled to be measured and 1 data symbol after each consecutive SSB symbols scheduled to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the SMTC periodicity follows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

Proposal 9. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRQ measurement * The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols scheduled to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB scheduled to be measured/RSSI symbols and 1 data symbol after each consecutive SSB scheduled to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2* is configured(in TS 38.331 [2]), the SMTC periodicity follows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols. |

 |
| R4-2001936 | Ericsson | * *Proposal 1: Upon exceeding LPSS/SSS,max, the UE is not required to meet the corresponding intra-frequency PSS/SSS detection requirement.*
* *Proposal 2: The maximum numbers of DL LBT failures for intra-frequency PSS/SSS detection are defined as in the table below.*

|  |  |  |
| --- | --- | --- |
| Procedure | Rel-15 samples | Maximum number of DL LBT failures |
| Parameter name | Parameter value | Condition |
| PSS/SSS detection, no gaps | 5 | LPSS/SSS,max | 7 | Max(TDRX,TSMTC)≤40 |
| 5 | 40<Max(TDRX,TSMTC)≤320 |
| 3 | TDRX>320 |
| PSS/SSS detection for deactivated SCell, no gaps | 5 | LPSS/SSS,deact,max | 7 | Max(TDRX, measCycleSCell)≤40 |
| 5 | 40< Max(TDRX, measCycleSCell)≤320 |
| 3 | TDRX>320 |
| PSS/SSS detection, with gaps | 5 | LPSS/SSS,gaps,max | 7 | Max(TDRX,TSMTC, MGRP)≤40 |
| 5 | 40<Max(TDRX,TSMTC, MGRP)≤320 |
| 3 | TDRX>320 |

* *Proposal 3: To address the consecutively missing SSBs issue:*
	+ *A note or clarification is added in the intra-frequency measurement requirements that the 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 4: Agree on further details, as shown below, for intra-frequency tables agreed in [2].*
* PSS/SSS detection, no measurement gaps:

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max( 600ms, ceil( (5+LPSS/SSS) x Kp) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+LPSS/SSS) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified.NOTE 2:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_intra, where LPSS/SSS ≤ LPSS/SSS,max.NOTE 3: LPSS/SSS,max =7 for Max(DRX cycle, SMTC period)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS,max=3 for 40<Max(DRX cycle, SMTC period)≤320, LPSS/SSS,max =3 for DRX cycle>320. |

* PSS/SSS detection for deactivated SCell, no measurement gaps:

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | (5+ LPSS/SSS) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+ LPSS/SSS) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | (5+ LPSS/SSS) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_intra, where LPSS/SSS ≤ LPSS/SSS,deact,max.NOTE 2: LPSS/SSS, deact,max =7 for Max(DRX cycle, measCycleSCell)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max =5 for 40<Max(DRX cycle, measCycleSCell)≤320, LPSS/SSS, deact,max =3 for DRX cycle>320. |

 |
| R4-2001937 | Ericsson | * *Proposal 1: Upon exceeding LPSS/SSS,max, the UE is not required to meet the corresponding inter-frequency PSS/SSS detection requirement.*
* *Proposal 2: The maximum numbers of DL LBT failures for PSS/SSS detection are defined as in the table below:*

|  |  |  |
| --- | --- | --- |
| Procedure | Rel-15 samples | Maximum number of DL LBT failures |
| Parameter name | Parameter value | Condition |
| PSS/SSS detection, with gaps | 8 | LPSS/SSS,gaps,max | 12 | Max(TDRX,TSMTC, MGRP)≤40 |
| 8 | 40<Max(TDRX,TSMTC, MGRP)≤320 |
| 5 | TDRX>320 |

* *Proposal 3: To address the consecutively missing SSBs issue:*
	+ *A note or clarification is added in the inter-frequency measurement requirements that the 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 4: Agree on further details, as shown below, for inter-frequency tables agreed in [2].*

PSS/SSS detection:

|  |  |
| --- | --- |
| Condition NOTE1,2 | TPSS/SSS\_sync\_inter |
| No DRX |  max(600ms, (8+LPSS/SSS) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(600ms, ceil((8+LPSS/SSS)x1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms  | (8+LPSS/SSS) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_inter, where LPSS/SSS ≤ LPSS/SSS,max.NOTE 4: LPSS/SSS,max =12 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS,max =8 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, LPSS/SSS,max =5 for DRX cycle>320.NOTE 5: During TPSS/SSS\_sync\_inter, any two closest SSB occasions available at the UE for PSS/SSS detection shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

Time index detection:

|  |  |
| --- | --- |
| Condition NOTE1,2 | TSSB\_time\_index\_inter |
| No DRX | max(120ms, (3+Lind) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil((3+Lind) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (3+Lind) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   Lind is the number of SMTC periods not available at the UE during TSSB\_time\_index\_inter, where Lind ≤ Lind,max.NOTE 4: Lind,max =5 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, Lind,max =3 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, Lind,max =2 for DRX cycle>320.NOTE 5: During TSSB\_time\_index\_inter, any two closest SSB occasions available at the UE for time index detection shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

Measurements:

|  |  |
| --- | --- |
| Condition NOTE1,2 | T SSB\_measurement\_period\_inter |
| No DRX | max(200ms, (8+Lmeas) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil((8+Lmeas) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+Lmeas) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   Lmeas is the number of SMTC periods not available at the UE during T SSB\_measurement\_period\_inter, where Lmeas ≤ Lmeas,max.NOTE 4: Lmeas,max =12 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, Lmeas,max =8 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, Lmeas,max =5 for DRX cycle>320.NOTE 5: During T SSB\_measurement\_period\_inter, any two closest SSB occasions available at the UE for measurements shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

 |
| R4-2000721 | Qualcomm | Proposal 4. RAN4 to discuss how to update Table 3.5.2-1 of TS 38.133 to include NR unlicensed bands after UE REFSENS requirements and labelling of them are decided in RF session. Proposal 5. RAN4 to decide how to capture the existing measurement accuracy requirements. Any of the two options below can be pursued:* Option 1: Current tables for existing measurement accuracy requirements (e.g., Table 10.1.2.1.1-1 for SS-RSRP intra-frequency absolute accuracy) are updated to include the NR unlicensed operating bands
* Option 2: Separate clauses are added to TS 38.133 with suffix “A” to capture the measurement accuracy requirements for NR unlicensed bands
 |

## Open issues summary

The list of open issues is:

|  |  |
| --- | --- |
|  | UE behaviour upon exceeding the maximum number of LBT failures during PSS/SSS detection |
|  | Maximum number of DL LBT failures during the intra-frequency PSS/SSS detection procedure |
|  | UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts |
|  | How to address consecutively missing SSBs from serving cell |
|  | PSS/SSS detection period |
|  | How to consider the QCLed beams during cell identification stage |
|  | UE behaviour in case of successive DL LBT failures during measurements |
|  | How to capture the agreements in the intra-frequency measurement tables in 38.133 |
|  | Maximum number of DL LBT failures during the inter-frequency PSS/SSS detection procedure |
|  | How to capture the agreements in the inter-frequency measurement tables in 38.133 |
|  | Scheduling availability during measurements in unlicensed spectrum |
|  | How to include NR unlicensed band in TS 38.133 |
|  | How to capture the measurement accuracy requirements for NR-U |

### UE behaviour upon exceeding the maximum number of LBT failures during PSS/SSS detection

**Issue 7-1: UE behavior upon exceeding the maximum number of DL LBT failures during PSS/SSS detection**

* Proposals
	+ Apple (R4-200780):
		- Upon exceeding the maximum acceptable number of DL LBT failures UE would stop the PSS/SSS detection on the target unlicensed frequency layer, and UE would switch to another carrier for new PSS/SSS detection if this carrier is configured in the MOs.
		- RAN4 shall allow UE to stop PSS/SSS detection if UE exceeds the maximum acceptable number of DL LBT failures for PSS/SSS detection on the target carrier and no other MOs are configured from network.
	+ Ericsson (R4-2001936 / R4-2001937): Proposal 1: Upon exceeding LPSS/SSS,max, the UE is not required to meet the corresponding intra-frequency PSS/SSS detection requirement.

* Recommended WF
	+ This topic needs to be further discussed, there is no consensus among companies. Delegates, please provide your views on the proposals above.

### Maximum number of DL LBT failures during the intra-frequency PSS/SSS detection procedure

The following was agreed on the RAN4 93 WF (R4-1915777)



FFS: whether and how to address the consecutively missing SSBs.

**Issue 7-2: Maximum number of DL LBT failures during the PSS/SSS detection procedure**

Proposals

* + Ericsson (R4-2001936): The maximum numbers of DL LBT failures for intra-frequency PSS/SSS detection are defined as in the table below.

|  |  |  |
| --- | --- | --- |
| **Procedure** | **Rel-15 samples** | **Maximum number of DL LBT failures** |
| **Parameter name** | **Parameter value** | **Condition** |
| PSS/SSS detection, no gaps | 5 | LPSS/SSS,max | 7 | Max(TDRX,TSMTC)≤40 |
| 5 | 40<Max(TDRX,TSMTC)≤320 |
| 3 | TDRX>320 |
| PSS/SSS detection for deactivated SCell, no gaps | 5 | LPSS/SSS,deact,max | 7 | Max(TDRX, measCycleSCell)≤40 |
| 5 | 40< Max(TDRX, measCycleSCell)≤320 |
| 3 | TDRX>320 |
| PSS/SSS detection, with gaps | 5 | LPSS/SSS,gaps,max | 7 | Max(TDRX,TSMTC, MGRP)≤40 |
| 5 | 40<Max(TDRX,TSMTC, MGRP)≤320 |
| 3 | TDRX>320 |

* Recommended WF
	+ These values follow the agreements made in RAN4 #93 for intra-frequency measurements. So the recommended way forward is to agree on Table above.

### UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts

**Issue 7-3: UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts**

Proposals

* + Apple (R4-200780): In RRC\_CONNECTED mode, UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the serving cell for at least X consecutive number of SSB bursts not available at the UE, where the value of X is TBD.
	+ Others?
* Recommended WF

This topic needs to be further discussed, there is no consensus among companies. Delegates, please provide your views on the proposals above.

### How to address consecutively missing SSBs from serving cell

**Issue 7-4: How to address consecutively missing SSBs from serving cell**

Proposals

* + Ericsson (R4-2001936 / R4-2001937): A note or clarification is added in the intra-frequency (and inter-frequency) measurement requirements that the 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*.*
* Recommended WF
	+ - RAN4 should not define additional requirements for consecutively missing SSBs.
			* FFS
				+ Option 1: a note is added on the specific table to clarify that the requirements apply provided that any two closest SSB occasions are not separated by more then 8 seconds.
				+ Option 2: no clarification is needed.

### PSS/SSS detection period

**Issue 7-5: PSS/SSS detection period, no measurement gaps**

Proposals

* + Ericsson (R4-2001936):
* PSS/SSS detection, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TPSS/SSS\_sync\_intra** |
| No DRX | max( 600ms, ceil( (5+LPSS/SSS) x Kp) x SMTC period )Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max( 600ms, ceil(1.5x (5+LPSS/SSS) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+LPSS/SSS) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified.NOTE 2:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_intra, where LPSS/SSS ≤ LPSS/SSS,max.NOTE 3: LPSS/SSS,max =7 for Max(DRX cycle, SMTC period)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS,max=3 for 40<Max(DRX cycle, SMTC period)≤320, LPSS/SSS,max =3 for DRX cycle>320. |

* + *.*
* PSS/SSS detection for deactivated SCell, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TPSS/SSS\_sync**\_**intra** |
| No DRX | (5+ LPSS/SSS) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+ LPSS/SSS) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | (5+ LPSS/SSS) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_intra, where LPSS/SSS ≤ LPSS/SSS,deact,max.NOTE 2: LPSS/SSS, deact,max =7 for Max(DRX cycle, measCycleSCell)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS, deact,max =5 for 40<Max(DRX cycle, measCycleSCell)≤320, LPSS/SSS, deact,max =3 for DRX cycle>320. |

* Recommended WF
	+ If RAN4 agrees on the WF proposed for the Issue 7.2.2, agree on tables above.

### How to consider the QCLed beams during cell identification stage

**Issue 7-6: How to consider the QCLed beams during celll identification stage**

Proposals

* Qualcomm (R4-2000718): A NOTE to be added in each of the tables in cell identification clauses for NR-U.
	+ At least one SSB index in the same SSB position index shall be detectable, as specified in clause 9.2A.2, in the time period for PSS/SSS detection.
* Others?
* Recommended WF
	+ Delegates, please provide your views on the proposal above.

### UE behaviour in case of successive DL LBT failures during measurements

**Issue 7-7: UE behaviour in case of successive DL LBT failures during measurements.**

*In previous RAN4 meetings (R4 92b, WF: R4-1912851), it was agreed that:*

* *UE behaviour upon exceeding the maximum L in measurement requirements:*
	1. *Upon exceeding the maximum acceptable number of DL LBT failures over the corresponding period of time, the UE has to restart the corresponding procedure, e.g., time index detection and measurements*
	2. *FFS UE behaviour for PSS/SSS detection*

Document R4-2000718 discusses the UE behaviour when successively restarting the measurement procedure.

* Proposals
	+ Qualcomm(R4-2000718) After *N* unsuccessful measurement attempts due to exceeding the max number of unavailable SMTC occasions, UE should restart from the detection stage again. Value of *N* can be further discussed in RAN4.
* Recommended WF
	+ Delegates, please provide your views on the proposal above.

### How to capture the agreements in the intra-frequency measurement tables in 38.133

**Issue 7-8: How to capture the agreements in the intra-frequency measurement tables in 38.133**

Proposals

* + Ericsson (R4-2001936):
* Time index detection, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TSSB\_time\_index\_intra** |
| No DRX | max(120ms, ceil( (3+Lind) x Kp )x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil (1.5 x (3+Lind) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | Ceil((3+Lind) x Kp) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified.NOTE 2:   Lind is the number of SMTC periods not available at the UE during TSSB\_time\_index\_intra, where Lind ≤ Lind,max.NOTE 3: Lind,max =5 for Max(DRX cycle, SMTC period)≤40 where DRX cycle is 0 for non-DRX, Lind,max =3 for 40<Max(DRX cycle, SMTC period)≤320, Lind,max =2 for DRX cycle>320. |

* Time index detection for deactivated SCell, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TSSB\_time\_index\_intra** |
| No DRX | (3+Lind) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms |  (3+Lind) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | (3+Lind) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1:   Lind is the number of SMTC periods not available at the UE during TSSB\_time\_index\_intra, where Lind ≤ Lind,deact,max.NOTE 2: Lind,deact,max =5 for Max(DRX cycle, measCycleSCell)≤40 where DRX cycle is 0 for non-DRX, Lind,deact,max =3 for 40<Max(DRX cycle, measCycleSCell)≤320, Lind, deact,max =2 for DRX cycle>320. |

* Measurements, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra**  |
| No DRX | max(200ms, ceil( (5+ Lmeas) x Kp) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+ Lmeas) x Kp) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil((5+ Lmeas) x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2:   Lmeas is the number of SMTC periods not available at the UE during T SSB\_measurement\_period\_intra, where Lmeas ≤ Lmeas,max.NOTE 3: Lmeas,max =7 for Max(DRX cycle, SMTC period)≤40 where DRX cycle is 0 for non-DRX, Lmeas,max =5 for 40<Max(DRX cycle, SMTC period)≤320, Lmeas,max =3 for DRX cycle>320. |

* Measurements for deactivated SCell, no measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra**  |
| No DRX | (5+ Lmeas) x measCycleSCell x CSSFintra |
| DRX cycle≤ 320ms | (5+ Lmeas) x max(measCycleSCell, 1.5xDRX cycle) x CSSFintra |
| DRX cycle> 320ms | (5+ Lmeas) x max(measCycleSCell, DRX cycle) x CSSFintra |
| NOTE 1:   Lmeas is the number of SMTC periods not available at the UE during T SSB\_measurement\_period\_intra, where Lmeas ≤ Lmeas,deact,max.NOTE 2: Lmeas,deact,max =7 for Max(DRX cycle, measCycleSCell)≤40 where DRX cycle is 0 for non-DRX, Lmeas,deact,max =5 for 40<Max(DRX cycle, measCycleSCell)≤320, Lmeas,deact,max =3 for DRX cycle>320. |

* PSS/SSS detection, with measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TPSS/SSS\_sync\_intra** |
| No DRX | max(600ms, (5+LPSS/SSS) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5x (5+LPSS/SSS)) x max(MGRP, SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | (5+LPSS/SSS) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_intra, where LPSS/SSS ≤ LPSS/SSS,gaps,max.NOTE 2: LPSS/SSS,gaps,max =7 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS,gaps,max =5 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, LPSS/SSS,gaps,max =3 for DRX cycle>320. |

* Time index detection, with measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **TSSB\_time\_index\_intra** |
| No DRX | max(120ms, (3+Lind) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(120ms, ceil(1.5x (3+Lind)) x max(MGRP, SMTC period,DRX cycle) x CSSFintra) |
| DRX cycle>320ms | (3+Lind) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1:   Lind is the number of SMTC periods not available at the UE during TSSB\_time\_index\_intra, where Lind ≤ Lind,gaps,max.NOTE 2: Lind,gaps,max =5 for Max(DRX cycle, SMTC period)≤40 where DRX cycle is 0 for non-DRX, Lind,gaps,max=3 for 40<Max(DRX cycle, SMTC period)≤320, Lind,gaps,max =2 for DRX cycle>320. |

* Measurements, with measurement gaps:

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra**  |
| No DRX | max(200ms, (5+Lmeas) x max(MGRP, SMTC period)) x CSSFintra |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x (5+Lmeas)) x max(MGRP, SMTC period,DRX cycle))x CSSFintra |
| DRX cycle>320ms | (5+Lmeas) x max(MGRP, DRX cycle) x CSSFintra |
| NOTE 1:   Lmeas is the number of SMTC periods not available at the UE during T SSB\_measurement\_period\_intra, where Lmeas ≤ Lmeas,gaps,max.NOTE 2: Lmeas,gaps,max =7 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, Lmeas,gaps,max =5 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, Lmeas,gaps,max =3 for DRX cycle>320. |

* Recommended WF
	+ Agree on the tables above.

### Maximum number of DL LBT failures during the inter-frequency PSS/SSS detection procedure

**Issue 7-9: Maximum number of DL LBT failures during the inter-frequency PSS/SSS detection procedure**

Proposals

* + Ericsson (R4-2001937): The maximum numbers of DL LBT failures for inter-frequency PSS/SSS detection are defined as in the table below.

|  |  |  |
| --- | --- | --- |
| **Procedure** | **Rel-15 samples** | **Maximum number of DL LBT failures** |
| **Parameter name** | **Parameter value** | **Condition** |
| PSS/SSS detection, with gaps | 8 | LPSS/SSS,gaps,max | 12 | Max(TDRX,TSMTC, MGRP)≤40 |
| 8 | 40<Max(TDRX,TSMTC, MGRP)≤320 |
| 5 | TDRX>320 |

* Recommended WF
	+ These values follow the agreements made in RAN4 #93 for intra-frequency measurements. So the recommended way forward is to agree on Table above.

### How to capture the agreements in the inter-frequency measurement tables in 38.133

**Issue 7-10: How to capture the agreements in the inter-frequency measurement tables in 38.133**

Proposals

* + Ericsson (R4-2001937): The maximum numbers of DL LBT failures for inter-frequency PSS/SSS detection are defined as in the table below.

|  |  |
| --- | --- |
| * **Condition NOTE1,2**
 | **TPSS/SSS\_sync\_inter** |
| No DRX |  max(600ms, (8+LPSS/SSS) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(600ms, ceil((8+LPSS/SSS)x1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+LPSS/SSS) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   LPSS/SSS is the number of SMTC periods not available at the UE during TPSS/SSS\_sync\_inter, where LPSS/SSS ≤ LPSS/SSS,max.NOTE 4: LPSS/SSS,max =12 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, LPSS/SSS,max =8 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, LPSS/SSS,max =5 for DRX cycle>320.NOTE 5: During TPSS/SSS\_sync\_inter, any two closest SSB occasions available at the UE for PSS/SSS detection shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

Time index detection:

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_time\_index\_inter** |
| No DRX | max(120ms, (3+Lind) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(120ms, ceil((3+Lind) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (3+Lind) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1.NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   Lind is the number of SMTC periods not available at the UE during TSSB\_time\_index\_inter, where Lind ≤ Lind,max.NOTE 4: Lind,max =5 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, Lind,max =3 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, Lind,max =2 for DRX cycle>320.NOTE 5: During TSSB\_time\_index\_inter, any two closest SSB occasions available at the UE for time index detection shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

Measurements:

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **T SSB\_measurement\_period\_inter** |
| No DRX | max(200ms, (8+Lmeas) x max(MGRP, SMTC period)) x CSSFinter |
| DRX cycle ≤ 320ms | max(200ms, ceil((8+Lmeas) x 1.5) x max(MGRP, SMTC period, DRX cycle)) x CSSFinter |
| DRX cycle > 320ms | (8+Lmeas) x DRX cycle x CSSFinter |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in clause 3.6.1NOTE 2: In EN-DC operation, the parameters, timers and scheduling requests referred to in clause 3.6.1 are for the secondary cell group. The DRX cycle is the DRX cycle of the secondary cell group.NOTE 3:   Lmeas is the number of SMTC periods not available at the UE during T SSB\_measurement\_period\_inter, where Lmeas ≤ Lmeas,max.NOTE 4: Lmeas,max =12 for Max(DRX cycle, SMTC period,MGRP)≤40 where DRX cycle is 0 for non-DRX, Lmeas,max =8 for 40<Max(DRX cycle, SMTC period,MGRP)≤320, Lmeas,max =5 for DRX cycle>320.NOTE 5: During T SSB\_measurement\_period\_inter, any two closest SSB occasions available at the UE for measurements shall be separated by no more than the maximum time requirement for the cell to remain known (8 seconds), as specified in section TBD. |

* Recommended WF
	+ If RAN4 agrees with issue 7.2.9 and 7.2.4, the proposed way forward is to agree on the tables above.

### Scheduling availability during measurements in unlicensed spectrum

**Issue 7-11: Scheduling availability during measurements**

Proposals

* + Qualcomm (R4-2000718):

Proposal 8. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRP or SS-SINR measurement

* The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols scheduled to be measured, and on 1 data symbol before each consecutive SSB symbols scheduled to be measured and 1 data symbol after each consecutive SSB symbols scheduled to be measured within SMTC window duration. If the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the SMTC periodicity follows *smtc2*; Otherwise SMTC periodicity follows *smtc1.*

Proposal 9. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRQ measurement

* The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols scheduled to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB scheduled to be measured/RSSI symbols and 1 data symbol after each consecutive SSB scheduled to be measured/RSSI symbols within SMTC window duration. If the high layer signalling of *smtc2* is configured(in TS 38.331 [2]), the SMTC periodicity follows *smtc2*; Otherwise the SMTC periodicity follows *smtc1.*

When intra-band carrier aggregation in unlicensed spectrum is performed, the scheduling restrictions due to a given serving cell should also apply to all other serving cells in the same band on the symbols that fully or partially overlap with the aforementioned restricted symbols.

* Recommended WF
	+ Delegates, please provide your comments on the proposals above.

### How to include NR unlicensed band in TS 38.133

**Issue 7-12: How to include NR unlicensed bands in TS 38.133**

Proposals

* + Qualcomm (R4-2000721):

Proposal 4. RAN4 to discuss how to update Table 3.5.2-1 of TS 38.133 to include NR unlicensed bands after UE REFSENS requirements and labelling of them are decided in RF session.

* Recommended WF
	+ Agree on the proposal: RAN4 to discuss how to update Table 3.5.2-1 of TS 38.133 to include NR unlicensed bands after UE REFSENS requirements and labelling of them are decided in RF session.

### How to capture the measurement accuracy requirements for NR-U

**Issue 7-13: How to capture the measurement accuracy requirements for NR-U**

Proposals

* + Qualcomm (R4-2000721):

• Option 1: Current tables for existing measurement accuracy requirements (e.g., Table 10.1.2.1.1-1 for SS-RSRP intra-frequency absolute accuracy) are updated to include the NR unlicensed operating bands

• Option 2: Separate clauses are added to TS 38.133 with suffix “A” to capture the measurement accuracy requirements for NR unlicensed bands

* Recommended WF
	+ Delegates, please provide your views on option 1 and 2.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1: Sub topic 1-2:….Others: |

### 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** |
| R4-2001804 | 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”* |

# Topic #8: Measurement capability and reporting criteria

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000722 | Qualcomm | **Observation 1. Per RAN1/2 agreements, a measurement object configuration for RSSI/CO reporting can only cover a single subband of 20 MHz. RSSI/CO reporting for multiple subbands requires multiple separate measurement objects.****Proposal 1. Regardless of whether UE is capable of wideband operation with CCA or configured to do so or not, one report for RSSI and channel occupancy measurement consists of one RSSI measurement and one channel occupancy measurement.** **Proposal 2. Legacy R15 measurement reporting criteria not to be impacted by wideband operation with CCA or scaled by the number of subbands.**  |
| R4-2000932 | MediaTek | Observation **1**: For one ARFCN, the RSSI measurement is confined within a single LBT bandwidth.Proposal1: The report for RSSI/CO measurement is per subband, for UE capable and configured with wideband operation with CCA. |
| R4-2001938 | Ericsson | * ***Proposal 1****: With Ecat=1, 1 report for RSSI and channel occupancy measurements is capable of minimum 1 RSSI measurement and 1 channel occupancy measurement over a channel [TS 37.213] per carrier frequency with CCA.*
* ***Proposal 2****: No wideband RSSI and channel occupancy reporting criteria are seen to be needed in Rel-16.*
 |

## Open issues summary

### Wideband RSSI and CO reporting criteria

**Issue 8-1:** **Wideband RSSI / CO** **reporting criteria**

* Proposals
	+ Option 1 Ericsson(R4-2001938) / MediaTek (R4-2000932): No wideband RSSI and CO reporting criteria in Rel-16.
* Recommended WF
	+ In Rel-16 NR-U, the RSSI and CO measurement report is confined in a sub-band.

### Per sub-band RSSI report

**Issue 8-2: 9Per sub-band RSSI report**

* Proposals
	+ Option 1 Qualcomm (R4-2000722) MediaTek (R4-2000932): A RSSI/CO report consists of 1 RSSI measurement and 1 CO measurement.
		- RSSI/CO report over multiple sub-bands requires multiple measurement objects.
	+ Option 2 Ericsson(R4-2001938): With Ecat=1, 1 report for RSSI and channel occupancy measurements is capable of minimum 1 RSSI measurement and 1 channel occupancy measurement over a channel [TS 37.213] per carrier frequency with CCA
* Recommended WF
	+ Delegates, please provide your views on the proposals above.

### Legacy Rel-15 reporting criteria

**Issue 8-3: Legacy Rel-15 reporting criteria**

* Proposals
	+ Qualcomm (R4-2000722):
		- Legacy R15 measurement reporting criteria not to be impacted by wideband operation with CCA or scaled by the number of subbands.
* Recommended WF
	+ Delegates, please provide your views on the proposal above.

## Companies views’ collection for 1st round

### Open issues

### 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** |
|  |  |
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|  |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **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”* |