**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) |

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. |

# 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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2001361.zip) | Ericsson | Proposal 1: Set the SSB based L1-RSRP evaluation period for NR-U as follows:   |  |  | | --- | --- | | 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

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| **Company** | **Comments** |
| Qualcomm | Sub topic 1-1: Qualcomm agrees on the WF for issue 1-1.  Sub topic 1-2: Qualcomm agrees on the WF for issue 1-2.  Sub topic 1-3: In our view, semi-persistent reporting is no different than period/aperiodic reporting in the way UL LBT failure impacts it. If L1-RSRP report is on PUSCH, the extension of reporting delay due to UL LBT failure is inherently allowed through HARQ retransmission of a PUSCH packet that was unsuccessfully received. If L1-RSRP report is on PUCCH, the R15 rules apply. Moreover, in case UE is not able to send HARQ-ACK of MAC-CE activation/deactivation command, it continues with its previous behavior (e.g., if it cannot send HARQ-ACK of MAC-CE activation command, it continues in the deactivated state.) R4-2001361 mentions that the latest CSI report is most important from NW view. However, a new CSI request should always allow sufficient time for measurement. Sub topic 1-4: See comments on sub topic 1-3 above. Moreover, if UE cannot send HARQ-ACK of MAC-CE deactivation command, it continues in the activated state. If gNB does not need the new measurements (as stated in R4-2001361), it can discard it. No new UE behavior should be defined.  Sub topic 1-5: We agree that the general principals of SSB-based L1-RSRP can also be applied for CSI-RS based L1-RSRP.  Others: |
| Ericsson | Sub topic 1-1: Agree with the moderator’s suggestion.  Sub topic 1-2: Agree with the moderator’s suggestion.  Sub topic 1-3: We prefer Option 1. The latest CSI report is most important from the network scheduling point of view. We think the L1-RSRP reporting delay should be extended for the last CSI if UE cannot transmit CSI reporting due to the UL LBT failure. If the UE is able to report the latest measurement result if the gNB allocates the UL resources, e.g., CSI request, then the UE transmits the CSI reporting on the allocated UL resource.  Sub topic 1-4: We prefer Option 1. For the semi-persistent CSI reporting with PUCCH, our concern is there is no clear UE behavior when UE cannot transmit HARQ-ACK for MAC-CE for the reporting activation/deactivation.  Example 1: Suppose gNB activates the semi-persistent CSI reporting, but UE cannot transmit HARQ-ACK due to UL LBT failure. In this case, gNB assumes UE starts the measurement or not start? If there is mismatch between UE and gNB, e.g., UE does not start measurement but gNB starts receiving CSI report on PUCCH, gNB cannot receive any information, it is waste of resources.  Example 2: Suppose gNB deactivates the semi-persistent CSI reporting, but UE cannot transmit HARQ-ACK due to UL LBT failure. In this case, gNB assumes UE stops the measurement or continues the measurement? If there is mismatch between UE and gNB, e.g., UE continues the measurement and reporting, but gNB stops to receive CSI and it allocates same PUCCH to another UE, then two UEs will transmit the information on the same PUCCH resource.  Sub topic 1-5: It is related to CSI-RS based beam management requirements. If RAN4 agree to define CSI-RS based RLM and beam management requirements, then RAN4 should also define CSI-RS based L1-RSRP measurement requirements. We propose the same number of samples for both SSB based L1-RSRP measurement and CSI-RS based L1-RSRP measurement, i.e., M=3, according to Rel-15 requirements. We also propose to reuse the same extension value L1 and L1,max as SSB based L1-RSRP measurement 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.** | | |
| Intel | Sub topic 1-2: WF for issue 1-2 can be agreed.  Sub topic 1-5: The general principals of SSB-based L1-RSRP can also be applied for CSI-RS based L1-RSRP. |
| Nokia | Sub-topic 1-1 Agree with the WF.  Sub-topic 1-2 Agree with the WF.  Sub-topic 1-3 Option 2: semi-persistent L1-RSRP reporting reuses Rel-15 reporting delay.  Sub-topic 1-4 Option 2.  Sub-topic 1-5 We agree with the proposal. The same principle used for SSB based L1-RSRP can be adopted for CSI-RS based L1-RSRP. We agree with the Table proposed by Ericsson. |
| MTK | Sub topic 1-1: we agree on the WF, i.e. L1=0.  Sub topic 1-2: we agree on the WF, reusing R15 reporting delay.  Sub topic 1-3: we support option 2. New mechanism on CSI reporting timing should be RAN1 issue and it should be discussed in RAN1.  Sub topic 1-4: we support option 2. In our view, the UE behaviors are:   * UE cannot transmit HARQ-ACK for MAC-CE for the reporting activation, it will be deactivated state, and not reporting is expected. * UE cannot transmit HARQ-ACK for MAC-CE for the reporting deactivation, it will be activated state, and reporting is expected.   Sub topic 1-5: We disagree to extend the CSI-RS measurement period depending on the LBT failure. CSI-RS was not designed for detection and thus the DL LBT failure is unknown at UE. |
| Huawei | Sub topic 1-3: We support option 2. We didn’t see the difference for the semi-persistent case.  Sub topic 1-4: It seems like the issue of UE behavior when the HARQ feedback cannot transmit due to LBT is not listed here. From our views, UE should keep its previous state before the successful HARQ-ACK transmission. For the deactivation case, there is no need to delay and restart the transmission, which could lead to further conflict. |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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| **Sub-topic#1-1** | **Issue 1-1: Value of L1,max when timeRestrictionForChannelMeasurement is configured**  There was no objection to the proposed WF.  *Tentative agreements:*  L1,max = 0 when **timeRestrictionForChannelMeasurement** is configured and the table is updated 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. | | |
| **Sub-topic#1-2** | **Issue 1-2: Periodic and aperiodic L1-RSRP reporting delay**  There was no objection to the proposed WF. Therefore, the tentative agreement is:  *Tentative agreements:*  Periodic and aperiodic L1-RSRP reporting delay reuses Rel-15 reporting delay |
| **Sub-topic#1-3** | **Issue 1-3: Semi-persistent L1-RSRP reporting delay**  4 companies agreed on option 2, following the discussion from periodic and aperiodic delay. and 1 company agreed with option 1. Further discussion is needed.  *Candidate options:*  There was no consensus about the semi-persistent L1-RSRP reporting delay. The following options are still valid:  Option 1: Extend the delay, how to extend the delay is FFS.  Option 2: Semi-persistent L1-RSRP reporting delay in NR-U reuses the Rel-15 reporting delay.  *Recommendations for 2nd round: continue the discussion in the first round, and if no consensus is reached, include both options in the FFS.* |
| **Sub-topic#1-4** | **Issue 1-4: Semi-persistent CSI reporting with PUCCH**  *Candidate options:*  There was no consensus about the semi-persistent CSI reporting delay with PUCCH. The following options are still valid:  Option 1: Extend the delay, how to extend the delay is FFS.  Option 2: Semi-persistent L1-RSRP reporting delay in NR-U reuses the Rel-15 reporting delay.  Additionally, as noted by Huawei (thank you for mentioning it), the following was missing from the original moderator summary. The following issues are new. Companies, please provide your views on the following:  **New Issue 1-4-1: Detailed UE behavior when receiving the MAC CE activation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK**  Option 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  Option 2:  If UE cannot transmit HARQ-ACK on MAC-CE activation due to UL CCA failure, UE should anyway start L1-RSRP measurement and reporting  **New Issue 1-4-2: Detailed UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK**  Option 1:  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  Option 2:  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.  Option 3:  If UE cannot transmit HARQ-ACK on the MAC CE deactivation due to the UL LBT failures, UE stops the L1-RSRP measurement and reporting.  *Recommendations for 2nd round: Continue the discussions above. If no consensus is reached this meeting, the issues can be included in the way forward.* |
| **Sub-topic#1-5** | **Issue 1-5: CSI-RS based L1-RSRP measurement period**  This issue depends on agreement on Topic 3, under the email discussion RAN4#94e #47. Therefore, it is not possible to reach a conclusion in this meeting, since the discussions are in parallel.  If RAN4 agrees in defining CSI-RS based RLM and Beam management requirements, the following can go to the way forward in this meeting. Please comment on the suggestion for the WF:  *Tentative agreements:*  FFS:  Option 1: CSI-RS L1-RSRP measurements follow the same approach of SSB L1-RSRP measurements:   * Same number of samples for both SSB based L1-RSRP measurement and CSI-RS * Same extension value L1 and L1-max as in SSB based L1-RSRP   Option 2: A new approach or conditions are needed for CSI-RS based L1-RSRP measurements under LBT failure.  Other options are not precluded.  *Recommendations for 2nd round: Discuss the text that will go to the way forward in this meeting.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way Forward on NR-U RRM requirements, Part 3 | Nokia |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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| **Sub-topic#1-3** | **Issue 1-3: Semi-persistent L1-RSRP reporting delay**  *Candidate options:*  There was no consensus about the semi-persistent L1-RSRP reporting delay. The following options are still valid:  Option 1: Extend the delay, how to extend the delay is FFS.  Option 2: Semi-persistent L1-RSRP reporting delay in NR-U reuses the Rel-15 reporting delay. |
| **Comments** | Qualcomm: We support option 2 and do not see any difference with periodic L1-RSRP. |
| **Nokia** | Option 2. |
|  | Ericsson: We prefer Option 1. The latest CSI report is most important from the network scheduling point of view. We think the L1-RSRP reporting delay should be extended for the last CSI if UE cannot transmit CSI reporting due to the UL LBT failure. If the UE is able to report the latest measurement result if the gNB allocates the UL resources, e.g., CSI request, then the UE transmits the CSI reporting on the allocated UL resource. |
| **MTK** | Option 2. New mechanism on CSI reporting timing should be RAN1 issue and it should be discussed in RAN1. |

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| **Sub-topic#1-4** | **Issue 1-4: Semi-persistent CSI reporting with PUCCH**  *Candidate options:*  Option 1: Extend the delay, how to extend the delay is FFS.  Option 2: Semi-persistent L1-RSRP reporting delay in NR-U reuses the Rel-15 reporting delay. |
| **Comments** | Qualcomm: We support option 2. There is no reason to extend the measurement delay. Furthermore, PUCCH does not have HARQ retransmission. Extending delay would require UL resource allocation to UE regardless of whether LBT failure is seen or not which is quite wasteful. |
| **Nokia** | Option 2. |
|  | Ericsson: It seems sub-topic 1-4 is divided with sub-sub-topics 1-4-1 and 1-4-2. Please find our comments below. |
| **MTK** | Option 2. |

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| **Sub-topic 1-4-1** | **New Issue 1-4-1: Detailed UE behavior when receiving the MAC CE activation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK**  Option 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  Option 2:  If UE cannot transmit HARQ-ACK on MAC-CE activation due to UL CCA failure, UE should anyway start L1-RSRP measurement and reporting |
| **Comments** | Qualcomm: we support option 1. It is reasonable and logical to assume that UE stays in the old state behaviour if it cannot transmit HARQ-ACK to switch to the new state. |
|  | Ericsson: We support option 1 as our proposal 5 in R4-2001361. |
|  | MTK: Option 1. |

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| **New issue**  **1-4-2** | **New Issue 1-4-2: Detailed UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK**  Option 1:  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  Option 2:  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.  Option 3:  If UE cannot transmit HARQ-ACK on the MAC CE deactivation due to the UL LBT failures, UE stops the L1-RSRP measurement and reporting. |
| **Comments** | Qualcomm: we support option 1. It is reasonable and logical to assume that UE stays in the old state behaviour if it cannot transmit HARQ-ACK to switch to the new state. |
|  | Ericsson: We support Option 2 as our proposal 6 in R4-2001361. Option 1 may cause the conflict on UL transmission if network has already scheduled the PUCCH resource to another UE after transmitting MAC-CE deactivation.  Example: UE1 is transmitting SP-CSI on PUCCH. NW sends deactivation to UE1 and schedule UE2 to transmit signal on the same PUCCH after deactivation. If UE1 continues UL transmission on PUCCH, it conflicts to UL transmission from UE2.  We therefore to consider delay the reporting. |
|  | MTK: we need more time to check this new issue. |

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| **Sub-topic#1-5** | **Issue 1-5: CSI-RS based L1-RSRP measurement period**  This issue depends on agreement on Topic 3, under the email discussion RAN4#94e #47. Therefore, it is not possible to reach a conclusion in this meeting, since the discussions are in parallel.  If RAN4 agrees in defining CSI-RS based RLM and Beam management requirements, the following can go to the way forward in this meeting. Please comment on the suggestion for the WF:  *Tentative agreements:*  FFS:  Option 1: CSI-RS L1-RSRP measurements follow the same approach of SSB L1-RSRP measurements:   * Same number of samples for both SSB based L1-RSRP measurement and CSI-RS * Same extension value L1 and L1-max as in SSB based L1-RSRP   Option 2: A new approach or conditions are needed for CSI-RS based L1-RSRP measurements under LBT failure.  Other options are not precluded.  *Recommendations for 2nd round: Discuss the text that will go to the way forward in this meeting.* |
| **Comments** | Qualcomm: WF text looks ok. |
|  | Ericsson: We support Option 1. |
|  | MTK: We agree with the WF. |

## 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

|  |  |  |
| --- | --- | --- |
| [R4-2000042](file:///C:\\Users\\portelal\\Documents\\000-NR_unlic-CORE\\3GPP%20RAN4%2094%20Athens\\Docs\\R4-2000042.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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2000044.zip) | ZTE Corporation | withdrawn |
| [R4-2000931](file:///C:\\Users\\portelal\\Documents\\000-NR_unlic-CORE\\3GPP%20RAN4%2094%20Athens\\Docs\\R4-2000931.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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2002086.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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2000042.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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2000042.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:\\Users\\portelal\\Documents\\000-NR_unlic-CORE\\3GPP%20RAN4%2094%20Athens\\Docs\\R4-2002086.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

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| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| ZTE | 2-4: We have withdrawn LS [R4-2000044](file:///C:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2000044.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. |
| Qualcomm | Sub topic 2-1: We don’t see options 1 and 3 to be in conflict. In our view, UE shall abandon measurement and since it does not have a measurement, it will not send a repot.  Sub topic 2-2: Large value of k has an impact on UE power consumption. We prefer k=2 as well.  Sub topic 2-3: The formulation in R4-2002086: (Tmeasure\_SFTD\_CCA = T1 + 2 × Tmeasure\_SFTD1 – 1 × SMTC period) is unclear to us. A diagram/picture justifying the above would have helped. Furthermore, the definition of unavailable SMTC or missing SMTC should be clarified similar to the concerns that we have shared in other measurement types. |
| Apple | Sub-topic 2-1: UE behavior shall be as option 1+option 3 (i.e. abandon measurement and shall not report anything) when exceeding the Tmeasure\_SFTD\_LBT\_max  Sub-topic 2-2: SFTD measurement is like a contribution work from UE to network to provide the timing difference info in the coverage, so it shall avoid to cost too much UE resource on that (blind detection will even cost more resource). We agree with option 2. |
| Ericsson | Sub topic 2-1: option 1 and option 3 are similar, essentially the same  Sub topic 2-2: option 2 is unreasonably too small resulting in that in practice even a little LBT failure will result in wasted measurement efforts. Support option3, but could compromise to option 1.  Sub topic 2-3: support Option 2. Option 1 is not aligned with the RAN4#93 agreement: “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.”  Sub topic 2-4: the proposal does not address the testing and testability issue (X and Y). Suggest looking at Ericsson R4-2002086 to see if that is agreeable instead. |
| Nokia | Sub-topic 2-1 We are fine combining option 1 and 3.  Sub-topic 2-2: Option 3 is too large. We are fine to compromise at k = 6, Option 1. |
| MTK | Sub topic 2-1: option 1 and option 3 are similar, and we could align the wording with RAN2.  Sub topic 2-2: option 2. For ENDC-SFTD, the k = 1.6 – 2.4, as shown as follows. Not sure why it is ok for EN-DC but will be too small for inter-RAT SFTD. Besides, the similar scaling value (1.5~3) can be also found in inter-/intra- frequency measurement.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | EN-DC SFTD | R15 samples | NLBT-fail,max | **Condition** | **K** | | 5 | 7 | max(TDRX,TSMTC)≤40 | 2.4 | | 8 | 5 | 40<max(TDRX,TSMTC)≤320 | 1.63 | | 5 | 3 | TDRX > 320 | 1.6 |   Sub topic 2-3: The testing can be discussed in performance part discussion. We can focus on core part. |

### CRs/TPs comments collection

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

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000041 | Qualcomm: The text is not consistent with other clauses in the way missing SMTC is described (uses DRS instead of SMTC). Also the definition of an unavailable SMTC should be clarified similar to the concerns that we have shared in other measurement types. |
| Nokia: there are still open issues being discussed, we cannot agree with this CR yet. |
|  |
| 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. |
| Ericsson: The contribution is proposing maximum time for when the UE can skip inter-RAT SFTD search (k=6), but not really addressing the problem with testing and testability (X and Y). Suggest looking at Ericsson R4-2002086 to see if that is agreeable (the technical contents), and if it is perhaps it can be incorporated into ZTE’s CR. |
| Nokia: there are still open issues being discussed, we cannot agree with this CR yet. |
| 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#2-1** | **Issue 2-1: UE behaviour when exceeding Tmeasure\_SFTD\_LBT\_max**  There was consensus that Option 1 and 3 can be combined, and it was proposed that the final wording can be aligned with RAN2 specification.  *Tentative agreements:*  *It is RAN4 understanding that the UE behavior when exceeding Tmeasure\_SFTD\_LBT\_max is that the UE shall not report the measurement and abandon the inter-RAT SFTD measurement.*  *The exact wording can be aligned with RAN2.* |
| **Sub-topic#2-2** | **Issue** 2**-2: Maximum number of LBT failures allowed during procedure**  There was no consensus in the proposals to define k in   * + FFS from RAN4 #93: Tmeasure\_SFTD\_LBT\_max = k× Tmeasure\_SFTD1, k=TBD≤10   However, option 3 just got support from one company, that was willing to compromise to option 1. Therefore, the following options can be further discussed:  *Candidate options:*   * + Option 1: k = 6   + Option 2: k =2 |
| **Sub-topic#2-3** | **Issue** 2**-3: Inter-RAT SFTD measurements reporting delay**  The comments on this issue were in different directions. There was one comment that the formulation was not clear, requesting further clarification, and other company mentioned that it can be discussed in performance part. Clearly the issue needs further discussion.  *Recommendations for 2nd round:* Continue these discussions in this meeting with clarifications if possible. If no agreement is reached, provide your views on  Option 1) This discussion should take place in the RRM Core requirements  Option 2) This discussion should take place in the RRM Performance requirements. |
|  |  |

*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** |
| R4-2000041 | *Based on 1st round of comments collection, there is no support for agreeing this CR. Since it also contains many topics which are still open for discussion, we suggest to come back to it on the next meeting.* |
| R4-2000043 | *Based on 1st round of comments collection, there is no support for agreeing this CR. Since it also contains many topics which are still open for discussion, we suggest to come back to it on the next meeting.* |
| R4-2002087 | *The content of this CR will be merged with the content of R4-2000043.* |

## Discussion on 2nd round (if applicable)

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| --- | --- |
| **Sub-topic#2-2** | **Issue 2-2: Maximum number of LBT failures allowed during procedure**  There was no consensus in the proposals to define k in   * + FFS from RAN4 #93: Tmeasure\_SFTD\_LBT\_max = k× Tmeasure\_SFTD1, k=TBD≤10   However, option 3 just got support from one company, that was willing to compromise to option 1. Therefore, the following options can be further discussed:  *Candidate options:*   * + Option 1: k = 6   + Option 2: k =2 |
| **Comments** | Qualcomm: we support option 2. |
|  | ZTE: Prefer Option 1 over Option 2. k=2 seems really not enough. |
|  | Ericsson: Option 1 (we have already compromised from Option 3), We can also take the average between option 2 and Option 3, which will also give 6, which is option 1. |
|  | MTK: Option 2. Analysis has been provided that k=2 is sufficient, since similar value has been used in ENDC SFTD. |

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| **Sub-topic#2-3** | **Issue 2-3: Inter-RAT SFTD measurements reporting delay**  **Original options:**   * 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:\\Users\\portelal\\Documents\\000-NR_unlic-CORE\\3GPP%20RAN4%2094%20Athens\\Docs\\R4-2002086.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 ×   *Recommendations for 2nd round:* Continue these discussions in this meeting with clarifications if possible. If no agreement is reached, provide your views on  Option 1) This discussion should take place in the RRM Core requirements  Option 2) This discussion should take place in the RRM Performance requirements. |
| **Comments** | Qualcomm: we support option 1 and do not even understand the formulation in option 2. |
|  | ZTE: Well actually we also had certain doubts towards Option 2 during the last meeting, but it was agreed and captured in WF. Not sure we should just ignore the agreement and go on with new ideas and proposals. The moderator / chair can instruct us on this. |
|  | Ericsson: Option 2 is about testability in the proposals. The background is provided in R4-2002086. However, if we can agree on a test case that is verifying that the UE continues to search and eventually manages to detect a cell, then we are fine with Option 1. This discussion can continue in the performance part, provided RAN4 agrees on specifying a relevant test case to address the issue. |
|  | MTK: The testing can be discussed in performance part discussion. We can focus on core part. |

## 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

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| --- | --- | --- |
| **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
* Option 3 (Ericsson R4-2001935):
  + - 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.
* Recommended WF
  + No extension for UL channel access category 1, i.e., =0, while the measurement reporting delay is extended for other cases.
  + 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 extension for UL channel access category 1, i.e., =0, while the measurement reporting delay is extended for other cases.
    - 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 extension for UL channel access category 1, i.e., =0, while the measurement reporting delay is extended for other cases.
    - 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** |
| Qualcomm | Sub topic 3-1: In our view option 2a is not different than option 1. Option 2a does not specify any new UE behavior and simply clarifies that extension of delay due to UL LBT failure is the same as HARQ retransmission attempts. If this was not clear, we apologize. In other words, we can agree to Option 1.  Sub topic 3-2: Similar to the comment in Sub topic 3-1, our intention with the proposal was not to define any new UE behavior. In our paper, we explained how UL LBT failure may sometimes result in more than one delivery of the same measurement result (Figure 1 in R4-2000718). The proposal is simply trying to capture the existing UE behavior in case of UL LBT failure. If such capturing creates more confusion, we can agree to Option 3.  ….  Further comment on added text in the WF: we do not agree that channel access category 1 should be differentiated or even mentioned in the spec yet. First, it is quite obvious that there is no UL CCA for channel access category 1 so discussions on UL LBT failure would not apply. Second, the view of majority of companies are the same for this category and other categories. So text like “No extension for UL channel access category 1…” is not agreeable to us.  Others: |
| Ericsson | Sub topic 3-1: Added Ericsson’s proposal as option 3 since what was named Ericsson’s proposal is not from our paper.  Sub topic 3-2: Option 1 and option 2 are similar. What is the justification for Option 3, since there is obviously an impact?  Sub topic 3-3: options 1 and 2 appear to be similar. Option 3 is confusing since “UL resources not available” is too ambiguous and for NR-U actually it’s not a seldom case like it was in Rel-15 (which justified the legacy approach) and thus needs to be clearly specified. |
| Nokia | Sub topic 3-1; We apologize if Ericsson’s proposal was not captured correctly. For Qualcomm’s comment, we see differences between option 1 and 2a. The following remark was made by a RAN2 colleague: after reaching the maximum number of HARQ retransmissions, the UE does not flush all the buffers, RLC will keep the retransmission, since SRBs are always send in acknowledged mode. This is why our preference is not to capture “abandon the measurement report” in RAN4 specification, and just refer to RAN2 specification, if needed, without explaining the procedure which can cause confusion. We prefer option 1.  Sub topic 3-2: The justification for Option 3, is that in our view, the UL LBT failure is no different from a unsuccessful UL transmission in licensed band, which requires retransmissions. Therefore, in our view, the delay can follow the Rel-15 delay.  Sub topic 3-3: Option 3. Our concern with option 1 and option 2 follows our comment in topic 3-1. Also, in option 1 and 2,two different mechanisms are cited (UL LBT failure recovery and HARQ retransmissions), therefore they were captured in two distinct ways. |
| MTK | Sub topic 3-1: we support option 1. RAN4 should not specify new UE behaviour, and it is not feasible to delete the message.  Sub topic 3-2: We prefer option 3, and to clarify the delay if needed. To our understanding, consistent UL LBT RAN2 procedure will take place if UL,max\_ref is reached. Hence, it is not necessary to specify the maximum extension.  Sub topic 3-3: Same comment as 3-2, it is not necessary to specify the maximum extension. |
| Huawei | Sub topic 3-1: As mentioned in our paper, the measurement report will be sent to PHY layer upon generation, and it is not possible to delete a particular message from PHY layer according a specific time limits. So further clarification is needed about the action “abandon the measurement report”  Sub topic 3-3: It is the same as L1-rsrp reporting. The process are controlled by NW and the impact of LBT failure is handle by the LBT recovery scheme and the HARQ retransmission. Clarification to exclude this time period is enough. |

### 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#3-1**  **And sub-topic #3-3** | **Issue** 3**-1: UE behaviour in case of successive UL LBT failures during event-triggered reporting**  In general, companies clarified that no new UE behaviour is needed for NR-U. Ericsson added a new option, but in our view, their proposal is captured in issue 3-3. There was an objection to the text proposed by Ericsson in the WF, so it was removed.  *Recommendations for 2nd round: Can companies agree in the following text?*  For event triggered reporting:   * + RAN4 should not specify a pre-defined value of UL,max   + RAN4 should not specify a new UE behaviour for when reaching UL,max.   There are RAN2 procedures in place for when either the HARQ retransmissions or UL LBT failure procedures are triggered.  FFS: whether/ how to refer to these procedures when discussing the extension of the measurement report. |
| **Sub-topic#3-2** | **Issue** 3**-2: Reporting delay for (event-triggered) periodic reporting**  Companies clarified their options and discussed the justifications for each of them. However, there was no consensus: 3 companies agree to option 3, and one company prefer to Option 2 (which was determined to be similar to Option 1) . So further discussion is needed.  *Candidate options:*  FFS: Decide the event-triggered periodic and periodic reporting delay:   * Option 1: Adopt the same definition as in Rel-15.   + - Option 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   *Recommendations for 2nd round:Continue the discussions of the 1st round, and try to agree on one of the options. If it is not possible, can RAN4 agree with the proposed text, to be captured in the WF of this meeting?* |
| **Sub-topic#3-3** | **Issue** 3**-3: Reporting delay for event-triggered reporting**  There was no agreement. 3 companies prefer option 3, and one company prefer option 2.  *Candidate options:*  FFS: Decide the event-triggered reporting delay:   * Option 1: No need to extend the delay, clarify that the measurement reporting delay excludes a delay which is caused by no UL resources available due to CCA. Wording can be further discussed.   + Option 2: 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   *Recommendations for 2nd round:Discuss the text above and agree on the WF for next meeting.* |

*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)

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#3-1**  **And sub-topic #3-3** | **Issue** 3**-1: UE behaviour in case of successive UL LBT failures during event-triggered reporting**  In general, companies clarified that no new UE behaviour is needed for NR-U. Ericsson added a new option, but in our view, their proposal is captured in issue 3-3. There was an objection to the text proposed by Ericsson in the WF, so it was removed.  *Recommendations for 2nd round: Can companies agree in the following text?*  For event triggered reporting:   * + RAN4 should not specify a pre-defined value of UL,max   + RAN4 should not specify a new UE behaviour for when reaching UL,max.   There are RAN2 procedures in place for when either the HARQ retransmissions or UL LBT failure procedures are triggered.  FFS: whether/ how to refer to these procedures when discussing the extension of the measurement report. |
| **Comments** | **Qualcomm:** We support relying on RAN2 specification and not specifying anything further. The first bullet above is agreeable to us which means the second bullet is not even relevant.  Nokia: We agree with the WF.  Huawei: RAN4 should not specify the pre-defined value.  MTK: We agree with the WF. |
| **Sub-topic#3-2** | **Issue** 3**-2: Reporting delay for (event-triggered) periodic reporting**  Companies clarified their options and discussed the justifications for each of them. However, there was no consensus: 3 companies agree to option 3, and one company prefer to Option 2 (which was determined to be similar to Option 1) . So further discussion is needed.  *Candidate options:*  FFS: Decide the event-triggered periodic and periodic reporting delay:   * Option 1: Adopt the same definition as in Rel-15.   + - Option 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   *Recommendations for 2nd round:Continue the discussions of the 1st round, and try to agree on one of the options. If it is not possible, can RAN4 agree with the proposed text, to be captured in the WF of this meeting?* |
| **Comments** | Qualcomm: We support option 1. Moreover, the persistent UL LBT failure recovery mechanism will highly likely end up being an optional UE capability which means it cannot be used in setting the min requirements.  Nokia: Option 1  Huawei: Option 1.  Ericsson: we propose a simplified option 2:  For periodic and event-triggered periodic measurement reporting, the UE measurement reporting delay is extended due to UL LBT failures until the time point of the successful reporting attempt or until the new periodic measurement is available, according to [TBD RAN2 specification]. No extension for UL channel access category 1.  MTK: option 1. |
| **Sub-topic#3-3** | **Issue** 3**-3: Reporting delay for event-triggered reporting**  There was no agreement. 3 companies prefer option 3, and one company prefer option 2.  *Candidate options:*  FFS: Decide the event-triggered reporting delay:   * Option 1: No need to extend the delay, clarify that the measurement reporting delay excludes a delay which is caused by no UL resources available due to CCA. Wording can be further discussed.   + Option 2: 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   *Recommendations for 2nd round:Discuss the text above and agree on the WF for next meeting.* |
| **Comments** | Qualcomm: we support option 1. Moreover, the persistent UL LBT failure recovery mechanism will highly likely end up being an optional UE capability which means it cannot be used in setting the min requirements.  Nokia: Option 1  Huawei: Option 1.  Ericsson: option 1 is not aligned with RAN4 agreements in RAN4#93/92-bis:   * Background: Agreed in RAN4#92-bis:   + Event-triggered reporting:     - UE measurement reporting delay is extended to account for UL LBT failures resulting in UE being not being able to transmit, provided the UL resources are configured     - This applies for all UL channel access categories other than the channel access category 1       * Existing reporting requirements apply for the reporting based on the UL channel access category 1 * Event triggered reporting:   + FFS: UE shall abandon the measurement report when the extension ΔUL, 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 ΔUL,max   + The extension is     - Option 1: determined by RAN1/RAN2 specifications     - Option 2: a pre-defined value   + measurement reporting delay can be further extended to account for DL LBT failures, in the same way as in the measurement period requirements   We propose a simplified option 2:   * + For event-triggered measurement reporting, the UE measurement reporting delay is extended due to UL LBT failures until the time point of the successful reporting attempt, according to [TBD RAN2 specification]. No extension for UL channel access category 1.   MTK: option 1. |

## 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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2000718.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:\Users\portelal\Documents\000-NR_unlic-CORE\3GPP%20RAN4%2094%20Athens\Docs\R4-2001437.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** |
| Qualcomm | Sub topic 4-1: We agree with WF.  Sub topic 1-2:  ….  Others: |
| Ericsson | Agree with the proposal |
| Nokia | Agree with the WF. |
| MTK | We can agree the WF only if the QCL factor Q is known to UE. When Q is known, the DMRS descrambling will be sufficient to derive the SBI, and then not additional time for PBCH is needed. Otherwise, the requirements for unkwon Q should be discussed, and the additional time for PBCH will be required. |
| Huawei | We have similar views as MTK. |

### 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#4-1** | **Issue 4-1: Additional time for PBCH payload reading for SSB index identification**  In general, companies agreed to the WF, if Q is known to the UE.  Below, follows the agreement from RAN1 #98b, for clarification.   |  | | --- | | Agreement:  For RRM measurements of a neighbor cell in IDLE, INACTIVE and CONNECTED UE states,   * Support signaling of a common Q value per frequency by broadcast RRC signaling (SIBx) and/or dedicated RRC signaling (measObjectNR) from the serving cell. * Support signaling from the serving cell of a Q value for a listed neighbour cell.   + If Q is signaled for a listed cell, it overrides any common Q value per frequency |   *Tentative agreement*   * + There is no need to specify additional time for PBCH reading during SSB index identification in FR1 NR-U, if Q is known to the UE.   *Candidate options*   * Option 1: We can assume that Q is always known to the UE * Option 2: We cannot assume that Q is always known to the UE   *Recommendations for 2nd round:* Discuss the options above considering the RAN1 agreement copied in this discussion. If companies agree that it is sufficient, we can remove the underlined part of the tentative agreement in the second 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*

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

## Discussion on 2nd round (if applicable)

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#4-1** | **Issue 4-1: Additional time for PBCH payload reading for SSB index identification**  In general, companies agreed to the WF, if Q is known to the UE.  Below, follows the agreement from RAN1 #98b, for clarification.   |  | | --- | | Agreement:  For RRM measurements of a neighbor cell in IDLE, INACTIVE and CONNECTED UE states,   * Support signaling of a common Q value per frequency by broadcast RRC signaling (SIBx) and/or dedicated RRC signaling (measObjectNR) from the serving cell. * Support signaling from the serving cell of a Q value for a listed neighbour cell.   + If Q is signaled for a listed cell, it overrides any common Q value per frequency |   *Tentative agreement*   * + There is no need to specify additional time for PBCH reading during SSB index identification in FR1 NR-U, if Q is known to the UE.   *Candidate options*   * Option 1: We can assume that Q is always known to the UE * Option 2: We cannot assume that Q is always known to the UE   *Recommendations for 2nd round:* Discuss the options above considering the RAN1 agreement copied in this discussion. If companies agree that it is sufficient, we can remove the underlined part of the tentative agreement in the second round. |
| **Comments** | **Qualcomm:** The only scenario where Q may not be known to UE is when the identified cell is not a listed cell but in this case, UE will not be asked to report SSB index since NW has not included it in the list. So in our view, option 1 is correct.  Nokia: we also believe that the agreements are sufficient to clarify the issue. We can assume that Q Is always known at the UE.  Ericsson: Option 1 is ok  MTK: We disagree with removing the underlined part. We believe the clarification is necessary to clarify that Q value should be provided. From RAN1 agreement, it is unclear whether this signalling will be always provided or not. Therefore, we are concerning the case that there is neither common Q value nor per-cell Q value provided, Then the additional time will be required. |

## Summary on 2nd round (if applicable)

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

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

# Topic #5: RSSI and Channel Occupancy measurements

## Companies’ contributions summary

|  |  |  |
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| **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** |
| Qualcomm | Sub Topic 5-1: Per RAN1 agreement, RSSI measurement bandwidth as configured in MO is always in subband unit (20 MHz). So it can never be contained within SSB. We fail to understand why RSSI intra-frequency definition should be dependent on CSI-RS BW. Moreover, our proposal simplifies the requirements for MG. Intra-frequency will always be without MG and inter-frequency will always be with MG. So two categories only as opposed to 4 categories in the other option.  Sub Topic 5-2: See comments for Sub Topic 5-1.  Sub Topic 5-3: Option 1 does not differentiate between L1 and L3 filtering. Note that L3 filtering support is agreed in RAN1. Option 1 wastes nearly half of the entries that 7-bit mapping allows. Option 1 does not have the wide dynamic range that option 2 provides.  Sub Topic 5-4: We agree to the WF.  Sub Topic 5-5: We can agree to the WF. However, the third bullet which discusses MG and gap sharing factor lacks specificity. We propose to also make the third bullet FFS for now.  Sub Topic 5-6: We agree to the WF and believe it can be revisited subject to RAN2 agreements.  Sub Topic 5-7: Further comment based on comments below: We are listing what the RMTC periodicities and length should be and propose sending an LS to RAN2. This issue has not been finalized in RAN2 yet and since it has impact on RAN4, we’re proposing to conclude it.  Sub topic 5-10 and 5-11: We have provided extensive analysis on why the measurement result will not be different if UE uses a smaller than 20 MHz BW from all angles: DL interference from other NR-U UEs, interference from WiFi, UL interference from other NR-U UEs. The proponents of measurement over 20 MHz have not provided any proof why it is necessary. Moreover, if measurement of quality metrics such as RSRQ and SINR is ok to be defined over SSB BW, why is measurement of RSSI which is a power metric need to be defined on a larger BW? |
| Ericsson | Sub topic 5-1: “condition 2” in the proposed WF could be “center frequency is aligned with center frequency of an intra-frequency SSB”  Sub topic 5-2: we should take the same approach as for other measurements: intra-frequency may also require gaps, if not within the active BWP.  Sub topic 5-3: CLI-RSSI framework has been adapted by RAN1/RAN2 for NR-U RSSI, so it is reasonable to reuse measurement reporting mapping for CLI-RSSI.  Sub topic 5-7: Requirements shall be defined for all configurable periodicities, no reason to exclude any periodicity of what can be configured.  Sub topic 5-8: needs further discussion  Sub topic 5-9: “before/after each consecutive RSSI symbol” looks confusing since RSSI can be configured over multiple consecutive symbols. Needs further discussion  Sub topic 5-10: No reason to limit the measurement BW to SSB BW and it is not acceptable to leave this completely to UE implementation to decide any BW smaller than what configured by the network. RAN1/RAN2 decided already that the BW is configured, and the network expects the measurement to be reflecting the situation over the configured BW not its part and the network will be taking decisions based on the configured BW. Otherwise why to configure at all?  Sub topic 5-11: relates to measurement report mapping sub topic above; no need to normalize.  Sub topic 5-12: needs further discussion, it’s performance part.  Sub topic 5-13: needs further thinking and discussion, it’s performance part. |
| Intel | Sub topic 5-10/12 for RSSI accuracy , how will define the ideal RSSI measurement? As RAN4 discussed in LTE LAA, the simulation approach doesn’t make sense. So how will RAN4 evaluate such RSSI accuracy? |
| Nokia | Sub-topic 5-1 Agree with the first condition. For condition 2, we prefer to adopt Option 1, and not have the measurement bandwidth associated with any other resource configured for measurement. Furthermore, this option simplifies the usage of measurement gaps in Issue 5-2-  Sub-topic 5-2 Depends on the decision in issue 5-1. We prefer the option proposed by Qualcomm, which is also aligned with our comment on the sub-topic above.  Sub-topic 5-3 Option 1: Reuse the measurement report mapping that was adopted in CLI-RSSI measurements.  Sub-topic 5-4 We Agree with the WF. No need to define channel occupancy measurement report mapping  Sub-topic 5-5 Agree with the WF.  Sub-topic 5-6 We can agree with the WF, measurement reporting requirements are to be specified for periodic RSSI and CO.  Sub-topic 5-7 We should define performance requirements for different configurations, not limiting it in RAN4.  Sub-topic 5-8 We need more discussion.  Sub-topic 5-9 Further clarification is needed, we agree with Ericssons’ comment.  Sub-topic 5-10 It is not reasonable to limit the measurement BW to the SSB. The RSSI measurement is an absolute measurement, that helps the gNB to assess the amount of interference in a given channel. Furthermore, it is used as basis for the CO measurement, which is related to the threshold used to determine if the channel is vacant or not. This comparison, if we consider the ETSI specification, is done based on the energy in the entire occupied bandwidth, not just in parts of it.  Sub-topic 5-11 No need to normalize. The RSSI is an absolute measurement, it should not be normalized to the SCS .  Sub-topic 5-12 Discussion for the performance part.  Sub-topic 5-13 Discussion for the performance part. |
| MTK | Sub topic 5-1: The 2nd proposal (from R4-2000720) seems clearer for us. (Agree with the first condition and option 1 in condition 2)  Sub topic 5-2: it related to 5-1. The 2nd proposal (from R4-2000720) seems clearer.  Sub topic 5-5: We have one comment on the WF. The sharing factor, CSSF should be also considered. Besides, the lower bound, e.g. 200ms, R15 L3 measurements should be also considered.  Sub topic 5-6: we agree on the WF.  Sub topic 5-7: RMTC duration should be caped in 5 ms, ie. 84 and 140 symbols to be valid only for 30 kHz SCS.  Sub topic 5-9: we are OK with the proposal, where R15 wording is reused.  Sub topic 5-10: support based on SSB BW. The RSSI BW is fixed as 20 MHz and it is not configurable. As long as UE can fulfill the accuracy requirement, the actual measurement BW is up to UE implementation.  Sub topic 5-11: normalization is needed.  Sub topic 5-12: To apply the shortest duration as the minimum requirement. In LTE LAA it is 1 symbol. |

### 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#5-1** | **Issue** 5**-1: RSSI Intra-frequency and Inter-frequency definition**  There was no objection to the first condition of the WF. There is no agreement on the second condition, but there is a clear preference for Option 1. Companies, please provide further comments to the options below (option 2 was adapted according to Ericsson’s suggestion).  *Candidate options:*   * + 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: The center frequency of the PRB set configured for RSSI measurement is aligned with the center frequency of an intra-frequency SSB.     - Inter-frequency measurements are defined when at least one condition above is not satisfied.   *Recommendations for 2nd round:*   1. Continue providing comments for the options above 2. If we cannot agree on option 1 or 2 in this meeting, is it ok to agree to the text above, as it is? |
| **Sub-topic#5-2** | **Issue** 5**-2: Need for measurement Gaps**  This decision depends on the decision on topic 5-1. It is not possible to agree on this topic without further agreements in the topic above. However, there is one topic that was not included in the answers in the first round:   * + 1) Can RAN4 agree that no new measurement gap patterns are needed for RSSI measurements?   *Recommendations for 2nd round:*  Companies, please provide input on the question above. We can return to the discussion about measurement gaps for RSSI measurements in the next meeting. |
| **Sub-topic#5-3** | **Issue** 5**-3: RSSI measurement report mapping**  This issue depends on issue 5-11 (normalization of the RSSI measurement, where there is again, no consensus). The candidate options are the same as before:  *Candidate option:*   * + 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   *Recommendations for 2nd round:*  Companies that didn’t provide their opinion on this issue in the first round, please do so in the second round. And all interested companies, please answer the question:  If we cannot agree on Option 1 or option 2 this meeting, can RAN4 agree on the text of the candidate options for the WF for next meeting? |
| **Sub-topic#5-4** | **Issue** 5**-4: Channel Occupancy Measurement Report mapping**  There were no objections to the proposed way forward.  *Tentative agreements:*   * No measurement report mapping is defined for Channel Occupancy measurements in NR-U. |
| **Sub-topic#5-5** | **Issue 5-5: RSSI/CO measurement periods**  This is the first time the topic is discussed in RAN4. Companies didn’t object the WF but proposed some minor changes. These changes are marked in yellow below.  *Tentative agreements (confirm if the comments were captured in the right way):*   * + - 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       * FFS: 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.     - FFS: how to consider the sharing factor CSSF, and the lower bound R15 L3 measurements   *Recommendations for 2nd round:*  Companies, please check if the comments were captured in the right way. |
| **Sub-topic#5-6** | **Issue** 5**-6: RSSI/CO measurement reporting requirements**  Companies didn’t object the proposed WF in the 1st round.  *Tentative agreements*   * + 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. |
| **Sub-topic#5-7** | **Issue 5-7: RMTC periodicity**  Based on the further clarification provided in the comments, I have made a change on the candidate options:  *Candidate options:*   * + Option 1: 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).   + Option 2: The configuration of RMTC periodicity and RMTC duration are in the scope of RAN2 discussions.   *Recommendations for 2nd round:*  Comment on the options above. |
| **Sub-topic#5-8** | **Issue** 5**-8: Interruption requirements**  This is the first time that this topic is discussed in RAN4. There were comments that more discussion is needed, but no other options were given. The original proposal is:   * + 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.   We propose including it on this topic WF as:  RAN4 to discuss interruption requirements during RSSI/CO measurements.  *Recommendations for 2nd round:*  Comment on the proposal, if the proposed text can be included in the WF. |
| **Sub-topic#5-9** | **Issue** 5**-9: Restrictions during RSSI measurements**  One company supported the proposal, and 2 companies mentioned that further discussion/clarification is needed, since the text “*before/after each consecutive RSSI symbol* looks confusing since RSSI can be configured over multiple consecutive symbols”. The original proposal is:   * 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 RSSI symbols and 1 data symbol after each 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.   Can Qualcomm clarify the text in the second round of the discussion?  *Recommendations for 2nd round*: continue discussions based on the new input. If no agreement is reached, can we agree on the following, and bring more views in the next meeting?  RAN4 to discuss scheduling restrictions during RSSI/CO measurements. |
| **Sub-topic#5-10** | **Issue** 5**-10: RSSI measurement bandwidth**  The comments were equally divided in two groups.  *Candidate options:*  RAN4 to define the RSSI measurement accuracy requirements based on:  Option 1: SSB bandwidth.  Option 2: Bandwidth configured by the gNB.  *Recommendations for 2nd round:* continue discussing the topic, based on the latest version of the comments. If no consensus is reached, is it agreeable to copy the text above in the way forward? |
| **Sub-topic#5-11** | **Issue** 5**-11: RSSI reporting normalization**  This issue is related to the issue above. There was no consensus in the discussion. The comments were divided in two groups:  *Candidate options:*  Option 1: The RSSI reporting is normalized to the SCS, allowing flexibility for the UE implementation to measure based on any value of N so long as accuracy requirements are met.  Option 2: No need to normalize the RSSI report.  *Recommendations for 2nd round:* continue discussing the topic, based on the latest version of the comments. If no consensus is reached, is it agreeable to copy the text above in the way forward? |
| **Sub-topic#5-12** | **Issue** 5**-12: RSSI measurement accuracy**  There were two groups of comments. The first group prefer to postpone this discussion to the performance part of NR-U, and the second group agreed with the proposal. Considering the number of open topics, the recommendation is to postpone this discussion at least to next meeting. |
| **Sub-topic#5-13** | **Issue** 5**-13: Channel Occupancy measurements**  There were two groups of comments. The first group prefer to postpone this discussion to the performance part of NR-U, and the second group agreed with the proposal. Considering the number of open topics, the recommendation is to postpone this discussion at least to next meeting. |

*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)

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#5-1** | **Issue** 5**-1: RSSI Intra-frequency and Inter-frequency definition**  There was no objection to the first condition of the WF. There is no agreement on the second condition, but there is a clear preference for Option 1. Companies, please provide further comments to the options below (option 2 was adapted according to Ericsson’s suggestion).  *Candidate options:*   * + 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: The center frequency of the PRB set configured for RSSI measurement is aligned with the center frequency of an intra-frequency SSB.     - Inter-frequency measurements are defined when at least one condition above is not satisfied.   *Recommendations for 2nd round:*   1. Continue providing comments for the options above 2. If we cannot agree on option 1 or 2 in this meeting, is it ok to agree to the text above, as it is? |
| **Comments** | Qualcomm: Option 2 of condition 2 does not make sense. In NR-U, SSB raster is agreed to be on the edge of the subband. If PRB set configured for RSSI measurement is supposed to be aligned with center frequency of SSB, then it means part of it will always be outside of the serving subband since measurement BW is also 20 MHz. So for a UE that does not support wideband operation (e.g., uses CA instead of wideband operation), intra-frequency RSSI will never happen. We support option 1.  Nokia: We also support option 1.  Ericsson: we think in general that the active BWP should not be linked with the definition of intra-frequency/inter-frequency, so our thought-through preference: RSSI is intra-frequency, if:   * + - * Condition 1: RMTC configured SCS is the same as the SCS of the serving cell SSB, and       * Condition 2: The center frequency of the PRB set configured for RSSI measurement is aligned with the center frequency of the serving cell SSB,   otherwise the RSSI measurement is inter-frequency.  Then, depending on whether or not the RSSI BW within the active BWP, the UE may or may not need measurement gaps.  MTK: Regarding the new proposal from E///, “The center frequency of the PRB set configured for RSSI measurement” seems confusing, because the RSSI is configured based on unit of subband and the PRB set is not configurable. Does Condition 2 mean that: The center frequency of **subband** configured for RSSI measurement is aligned with the center frequency of the serving cell SSB? |
| **Sub-topic#5-2** | **Issue** 5**-2: Need for measurement Gaps**  This decision depends on the decision on topic 5-1. It is not possible to agree on this topic without further agreements in the topic above. However, there is one topic that was not included in the answers in the first round:   * + 1) Can RAN4 agree that no new measurement gap patterns are needed for RSSI measurements?   *Recommendations for 2nd round:*  Companies, please provide input on the question above. We can return to the discussion about measurement gaps for RSSI measurements in the next meeting. |
| **Comments** | Qualcomm: the answer to Q1 above depends on the max length of RMTC and the allowed periodicities which is still being discussed in RAN2. That’s the reason that we proposed to decide on it and notify RAN2 with an LS (R4-2000719) but some companies believe this is RAN2’s business (which may well be).  Nokia: We believe that it is RAN2 business to decide on the configurable RMTC periodicities, so we need to postpone this decision.  Ericsson: RAN2 is not deciding RMTC length, so whichever periodicities they will decide, this cannot justify the need for new MGL and hardly new MG periodicities are acceptable for this purpose either. |
| **Sub-topic#5-3** | **Issue** 5**-3: RSSI measurement report mapping**  This issue depends on issue 5-11 (normalization of the RSSI measurement, where there is again, no consensus). The candidate options are the same as before:  *Candidate option:*   * + 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   *Recommendations for 2nd round:*  Companies that didn’t provide their opinion on this issue in the first round, please do so in the second round. And all interested companies, please answer the question:  If we cannot agree on Option 1 or option 2 this meeting, can RAN4 agree on the text of the candidate options for the WF for next meeting? |
| **Comment** | Qualcomm: We support option 2. CLI-RSSI is just the re-use of LTE RSSI and has the deficiencies we outlined in our paper.  Nokia: for the purpose of the RSSI measurement in unlicensed bands, we believe that we can continue adopting the measurement report mapping in Option 1.  ZTE: Support Option 1. Can agree to capture both options in WF and come back next meeting to decide.  Huawei: It is related to the Issue 5-11. Option 2 is based on a normalized report. We should come back next meeting.  Ericsson: Option 1 |
| **Sub-topic#5-5** | **Issue 5-5: RSSI/CO measurement periods**  This is the first time the topic is discussed in RAN4. Companies didn’t object the WF but proposed some minor changes. These changes are marked in yellow below.  *Tentative agreements (confirm if the comments were captured in the right way):*   * + - 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       * FFS: 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.     - FFS: how to consider the sharing factor CSSF, and the lower bound R15 L3 measurements   *Recommendations for 2nd round:*  Companies, please check if the comments were captured in the right way. |
| **Comments:** | Qualcomm: We’re fine with the text.  Nokia: we agree with the text.  ZTE: Agree with suggested WF.  Ericsson: scaling with number of frequencies is the LTE approach, while in NR we have CSSF which needs to be accounted also for RSSI/CO. Do not agree to consider the number of MOs in the measurement period, even as FFS.  MTK: agree with the WF |
| **Sub-topic#5-7** | **Issue 5-7: RMTC periodicity**  Based on the further clarification provided in the comments, I have made a change on the candidate options:  *Candidate options:*   * + Option 1: 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).   + Option 2: RAN4 requirements will be defined for all RMTC configurations.   *Recommendations for 2nd round:*  Comment on the options above. |
| **Comments** | Qualcomm: we’re fine with option 2 if companies prefer to wait further for RAN2. Note that sub-topic 5-2 will be pending RAN2 decision if option 2 is selected.  Nokia: we believe that these topics are under the scope of RAN2.  Ericsson: we do not decide the scope of RAN2, but we control the applicability of the requirements and we think that all RMTC configurations should be supported by RAN4 requirements.  MTK: support option 1. Not clear about why the longer measuring time for 15kSCS should be supported. (i.e. > 5 ms) |
| **Sub-topic#5-8** | **Issue** 5**-8: Interruption requirements**  This is the first time that this topic is discussed in RAN4. There were comments that more discussion is needed, but no other options were given. The original proposal is:   * + 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.   We propose including it on this topic WF as:  RAN4 to discuss interruption requirements during RSSI/CO measurements.  *Recommendations for 2nd round:*  Comment on the proposal, if the proposed text can be included in the WF. |
| **Comments** | Ericsson: the wording gives an impression that there are no other requirements. Also, the conditions need to be discussed separately. So, perhaps we need to discuss interruptions with RSSI at a higher level first and then go into the details, not the other way around. |
| **Sub-topic#5-9** | **Issue** 5**-9: Restrictions during RSSI measurements**  One company supported the proposal, and 2 companies mentioned that further discussion/clarification is needed, since the text “*before/after each consecutive RSSI symbol* looks confusing since RSSI can be configured over multiple consecutive symbols”. Qualcomm commented that “consecutive” could be removed. The new proposal is:   * 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 RSSI symbols and 1 data symbol after each 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.   *Recommendations for 2nd round*: continue discussions based on the new input. If no agreement is reached, can we agree on the following, and bring more views in the next meeting?  RAN4 to discuss scheduling restrictions during RSSI/CO measurements. |
| **Comments** | Ericsson: we can agree on “RAN4 to further discuss scheduling restrictions during RSSI/CO measurements”. |
| **Sub-topic#5-10** | **Issue** 5**-10: RSSI measurement bandwidth**  The comments were equally divided in two groups.  *Candidate options:*  RAN4 to define the RSSI measurement accuracy requirements based on:  Option 1: SSB bandwidth.  Option 2: Bandwidth configured by the gNB.  *Recommendations for 2nd round:* continue discussing the topic, based on the latest version of the comments. If no consensus is reached, is it agreeable to copy the text above in the way forward? |
| **Comments** | Qualcomm: we support option 1 and challenge companies that support option 2 to bring material or technical argument showing why option 2 would result in a different (not more accurate) RSSI measurement.  Nokia: we support Option 2. We will bring a discussion paper on this issue next meeting.  ZTE: When it comes down to defining measurement accuracy I think these two options will result in similar results. No obvious preference though.  Huawei: For option 2, does it mean for different configured bandwidth we have different accuracy requirements?  Ericsson: support Option 2. the NW when configuring the RSSI over a certain BW expects the UE to measure and assess the channel accessibility based on the configured BW, so it is not only about the accuracy.  MTK: support option 1. |
| **Sub-topic#5-11** | **Issue** 5**-11: RSSI reporting normalization**  This issue is related to the issue above. There was no consensus in the discussion. The comments were divided in two groups:  *Candidate options:*  Option 1: The RSSI reporting is normalized to the SCS, allowing flexibility for the UE implementation to measure based on any value of N so long as accuracy requirements are met.  Option 2: No need to normalize the RSSI report.  *Recommendations for 2nd round:* continue discussing the topic, based on the latest version of the comments. If no consensus is reached, is it agreeable to copy the text above in the way forward? |
| **Comments** | Qualcomm: we support option 1. The RSSI measurement definition in TS 38.215 is a function of “N” (same as in LTE) and to avoid the issues we recently discovered in LTE LAA, normalization is recommended.  Nokia: to Qualcomms comment: That’s the reason why we support Option 2 in issue 5-10. If both the UEs and gNB are aware of the measurement bandwidth, there is no need to fix the problem discovered in LTE LAA, because N would be well defined. In this issue, We support Option 2.  ZTE: To Nokia: In our view, 5-11 and 5-10 are different topics. 5-10 deals with how the measurement accuracy is defined, while 5-11 deals with reporting. When reporting RSSI measurement results, of course both UE and gNB needs to know the bandwidth used for the measurement, or, the UE reports a normalized measurement result. I think this is a bit different than “which bandwidth to use when defining accuracy requirement”.  Huawei: We prefer to option 1. For option 2, the reporting range varies by the configured bandwidth.  Ericsson: Option 2 (no normalization).  MTK: support option 1. |

## 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 identified  NOTE 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** |
| Qualcomm | Sub topic 6-2: We share the same view as MediaTek’s.  Sub topic 6-2: Some further comments on Ericsson’s comments below: In FR1 range, beamforming is actually less likely. So the most likely scenario is that gNB sends one beam with a Q factor. In the most extreme case, UE will have to monitor all 20 positions. In the example shown by Ericsson, it will mean monitoring 4 possible positions.  ….  Others: |
| Ericsson | Sub topic 61: disagree  Sub topic 6-2: “at least one SSB” should not be used for several reasons. RAN1 agreement:   |  | | --- | | Agreement:  From a UE’s perspective, the number of transmitted SSBs within a DRS transmission window is not larger than Q. |   So, gNB transmits Q SSBs on Q beams (in most typical implementation), which means it’s not very likely for the UE to receive more than one QCLed SSBs.  The same applies for measurements and RLM.  Furthermore, if we say “at least one”, then the UE may start monitoring the wrong SSB which may then be not transmitted and the DRS transmission window may then be dynamically shifted to adapt to LBT failures and the other SSBs will be transmitted instead. The “at least one” is thus also limiting the NW flexibility to shift the transmission window while adapting to LBT, which is one of the most important RAN1 NR-U features. For example if Q=4 and there are no QCL SSBs and as we also know there are 20 possible positions where it is possible to transmit SSBs then NW can transmit bursts like:  1,2,3,4,x,x,x,x,x,x,x,x,x,x,x,x,x,x  X,2,3,4,1,x,x,x,x,x,x,x,x,x,x,x,x,x  X,x,3,4,1,2,x,x,x,x,x,x,x,x,x,x,x,x  X,x,x,4,1,2,3,x,x,x,x,x,x,x,x,x,x,x  X,x,x,x,1,2,3,4,x,x,x,x,x,x,x,x,x,x  …  …  X,x,x,x,x,x,x,x,x,x,x,x,x,x,1,2,3,4  (x=no transmission)  And this changes dynamically between bursts – so for instance if measuring gNB beam #2, in this example, there are 5 possible positions beam 2 can come, and each burst it might be a different one that actually happens.  Even if the UE does receive some QCL’d SSBs  (eg the actual transmission represents …x,x,x,1,1,2,2,x,x,x…), the UE has no knowledge that they are QCL’d, only the BS or BS designer knows that.  Sub topic 6-3: the note is unnecessary and may even cause confusion. |
| Intel | Sub topic 6-2: The proposal from MTK can be agreed for us. |
| Nokia | Sub-topic 6-1 We cannot agree to the proposed definition.  Sub-topic 6-2:\_This issue is directly related to the enhancement proposed by RAN1 to cope with the DL LBT failure when sending SSBs. If the UEs are required in LBE mode to monitor only one QCLed SSB (option 1), there is no reason for the gNB to attempt to send the QCLed SSBs in other candidate positions if the first candidate position is blocked by CCA failure, hence the enhancement brought by “beam-cycling” would be lost. According to RAN1#99 Agreement:  *From a UE’s perspective, the number of transmitted SSBs within a DRS transmission window is not larger than Q.*  Additionally, it is important to highlight that the extension of all measurement /evaluation periods at least in Nokia’s perspective (R4-1914177 and R4-1914178 ) were defined based on the assumption that this enhancement proposed by RAN1 would create additional opportunities for transmitting SSBs within an SMTC in case of LBT failure. Furthermore, the network can configure the duration of the “DRS transmission window” (per Ran1 #98b agreement) and consequently reduce the burden at the UE for monitoring multiple QCLed beams. RAN1 agreement only states that the maximum window size is 5ms,  Sub-topic 6-3 We need to agree on issue 6-1 and issue 6-2 before agreeing on this issue. |
| MTK | Sub topic 6-1: support Qualcomm’s proposal.  Sub topic 6-2: Measurement complexity will increase a lot if UE is required to measuremet on 20 possbile posisions for one cell. E.g. 160 SSBs for one carrier with 8 cells. In R15, for one carrier, 7 or 15 SSBs is required to be measuremet;  Sub topic 6-3: The note could be needed, based on the conclusion of 6-1 & 6-2. |
| Huawei | Sub topic 6-1: We think it’s related to the discussion in 6-2.  Sub topic 6-2: We support Qualcomm’s proposal. Actually our proposal is the same. UE is requires to monitor at least one SSB within the SSB sets that are QCL-ed. Based on the assumption, the proposal in Sub topic 6-1 is needed. If the detected SSB in the SMTC is unavailable, the SMTC should be considered as an unavailable SMTC even the SSBs on other positions are available. |

### 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#6-1**  **Sub-topic#6-2**  **Sub-topic#6-3** | All these issues depend on the decision of how many QCLed beams the UE is required to monitor, so the summary is combined here. Additionally, it is important to emphasize that a very similar discussion is ongoing under the RAN4#94e\_#47 list.  Original Proposal: 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.  There is no consensus between companies, the comments are divided as follows:  Group 1: Agree with the proposal. Measurement complexity will increase if UE is required to monitor all the candidate SSB positions. Additionally, one of the most common use cases in NR-U is single beam, which could result in the UE monitoring 20 candidate positions.  Group 2: Disagree with the proposal. One of the main features of NR-U is the flexibility to shift the transmission window while adapting to LBT. This feature would be lost if UEs are not required to monitor other candidate indexes. Additionally, the gNB can configure the duration of the DRS transmission window, decreasing the number of candidate positions that the UE needs to monitor.  It is clear, from the comments, that no company supports that the UE is required to monitor all SSBs regardless of QCL assumptions, so that option can be edited from the candidate options (Ericsson comment)  Considering the disagreement between companies, the only possible way forward is to compromise.  *Candidate options:*  We suggest to update the list of options from last meeting based on the comments:   * 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   *Recommendations for 2nd round:* Companies are encouraged to comment on the two options above, or propose compromise solutions, taking also into account the discussions on RAN4#94e\_47. |
|  |  |

*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)

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#6-1**  **Sub-topic#6-2**  **Sub-topic#6-3** | All these issues depend on the decision of how many QCLed beams the UE is required to monitor, so the summary is combined here. Additionally, it is important to emphasize that a very similar discussion is ongoing under the RAN4#94e\_#47 list.  Original Proposal: 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.  The text below was added from the FFS from last meeting, under the RLM agenda.   * 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   *Recommendations for 2nd round:* Companies are encouraged to comment on the options above, or propose compromise solutions, taking also into account the discussions on RAN4#94e\_47. |
| **Comments** | Qualcomm: we support option 1. Moreover, we fail to understand how UE can even distinguish a missed SSB due to LBT failure in the “identification” stage which relies on more than 1 sample in R15 requirements. We have raised this issue in our discussion paper but the above summary is lumping all stages and types of measurements together, unfortunately.  Nokia: regarding Qualcomm’s comment above: the issue of LBT failure in the identification stage was originally captured in issue 7- 6. It was not combined here. We cannot support option 1, for the reasons mentioned in the First Round. This topic needs further discussions.  Huawei: we support option 1.   * 1. Ericsson: disagree with the QCL constraint, because the UE does not even know in advance which SSBs will be transmitted in the next SMTCs, possibly SSBs with completely different indexes, etc, depending on flexible SMTC.   MTK: Option 1. Same discussion as RLM issue. |

## 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 identified  NOTE 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 3.6.1  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:   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

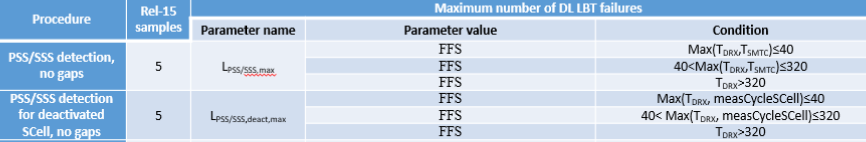
**Issue** 7**-1: UE behavior upon exceeding the maximum number of DL LBT failures during PSS/SSS detection**

* 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 for intra- and inter-frequency cells**

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 available at the UE 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 identified  NOTE 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 3.6.1  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:   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** |
| Qualcomm | Sub topic 7-1: In our view, the proposals from R4-2000780 is not necessary to be specified. The prescribed behaviors are all UE implementation specific. Sub topic 7-2: WF is agreeable to us.  Sub topic 7-3: This proposal is unnecessary since UE has to meet the reporting delay requirements for intra-frequency and inter-frequency cells anyways based on existing specifications.  Sub topic 7-4: We prefer option 2 in the FFS part of the WF but are ok with option 1 as well.  Sub topic 7-5: WF is agreeable to us subject to agreement on Sub Topic 7-6.  Sub topic 7-8: WF is agreeable to us subject to agreement on Sub Topic 7-6.  Sub topic 7-9: WF is agreeable to us subject to agreement on Sub Topic 7-6.  Sub topic 7-10: WF is agreeable to us subject to agreement on Sub Topic 7-6.  Sub topic 7-13: In our view, option 1 is significantly easier to implement and saves a lot of unnecessary text in TS 38.133. If not mistaken, this was the recommended path from the discussions in RAN4#92-Bis meeting. |
| Apple | Sub-topic 7-1: we think it is necessary to clarify the UE behavior in spec, because, for example, if we consider the multiple inter-freq MOs case, the requirement is in general scaled by MO/frequencies number, but UE is getting stuck on one MO measurement, does that mean UE can fail the cell detection on all those frequencies? We need to clearly state the UE behavior in spec to make sure the CC who has consistent LBT failure will not destroy the cell detection on other CCs, and the delay of other CC detection shall still meet the requirement. To be more specific, if UE needs X SMTCs on one CC for cell detection, and UE is configured with 2 frequency layers and the max number of DL LBT failures during PSS/SSS detection is defined as Y; if on CC#1 UE exceed Y due to LBT failure, based on our solution the delay requirement for CC#2 needs to be (Y+X) SMTC rather than “don’t need to meet requirement”. We are fine to further discuss on more details.  Sub-topic 7-3: In IDLE mode we have agreements that “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 Mp consecutive number of DRX cycles not available at the UE”, and we think the mobility performance in CONNECTED mode is even more important than IDLE mode, so we propose to have similar clarification for spec. |
| Ericsson | Sub topic 7-1: the behavior shall be that the UE shall attempt to detect the cell N times (fails each time when the Lmax is exceeded), after which the UE shall initiate detection of a different cell according to RAN4/RAN2 procedures.  Sub topic: agree with the proposed WF  Sub topic 7-3: this to some extent already ensured by the known cell limit (extended to 8 seconds in RAN4#93), at least for long DRX. No need additional conditions on consecutive number of missing SSBs/SMTCs etc.  Sub topic 7-4: I have corrected our proposal a bit and also the title of the issue because it makes a big difference. This clarification is necessary, because otherwise the UE will just “forget” the cell and this is indeed related to the number of LBTs too so it is actually helpful to have it here.  Sub topic 7-5: proposed WF is agreeable  Sub topic 7-7: see the response for 7.2.1.  Sub topic 7-8: agree with the proposed WF  Sub topic 7-9: agree with the proposed WF  Sub topic 7-10: agree with the proposed WF  Sub topic 7-11: needs further discussion.  Sub topic 7-12: how to include is already addressed by Ericsson CRs where the bands just added into corresponding band group. How to align the conditions with the RF group is a second question, we need to wait and then just use them, but that’s performance part.   |  |  |  |  | | --- | --- | --- | --- | | R4-2001393.zip | 8.1.4.14 | CR | Updates to clause 1-3 (General) for NR-U in 36.133 | | R4-2001394.zip | 8.1.4.14 | CR | Updates to clause 1-3 (General) for NR-U in 38.133 |   Sub topic 7-13: option 2 is actually discussed under the specification structure agenda. Based on the outcome of that discussion, whether to have separate sections, tables, etc. is the next discussion, which is performance part. |
| Nokia | Sub-topic 7-1 This is the first time we discuss the issue. Since there is no consensus, we can the 3 options in the way-forward, and companies can comment on that on the following meeting.  Sub-topic 7-2 Agree with the way forward.  Sub-topic 7-3 This needs further discussions. There are many procedures in place that control the behavior of the UE if the serving cell is unavailable, in our view we don’t need to include anything new on top of all the agreements that we already had.  Sub-topic 7-4 Thanks, Ericsson for the correction and clarification. Agree with the WF, both options are OK  Sub-topic 7-5 Agree with the Table, if Issue 7-2 is agreed  Sub-topic 7-6 We cannot agree to the proposed definition. As said before, the beam cycling is one of the most important features in NR-U, and defining unavailability fo the SMTC occasion based on the SSB position index, instead of the SSB index, would make this enhancement uneffective.  Sub-topic 7-7 Defining a maximum number of measurement restarts would need a new UE behavior in RAN4. Needs more discussion  Sub-topic 7-8 Agree with the WF  Sub-topic 7-9 Agree with the WF  Sub-topic 7-10 Agree iwth the WF  Sub-topic 7-11 Needs more discussion.  Sub-topic 7-12 Agree with the WF  Sub-topic 7-13 This is a performance discussion. So we should postpone. |
| MTK | Sub topic 7-1: In our view, the proposals from R4-2000780 are not necessary to be specified. UE could stop or continue and it is up to UE implementation.  Sub topic 7-2: We disagree with the WF. Maximum period for PSS/SSS is not necessary to be specified, since UE could keep trying.  Sub topic 7-3: This proposal is unnecessary. Regardless serving cell is available or not, UE would measure neighboring all the time.  Sub topic 7-4: One clarification on option 1 in WF, why it should be 8 seconds but not other values. Is it related to known cell condition?  Sub topic 7-5: the maximum period for PSS/SSS is not necessary to be specified. (related to 7-2)  Sub topic 7-6: We agree with this proposal.  Sub topic 7-7: We agree with this proposal.  Sub topic 7-8: we can not agree now.   * For time index, it should add one note “Q is known to UE”. Otherwise, additional time for PBCH decoding will be required. (related to topic 4) * For PSS/SSS, the maximum period is not necessary to be specified. (related to 7-2)   Sub topic 7-9: the maximum period for PSS/SSS is not necessary to be specified. (related to 7-2)  Sub topic 7-10: same comment as 7-8. we can not agree now.  Sub topic 7-11: We are fine with this proposal. |
| Huawei | Sub topic 7-1: It is related to UE implementation. These particular behaviors are not needed.  Sub topic 7-2: There is no need to define the maximum number for PSS/SSS detection.  Sub topic 7-3: The requirement and the number of unavailable SSBs are not necessary.  Sub topic 7-5: related to Sub topic 7-2.  Sub topic 7-6: The note is needed with respect to the UE measurement requirement. |

### 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 | Ericsson: we prefer the original wording “configured with” |
| Nokia: we are fine with the original wording. The text was only modified, due to comments in R4-1915778, but we will revert to the original wording. |
|  |

## 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#7-1** | **Issue** 7**-1: UE behavior upon exceeding the maximum number of DL LBT failures during PSS/SSS detection**  *Tentative agreements:*No  From the discussions, there was no consensus, so the following options are suggested:  *Candidate options:*  Option 1) Behavior is implementation specific  Option 2) Upon exceeding LPSS/SSS,max, the UE is not required to meet the corresponding intra-frequency PSS/SSS detection requirement.  Option 3)   * 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.   *Recommendations for 2nd round:* Further discussion is needed, considering the comments in the first round. |
| **Sub-topic#7-2**  **+**  **Sub-topic#7-5**  **+**  **Sub-topic #7.9** | **Issue** 7**-2: Maximum number of DL LBT failures during the PSS/SSS detection procedure**  **Issue 7-5 PSS/SSS detection period.**  **Issue** 7**-9: Maximum number of DL LBT failures during the inter-frequency PSS/SSS detection procedure**  *Tentative agreements:*No  Only two companies objected to the suggested way forward, and questioned whether the values were necessary or not. However, in RAN4 #92, RAN4 has already agreed that L-max values should be decided:    *Recommendations for 2nd round:* More discussion is needed. Companies, please provide your comments considering the previous agreements in RAN4. |
| **Sub-topic#7-3** | **UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts**  The majority of companies agree that the proposal is unnecessary: there is no need to specify this behaviour. However, the company that proposed the behaviour provided additional information.  *Recommendations for 2nd round:* Continue the discussion in the 2nd round, considering the additional information provided.  Suggested WF:  FFS: whether it is necessary to specify a UE behavior in connected mode when the serving cell is unavailable for consecutive SSB bursts. |
| **Sub-topic#7-4** | **Issue** 7**-4: How to address consecutively missing SSBs for intra- and inter-frequency cells**  No company objected the first bullet of the WF.  *Tentative agreement:*  For intra and inter-frequency cells:  RAN4 should not define additional requirements for consecutively missing SSBs  *Recommendations for 2nd round:*  No company objected adding the note. 1 company requested a clarification on the text of the proposed note. Continue the discussions in the second round.  *Options:*  If the clarification of Ericsson is sufficient, do you agree with the following note on the specification?  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.  Option 1) Yes.  Option 2) No |
| **Sub-topic#7-6** | **Issue** 7**-6: How to consider the QCLed beams during celll identification stage**  One company objected, and 2 companies agreed with the proposal. However, this issue is related to Topic 6, in which a strong objection was found.  Original proposal:   * 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.   *Recommendations for 2nd round:* Continue the discussions in the 2nd round, Companies please comment whether you agree or not with the proposal above. If there is a difference between your views in this issue and the issue in Topic 6, please clarify. |
| **Sub-topic#7-7** | **Issue** 7**-7: UE behaviour in case of successive DL LBT failures during measurements.**  During the discussions, a new proposal was included:  *Candidate options:*   * + Option 1) 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.   + Option 2) the behavior shall be that the UE shall attempt to detect the cell N times (fails each time when the Lmax is exceeded), after which the UE shall initiate detection of a different cell according to RAN4/RAN2 procedures. Value of *N* can be further discussed in RAN4.   + Option 3) No new UE behavior is needed.   *Recommendations for 2nd round:* Discuss the options in the 2nd round. |
| **Sub-topic#7-8**  **And**  **Sub-topic #7-10** | **Issue** 7**-8: How to capture the agreements in the intra-frequency measurement tables in 38.133**  **Issue** 7**-10: How to capture the agreements in the inter-frequency measurement tables in 38.133**  2 companies agreed with the WF, One company mentioned that the WF is agreeable, pending decision on topic 7-6. Topic 7-6 refers to the definition in NOTE 2 in the proposed WF.  Other company mentioned that it is not possible to decide now, and we need to wait for the discussion in topic 4 and issue 7-2.  *Recommendations for 2nd round:* Deprioritize the discussions and focus on the discussions on topics 7-2, 7-6 and topic 4. |
| **Sub-topic#7-11** | **Issue** 7**-11: Scheduling availability during measurements**  No company objected, but two companies mentioned that it should be further discussed.  *Recommendations for 2nd round:* Is it possible to agree with the following as FFS?  FFS: 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.*   FFS: 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.*   FFS: 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.  Option 1: yes  Option 2: no |
| **Sub-topic#7-12** | **Issue** 7**-12: How to include NR unlicensed bands in TS 38.133**  One company commented that part of the issue is already addressed in a CR. How to align the conditions with RF group should be postponed to performance part.  *Recommendation for 2nd round.*  Can we agree in the following?  RAN4 to wait until the performance part and for the discussions in RF group to align the conditions for updating Table 3.5.2-1 of TS 38.133 to include NR unlicensed. |
| **Sub topic 7#13** | **Issue** 7**-13: How to capture the measurement accuracy requirements for NR-U**  This topic is partially discussed in other agenda item. Additionally, this discussion can be left for the performance part.  *Recommendation for 2nd round.*  Deprioritize the discussion of this topic. |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2001804 | *One comment was received about the CR wording. Needs revision.* |

## Discussion on 2nd round (if applicable)

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#7-1** | **Issue** 7**-1: UE behavior upon exceeding the maximum number of DL LBT failures during PSS/SSS detection**  *Tentative agreements:*No  From the discussions, there was no consensus, so the following options are suggested:  *Candidate options:*  Option 1) Behavior is implementation specific  Option 2) Upon exceeding LPSS/SSS,max, the UE is not required to meet the corresponding intra-frequency PSS/SSS detection requirement.  Option 3)   * 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.   *Recommendations for 2nd round:* Further discussion is needed, considering the comments in the first round. |
| **Comments** | Qualcomm: we support option 1 but can agree to option 2 as well. We disagree with option 3.  Apple: we support option 3 and we provided the justification in 1st round. We need more time to check if option 2 is acceptable to us.  Huawei: Does option 1 also imply that UE is not required to meet the corresponding intra-frequency PSS/SSS detection requirement as option 2?  Ericsson: we support option 2, but we still need UE behaviour, shouldn’t the UE just follow the normal procedure upon detection failure?  MTK: we support option 1. For option 2, if UE just follow the normal procedure upon detection failure, what’s the meaning to have the maximum value? Since it will have the same UE behavior regardless whether detection failure or not. |
| **Sub-topic#7-2**  **+**  **Sub-topic#7-5**  **+**  **Sub-topic #7.9** | **Issue** 7**-2: Maximum number of DL LBT failures during the PSS/SSS detection procedure**  **Issue 7-5 PSS/SSS detection period.**  **Issue** 7**-9: Maximum number of DL LBT failures during the inter-frequency PSS/SSS detection procedure**  *Tentative agreements:*No  Only two companies objected to the suggested way forward, and questioned whether the values were necessary or not. However, in RAN4 #92, RAN4 has already agreed that L-max values should be decided:    *Recommendations for 2nd round:* More discussion is needed. Companies, please provide your comments considering the previous agreements in RAN4. |
| **Comments** | Nokia: Our view is that the maximum number of LBT failures during the intra or inter-frequency PSS/SSS detection should be defined. We are OK with the original Way Forward for all 3 topics.  Ericsson: yes, the maximum L numbers shall be defined for PSS/SSS.  MTK: we still fail to see the necessity and benefit to define this value. And it is related to the decision on topic 7-1. |
| **Sub-topic#7-3** | **UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts**  The majority of companies agree that the proposal is unnecessary: there is no need to specify this behaviour. However, the company that proposed the behaviour provided additional information.  *Recommendations for 2nd round:* Continue the discussion in the 2nd round, considering the additional information provided.  Suggested WF:  FFS: whether it is necessary to specify a UE behavior in connected mode when the serving cell is unavailable for consecutive SSB bursts. |
| **Comments** | Qualcomm: it is not necessary to specify UE behaviour. In idle mode, measurement of neighbour cells is dependent on serving cell evaluation to some extent. In connected mode, UE has to meet the intra-/inter-frequency RRM requirements at all times.  Apple: In IDLE if UE cannot detect serving cell and reached certain threshold “Mp or Mq”, UE is required to initiate the neighbour cell, and in ILDE mode we also have intra/inter- frequency RRM measurement. In connected mode UE also need to measure serving cell to decide if neighbour cell measurement shall be triggered or not. Don’t understand why IDLE case is different from connect mode case.  Nokia: In connected mode, the network uses measurement objects to configure intra or inter-frequency measurements, which is not the case in IDLE mode. We believe that it is not necessary to specify any new UE behaviour CONNECTED mode in case the serving cell is unavailable for consecutive SSBs. There are many procedures already defined in case the serving cell becomes unavailable.  Apple: In IDLE mode UE can read the system information to known the neighbour cell measurement configuration on SIB3 and SIB4 and UE will do the evaluation of serving cell to check if the neighbour cell measurement shall be triggered(based on certain S thresholds); and then considering LBT failure we designed mechanism that if UE reach max LBT failure number we require UE to do neighbour cell measurement regardless of the actual serving cell evaluation results or S thresholds. In connected mode, UE is configured with s-MeasureConfig to decide if the neighbour cell shall be measured or not, and this s-MeasureConfig is based on serving cell evaluation/measurement, if LBT failure interrupts the serving cell evaluation consistently, we shall also require UE to do neighbour cell measurement regardless of s-MeasureConfig. I don’t see the difference between IDLE and connected mode from this perspective.  Ericsson: no need to define additional UE behaviour for RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts  MTK: it is not necessary. |
| **Sub-topic#7-4** | **Issue** 7**-4: How to address consecutively missing SSBs for intra- and inter-frequency cells**  No company objected the first bullet of the WF.  *Tentative agreement:*  For intra and inter-frequency cells:  RAN4 should not define additional requirements for consecutively missing SSBs  *Recommendations for 2nd round:*  No company objected adding the note. 1 company requested a clarification on the text of the proposed note. Continue the discussions in the second round.  *Options:*  If the clarification of Ericsson is sufficient, do you agree with the following note on the specification?  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.  Option 1) Yes.  Option 2) No |
| **Comments** | Ericsson: support option 1  MTK: it needs more discussion. The clarification on the definition of “any two closest SSB occasions” is needed. Should these 2 SSBs are with the same SSB index or at the same SSB position? Our concern is that UE would be required to detect all SSB positions on every SMTC. |
| **Sub-topic#7-6** | **Issue** 7**-6: How to consider the QCLed beams during celll identification stage**  One company objected, and 2 companies agreed with the proposal. However, this issue is related to Topic 6, in which a strong objection was found.  Original proposal:   * 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.   *Recommendations for 2nd round:* Continue the discussions in the 2nd round, Companies please comment whether you agree or not with the proposal above. If there is a difference between your views in this issue and the issue in Topic 6, please clarify. |
| **Comments** | Nokia: we need to further discuss this topic. We cannot agree to the proposal.  Huawei: It is related to the conclusion in topic 6.We think the note is needed when UE is required to monitor at least one SSB within the QCL-ed sets.  Ericsson: the issue should be discussed in one place. Do not agree with the proposal.  MTK: we support this proposal. Same view as topic 6. |
| **Sub-topic#7-7** | **Issue** 7**-7: UE behaviour in case of successive DL LBT failures during measurements.**  During the discussions, a new proposal was included:  *Candidate options:*   * + Option 1) 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.   + Option 2) the behavior shall be that the UE shall attempt to detect the cell N times (fails each time when the Lmax is exceeded), after which the UE shall initiate detection of a different cell according to RAN4/RAN2 procedures. Value of *N* can be further discussed in RAN4.   + Option 3) No new UE behavior is needed.   *Recommendations for 2nd round:* Discuss the options in the 2nd round. |
| **Comments** | Qualcomm: We’re not sure when/how option 2 was brought up and can’t see a written record of it in the summary. Also, option 2 seems to discuss successive failure in the “detection stage” while option 1 (our proposal) is addressing successive failure in the “measurement stage”.  Nokia: the proposal was mentioned by Ericsson in the first round of discussions, but it was copied without any edition (despite the highlighted text), so there is indeed a mismatch between the topic and the proposal. Can Ericsson clarify? We need further discussion in this topic.  Ericsson: it was for detection. Here: option 1 is Ok.  MTK: We support option 1 for “measurement stage”. For “detection stage”, we support option 3. |
| **Sub-topic#7-11** | **Issue** 7**-11: Scheduling availability during measurements**  No company objected, but two companies mentioned that it should be further discussed.  *Recommendations for 2nd round:* Is it possible to agree with the following as FFS?  FFS: 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.*   FFS: 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.*   FFS: 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.  Option 1: yes  Option 2: no |
| **Comments** | Qualcomm: Yes.  Ericsson: needs further discussion  MTK: agree to FFS. |

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| **CR/TP number** | **Comments** |
| R4-2002285 (revision of R4-2001804) |  |

## 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

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| **Company** | **Comments** |
| Qualcomm | Sub topic 8-1: WF is agreeable to us.  Sub topic 8-2: We do not see the need to specify “a channel” and its reference to TS 37.213. The MO will have the ARFCN of the measurement BW.  ….  Others: |
| Ericsson | Sub topic 8-1: our specific proposal (R4-2001938) is “*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.*”  Sub topic 8-3: other measurements are per carrier, as in Rel-15. |
| Nokia | Sub-topic 8-1 Agree with the WF  Sub-topic 8-2 Option 1 is agreeable |
| MTK | Sub topic 8-1: WF is fine for us.  Sub topic 8-2: For option 2, could E/// clarify the word “carrier frequency” in the proposal. Is it *rmtc-measARFCN-r16* in MO? One carrier is one suband or it could have mulatiple subband? |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
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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#8-1** | **Issue** 8**-1: Wideband RSSI / CO** **reporting criteria**  No objections were identified, 3 companies agreed with the WF. One of the comments was unclear, so I will rephrase the original WF, copying directly the words from R4-2001938:  *Candidate options:*  Can we agree with:  Issue 1) No wideband RSSI and channel occupancy reporting criteria are seen to be needed in Rel-16.   * Option 1: Yes * Option 2: No |
| **Sub-topic#8-2** | **Issue 8-2: 9Per sub-band RSSI report**  **Some companies asked for clarification in option 2.**   * + 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   *Recommendation for 2nd round:* Continue the discussion after further clarification. |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#8-1** | **Issue** 8**-1: Wideband RSSI / CO** **reporting criteria**  No objections were identified, 3 companies agreed with the WF. One of the comments was unclear, so I will rephrase the original WF, copying directly the words from R4-2001938:  *Candidate options:*  Can we agree with:  Issue 1) No wideband RSSI and channel occupancy reporting criteria are seen to be needed in Rel-16.   * Option 1: Yes * Option 2: No |
| **Comments** | Qualcomm: Yes.  Nokia: Yes  Ericsson: agree  MTK: Yes. |
| **Sub-topic#8-2** | **Issue 8-2: 9Per sub-band RSSI report**  **Some companies asked for clarification in option 2.**   * + 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   *Recommendation for 2nd round:* Continue the discussion after further clarification. |
| **Comments** | Qualcomm: option 1. Reference to TS 37.213/channel is not necessary.  Ericsson: option 2. “channel” is the RAN1 definition of LBT BW and actually suggested by RAN1 people, the term they are now using across specs, so option 2 is basically saying over subband (i.e., not wideband)  MTK: Option 1. One clarification question to option 2, when the carrier BW is a multiple of subbands, should 1 MO or multiple MO to be configured for the report? |

## 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”* |