**3GPP TSG-RAN WG4 Meeting # 95e R4-200XXXX**

**Electronic Meeting, 25 May – 5 June, 2020**

**Agenda item:** 6.1.5.11 and 6.1.5.12

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

**Title:** Email discussion summary for [95e][206] NR\_unlic\_RRM\_3

**Document for:** Information

# Introduction

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

*6.1.5.11 – Measurement requirements*

*6.1.5.12 – Measurement capability and reporting criteria*

*The discussion is divided in the following topics and sub-topics. The proposed priority of discussions is within the specific issues and sub-topics.*

# Topic #1: SFTD measurements

*In this topic, we discuss SFTD measurements:*

*Issue 1-1: Maximum scaling of inter-RAT SFTD measurements*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2006019 | ZTE | Proposal 1: Tmeasure\_SFTD\_LBT\_max = 4 × Tmeasure\_SFTD1. |
| R4-2006859 | MediaTek Inc. | Observation 1: For EN-DC SFTD measurement in NR-U, the maximum scaling is ranged from 1.6 to 2.4.  Proposal 1: k=3, as the maximum scaling of inter-RAT SFTD measurements towards NR-U (Option 2). |

## Open issues summary

*In this topic we discuss SFTD measurements. Here follows a background from the agreements in last 3 meetings:*

***Inter-RAT SFTD measurements***

*RAN4#93*

* *UE behavior upon exceeding Tmeasure\_SFTD\_LBT\_max: UE shall stop the search*
  + *FFS whether UE abandons the measurement*
  + *Tmeasure\_SFTD\_LBT\_max = k× Tmeasure\_SFTD1, k=TBD≤10*

*RAN4#94e*

* *Option 1: k = 6*
* *Option 2: k = 2*

*RAN4 94e Bis*

* *Issue 1-1: Maximum scaling of inter-RAT SFTD measurements*
  + *Final candidate options:*
    - *Option 1: k=4.*
    - *Option 2: k =3.*
  + *Note from the moderator: No conclusion in RAN4#94e bis. Most companies compromised to k =4, but one company would agree to compromise on k =3. It is worth noting that the original proposals were k =10 and k=2. The proponents of k=10, already compromised to k=6 and now, k=4. The discussion should be continued in RAN4 #95e.*
* *Issue 1-2: UE behavior when reaching the maximum extension of the SFTD measurement*
  + *UE behavior upon exceeding Tmeasure\_SFTD\_LBT\_max: UE shall stop the search and stop performing the related measurement.*

### Issue 1-1: Maximum scaling of inter-RAT SFTD measurements

* **Proposals**
  + Option 1 (ZTE R4-2006019): k = 4
  + Option 2 (MediaTek R4-2006859): k = 3
* **Recommended WF**
  + k = 4,
  + This is already a compromise to the original proposed values (k = 10 and k = 2), and was supported by the majority of companies in the last meeting

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue 1-1** | ***Issue 1-1: Maximum scaling of inter-RAT SFTD measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

### 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** |
| R4-2006020 | Title: CR to address NR-U in inter-RAT SFTD measurements in 36.133  Source: ZTE  Formal version of draft CR R4-2005376, which was endorsed in the last meeting. |
| Company A |
| Company B |
| R4-2006025 | Title: CR to address NR-U in EN-DC SFTD measurements in 36.133  Source: ZTE  This is the formal version of draft CR R4-2004845, which was endorsed in the last meeting. |
| Company A |
| Company B |

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #2: Remaining issues in intra and inter-frequency measurements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2006159 | Qualcomm Inc | **Proposal 1. Semi-persistent L1-RSRP reporting delay in NR-U reuses R15 reporting delay.**  **Proposal 2. Semi-persistent CSI reporting delay in NR-U reuses R15 reporting delay.**  **Proposal 3. 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:**   * **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**   **Proposal 4. Adopt modified option 1 for event-triggered (periodic) and periodic reporting delay**  **Proposal 5. Q can be assumed to be always known to the UE.**  **Proposal 6. Adopt option 2 for UE behavior in case of successively exceeding max number of DL LBT failure during measurements.**  **Proposal 7. 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 8. 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.** |
| R4-2006182 | Apple | **Proposal: in RRC\_CONNECTED mode,**  **- when the s-MeasureConfig is configured and serving cell measurement needs MG, 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\_connected consecutive number of SSB bursts not available at the UE, where,**  **• Mp\_connected = 7 when Max(TDRX, TSMTC)≤ 40ms,**  **• Mp\_connected = 5 when 40ms< Max(TDRX, TSMTC)≤320ms,**  **• Mp\_connected = 3 when TDRX >320ms.**  **- when the s-MeasureConfig is configured and serving cell measurement does not needs MG, 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\_connected\_gaps consecutive number of SSB bursts not available at the UE, where,**  **• Mp\_connected\_gaps = 7 when Max(TDRX, TSMTC, MGRP)≤ 40ms,**  **• Mp\_connected\_gaps = 5 when 40ms< Max(TDRX, TSMTC, MGRP)≤320ms,**  **• Mp\_connected\_gaps = 3 when TDRX >320ms.** |
| R4-2006026 | ZTE | **Proposal 1: After 4 unsuccessful measurement attempts due to exceeding the max number of unavailable SMTC occasions, UE should restart from the detection stage again.** |
| R4-2006023 | ZTE | 1. Q can be assumed to be always known to the UE. |
| R4-2006860 | MediaTek Inc | **Proposal 1: In NR-U, scheduling restriction should depend on the signaling of *deriveSSB\_IndexFromCell.***  **Proposal 2: The signaling of *smtc2* is not applicable in unlicensed band.**  **Proposal 3: The text proposal for scheduling restriction during SS-RSRP and SS-SINR measurement:**   * **When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRP or SS-SINR measurement**   **- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within DRS window duration. (similar to Option 1 in RAN4-94-e-Bis)**  **- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration.**  **Proposal 4: The text proposal for scheduling restriction during SS-RSRQ measurement:**   * **When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRQ measurement**   **- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured and RSSI symbols, and on 1 data symbol before each consecutive SSB symbols to be measured and RSSI symbols and 1 data symbol after each consecutive SSB symbols to be measured and RSSI symbols within DRS window duration. (similar to Option 1 in RAN4-94-e-Bis)**  **- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration.**  Proposal 5: The text proposal for scheduling restriction during RSSI/CO measurement:   * **When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurement**   **- If *deriveSSB\_IndexFromCell* is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on RSSI symbols, and on 1 data symbol before RSSI symbols and 1 data symbol after RSSI symbols within RMTC window duration. (Similar to Option 1 in RAN4-94-e-Bis)**  **- If *deriveSSB\_IndexFromCell* is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within RMTC window duration.**  **Proposal 6: In NR-U, the scheduling restriction of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH (clause 9.2.5.3.2 in TS 38.133) is applicable.** |
| R4-2007702 | Huawei, HiSilicon | **Observation 1: In case of successively exceeding the maximum number of DL LBT failure during measurements, UE shall restart from detection among all cells in the carrier frequency instead of detecting the same cell again.**  **Proposal 2: Q can be assumed to be always known to the UE.**  **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.** |
| R4-2008011 | Ericsson | * ***Proposal 1****: Clarify in detection and measurement requirements that the 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.* * ***Proposal 2****: Upon successively exceeding N times the Lmax value for measurements, the UE shall stop the measurement attempts on this SSB and assume that the cell is not detected, where*   + *N=TBD*   + *FFS: N depends on DRX cycle length*   + *FFS: N is explicitly specified or determined by the existing procedures, e.g., the UE can reattempt the measurements until the earlier agreed 8 seconds limit (during which the undetectable cell can remain know) expires.* * ***Proposal 3****: Q can be assumed to be always known to the UE in the measurement requirements.* * ***Proposal 4****: No need to define scheduling restrictions for SS-RSRP, SS-RSRQ, and SS-SINR in NR-U.* * ***Proposal 5****: After no SSBs of a cell can be received during up to 8 seconds, the cell will not be considered as detectable and the Rel-15 UE behavior will apply. No other UE behavior or requirement on the consecutive SSBs in the serving cell is needed.* |
| R4-2007266 | Nokia,. Nokia Shanghai Bell | 1. RAN1 has introduced a feature in NR-U to allow for multiple opportunities for sending the SSBs during a DRS transmission window. The purpose of this feature is to minimize the effects of LBT failures for sending SSBs, allowing for some flexibility for sending DRS. 2. RAN1 sent an LS to RAN4 last meeting, in which it is clear that Q can be assumed to always be known at the UE. 3. RAN4 to assume that Q is always available at the UE. 4. The RAN1 design on beam cycling is applicable only to LBE, since it assumes that within the same frame the gNB might have different opportunities to get channel access. In FBE, only the first Q candidate SSB indexes are relevant. 5. RAN4 to specify different requirements for LBE and FBE modes. 6. RAN4 not to specify N2 values for FBE mode. For FBE there is only one candidate position per Q. 7. The duration of the DRS transmission window is configurable by the gNB, from 0.5 to 5 ms. 8. To keep a long DRS transmission window when it is not necessary to do so, i.e. in low interference conditions, is inefficient for the gNB. In low interference conditions, the DRS transmission window will be shorter, so that the gNB can allocate the resources in a more efficient manner. 9. In high interference conditions, the DRS transmission window might be longer, but that is precisely the scenario for which the RAN1 enhancement was introduced. 10. The gNB has no control on the candidate position that will be used for transmission, since it depends on the channel access conditions. It is not possible to guarantee that the same SSB index will be always transmitted at the same candidate position. 11. During cell detection, the UE needs to measure all Q SSBs. UE needs to search all candidate positions. 12. For cell identification, UE is required to monitor all candidate positions within the DRS transmission window. 13. RAN4 to wait for RAN1 feedback before agreeing on any value of N2 for intra and inter-frequency measurements. |
| R4-2006161 | Qualcomm Incorporated | Proposal 1. With Ecat = 1, one RSSI/CO report consists of 1 RSSI measurement and 1 CO measurement. |
| R4-2007268 | Nokia, Nokia Shanghai Bell | 1. For semi-persistent CSI reporting using PUCCH, 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 2. For semi-persistent CSI reporting using PUCCH, the reporting delay reuses Rel15 reporting delay. 3. For semi-persistent CSI reporting using PUSCH, the reporting delay reuses Rel15 reporting delay. |
| R4-2006775 | ZTE | 1. Option 1 should be agreed, which is: This measurement reporting delay excludes a delay, which is caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL LBT failures until the successfull transmission of the report.”" 2. " For Event Triggered periodic and periodic reporting delay, agree on Option 1 which is For event-triggered periodic and periodic reporting delay, the same definition shall be adopted as in Rel-15." |
| R4-2006021 | ZTE | Proposal 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.  Proposal 2: Semi-persistent L1-RSRP / CSI reporting delay in NR-U reuses the Rel-15 reporting delay. |
| R4-2007389 | Ericsson | Proposal 1: For CSI-RS based L1-RSRP measurements, RAN4 should wait for the conclusion of CSI-RS validation discussed in RAN1.  Proposal 2: If RAN1 agree with the mechanism of CSI-RS validation, 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: Reuse the Rel-15 semi-persistent CSI (L1-RSRP) reporting delay for NR-U even if UE cannot transmit the reporting due to the UL LBT failure.  Observation: Following RAN1 procedure in TS38.214 5.2.1.5.2, UE should stop the semi-persistent CSI reporting when UE cannot transmit HARQ-ACK for MAC CE deactivation command.  Proposal 4: 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 delays the CSI reporting.   * If UE does not receive the deactivation command during the delay period, UE restarts to transmit the delayed CSI reporting. FFS how to extend the delay. * If UE receive the deactivation command and can transmit HARQ-ACK, the UE abandon the stored CSI. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 UE behaviour in case of N successive DL LBT failure during measurements

#### Issue 2-1-1: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements

*During last meeting, the following options were discussed (R4-2005375):*

* *Issue 2-4-1: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements*
* *Candidate Options:*
  + *Option 1 (Original): After N unsuccessful measurement attempts of an already identified cell due to exceeding the max number of unavailable SMTC occasions, UE may restart from the detection stage again. Value of N can be further discussed in RAN4.*
  + *Option 2 : After N unsuccessful measurement attempts of an already identified cell due to exceeding the max number of unavailable SMTC occasions, UE shall stop the measurement attempts on this SSB, where N is TBD.*
  + *Option 3: The requirements do not apply after N unsuccessful measurement attempts of an already identified cell due to exceeding the max number of unavailable SMTC occasion. N is TBD.*
* **Proposals in this meeting**
  + Option 1: In case of successively exceeding the maximum number of DL LBT failure during measurements, UE shall restart from detection among all cells in the carrier frequency instead of detecting the same cell again
    - (Huawei, HiSilicon, observation 1 in R4-2007702): In case of successively exceeding the maximum number of DL LBT failure during measurements, UE shall restart from detection among all cells in the carrier frequency instead of detecting the same cell again.
    - (ZTE, proposal 1 in R4-2006026): After 4 unsuccessful measurement attempts due to exceeding the max number of unavailable SMTC occasions, UE should restart from the detection stage again.
  + Option 2: After N unsuccessful measurement attempts of an already identified cell due to exceeding the max number of unavailable SMTC occasions, UE shall stop the measurement attempts on this SSB,
    - *(Qualcomm, proposal 6 in R4-2006159):* Adopt option 2 for UE behavior in case of successively exceeding max number of DL LBT failure during measurements.
    - *•(Ericsson, Proposal 2 in R4-2008011): Upon successively exceeding N times the Lmax value for measurements, the UE shall stop the measurement attempts on this SSB and assume that the cell is not detected, where*
      * *o N=TBD*
      * *o FFS: N depends on DRX cycle length*
      * *o FFS: N is explicitly specified or determined by the existing procedures, e.g., the UE can reattempt the measurements until the earlier agreed 8 seconds limit (during which the undetectable cell can remain know) expires.*
* **Recommended WF**

**In both options,**

* + After N unsuccessful measurement attempts of an already identified cell due to exceeding the max number of unavailable SMTC occasions, UE shall stop the measurement attempts on this SSB
    - FFS: whether UE shall restart from detection stage again.
  + *Delegates, please discuss the options focusing on which parts of the WF can be agreeable in the 1st round.*

#### Issue 2-1-2: Value of N

Among the proposals in the issue above, there are also different proposals on how the value of ”N” times the Lmax value for measurements is exceeded.

* **Proposals in this meeting**
  + Option 1: N is equal to 4
    - (ZTE, proposal 1 in R4-2006026)
  + *Option* 2: *N is FFS (Ericsson, Proposal 2 in R4-2008011)*
    - *FFS: N depends on DRX cycle length.*
    - *FFS: N is explicitly specified or determined by the existing procedures, e.g., the UE can reattempt the measurements until the earlier agreed 8 seconds limit (during which the undetectable cell can remain know) expires*
* **Recommended WF**
  + *Discussion is needed. Please provide your views on the options above.*

#### Issue 2-1-3: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements

* **Proposals in this meeting**
  + Option 1: Clarify in detection and measurement requirements that the 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.'
    - Ericsson, proposal 1 in R4-2008011
* **Note from the moderator**
  + This topic was agreed in the 1st round of discussions last meeting, as it is the chairman notes from RAN4 94bis. It was not listed in the Way Forward.

I copy here the agreement, on page 151:

* + **Topic #2: Remaining issues in intra and inter-frequency measurements**
    - Issue 2-2-1: Add a note on the intra-frequency and inter-frequency measurements requirements
    - Agreement: A clarification is added in the intra-frequency measurement (and inter-frequency) 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. FFS: the definition of SSB occasions available.
* **Recommended WF**
  + Do not discuss this issue further in this meeting. It was agreed on last meeting.

### Sub-topic 2-2 UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts

*In the last meeting, the following was discussed (R4-2005375):*

* *Issue 2-7-1: UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts*
* *Candidate options:*
  + *Option 1: 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.*
  + *Option 2: Don’t introduce new UE behaviors as the problem can be taken care of by existing mechanisms.*

#### Issue 2-2-1: UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts

* **Proposals**
  + Option 1: UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure the serving cell for consecutive SSB bursts.
    - (Apple, R4-2006182): in RRC\_CONNECTED mode,
      * - when the s-MeasureConfig is configured and serving cell measurement needs MG, 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\_connected consecutive number of SSB bursts not available at the UE, where,
        + • Mp\_connected = 7 when Max(TDRX, TSMTC)≤ 40ms,
        + • Mp\_connected = 5 when 40ms< Max(TDRX, TSMTC)≤320ms,
        + • Mp\_connected = 3 when TDRX >320ms.
      * - when the s-MeasureConfig is configured and serving cell measurement does not needs MG, 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\_connected\_gaps consecutive number of SSB bursts not available at the UE, where,
        + • Mp\_connected\_gaps = 7 when Max(TDRX, TSMTC, MGRP)≤ 40ms,
        + • Mp\_connected\_gaps = 5 when 40ms< Max(TDRX, TSMTC, MGRP)≤320ms,
        + • Mp\_connected\_gaps = 3 when TDRX >320ms.
    - (Huawei, HiSilicon, Proposal 3 in R4-2007702): 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.
  + Option 2: After no SSBs of a cell can be received during up to 8 seconds, the cell will not be considered as detectable and the Rel-15 UE behavior will apply. No other UE behavior or requirement on the consecutive SSBs in the serving cell is needed.
    - (Ericsson, Proposal 5 in R4-2008011)
* **Recommended WF**
  + Discuss both options.

### Sub-topic 2-3 Assumption of Q in PBCH reading

In the last meeting, the following was discussed:

* Issue 2-5-1: Assumption of Q in PBCH reading
  + Option 1: Q can be assumed to be always known to the UE
  + Option 2: RAN4 to wait for ASN.1 freeze to decide on whether SSB-PositionQCL-Relationship-r16 can always be assumed known to UE

#### Issue 2-3-1: Assumption of Q in PBCH reading

* **Proposals in this meeting**
  + Option 1: Q can be assumed to be always known at the UE
    - Qualcomm (Proposal 6, R4-2006159)
    - ZTE (Proposal 1, R4-2006026)
    - Huawei, HiSilicon (Proposal 2 in R4-2007702)
    - Ericsson (Proposal 4, in R4-2008011)
    - Nokia, Nokia Shanghai Bell (Proposal 1 in R4-2007266)
* **Recommended WF**
  + Q can be assumed to be always known at the UE

### Sub-topic 2-4 Scheduling Restriction

In the last RAN4 meeting, the following was discussed:

* *Issue 2-6-1: Scheduling restriction during SS-RSRP and SS-SINR measurement* 
  + - *Option 1: 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.*
* *Issue 2-6-2: Scheduling restriction during SS-RSRQ*
  + *Option 1:*
    - *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."*

#### Issue 2-4-1: To define scheduling restrictions during SS-RSRP, SS-SINR and SS-RSRQ measurement

In this issue, the need to define scheduling restrictions for NR-U during SS-RSRP, SS-SINR and SS-RSRQ is discussed. One company proposed that there is no need to define scheduling restrictions for NR-U, since the scheduling restrictions assume synchronous networks, and two other companies proposed to define scheduling restrictions during these measurements.

Therefore, the first issue to be discussed is whether RAN4 should define scheduling restrictions for NR-U.

* **Proposals in this meeting**
  + Option 1: RAN4 to define scheduling restrictions during SS-RSRP, SS-SINR and SS-RSRQ measurements in NR-U
    - (Qualcomm, Proposal 7 and 8 in R4-2006159).
    - (MediaTek, Proposal 1, 3, 4, 5 and 6 in R4-2006860)
  + Option 2: No need to define scheduling restrictions for SS-RSRP, SS-RSRQ and SS-SINR in NR-U.
    - (Ericsson, Proposal 4 in R4-2008011)
* **Recommended WF**
  + Discussion is needed. From the moderator perspective, we understand that both synchronous and asynchronous networks are possible in NR-U. Can the proponent of Option 2 clarify their proposal?

#### Issue 2-4-2: Applicability of the signalling of SMTC2 to NR-U

* **Proposals in this meeting**
  + Option 1: The signaling of smtc2 is not applicable in unlicensed band.
    - (MediaTek, Proposal 2 in R4-2006860)
* **Recommended WF**
  + Discussion is needed.

#### Issue 2-4-3: Different scheduling restriction when deriveSSB\_IndexFromCell is enabled, or not enabled, during SS-RSRQ measurements.

In this issue, proposals related to scheduling restriction and scheduling restriction differentiation when deriveSSB\_IndexFromCell is enabled are captured. The motivation, copied from R4-2006860 is that:

*NR-U operation is on TDD band, but the deriveSSB\_IndexFromCell could be not enabled for the asynchronized deployment. Therefore, the schduling restriction should depend on the signaling of deriveSSB\_IndexFromCell, in analogy to clause 9.2.5.3.2 in TS 38.133 but without conditioning on different SCS.*

* **Proposals in this meeting**
  + Option 1: In NR-U, scheduling restriction should depend on the signaling of deriveSSB\_IndexFromCell.
    - (MediaTek, Proposal 1 in R4-2006860): In NR-U, scheduling restriction should depend on the signaling of deriveSSB\_IndexFromCell.
    - (MediaTek, Proposal 4 in R4-2006860): The text proposal for scheduling restriction during SS-RSRQ measurement:
      * When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRQ measurement
        + If deriveSSB\_IndexFromCell is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured and RSSI symbols, and on 1 data symbol before each consecutive SSB symbols to be measured and RSSI symbols and 1 data symbol after each consecutive SSB symbols to be measured and RSSI symbols within DRS window duration. (similar to Option 1 in RAN4-94-e-Bis)
        + If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration.
  + Option 2: No differentiation on the scheduling restriction for when deriveSSB\_IndexFromCell is enabled or not. (Implied from (Qualcomm, Proposal 8 in R4-2006159)).
    - (Qualcomm, Proposal 8 in R4-2006159):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.
* **Recommended WF**
  + Discussion is needed. This issue depends on issue 2-4-1 (and 2-4-2), but companies are encouraged to provide their views on both cases. Do companies see the need to differentiate the scheduling restriction depending on the configuration of deriveSSB\_IndexFromCell?
  + Companies are also encouraged to provide feedback on the exact text on the different proposals.

#### Issue 2-4-4: Different scheduling restriction when deriveSSB\_IndexFromCell is enabled during SS-RSRP and SS-SINR measurements.

In this issue, proposals related to scheduling restriction and scheduling restriction differentiation when deriveSSB\_IndexFromCell is enabled are captured. The motivation, copied from R4-2006860 is that:

*NR-U operation is on TDD band, but the deriveSSB\_IndexFromCell could be not enabled for the asynchronized deployment. Therefore, the schduling restriction should depend on the signaling of deriveSSB\_IndexFromCell, in analogy to clause 9.2.5.3.2 in TS 38.133 but without conditioning on different SCS.*

* **Proposals in this meeting**
  + Option 1: In NR-U, scheduling restriction during SS-RSRP and SS-SINR should depend on the signaling of deriveSSB\_IndexFromCell.
    - (MediaTek, Proposal 1 in R4-2006860): In NR-U, scheduling restriction should depend on the signaling of deriveSSB\_IndexFromCell.
    - (MediaTek, Proposal 3 in R4-2006860): The text proposal for scheduling restriction during SS-RSRP and SS-SINR measurement:
      * The text proposal for scheduling restriction during SS-RSRP and SS-SINR measurement:
        + When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRP or SS-SINR measurement

- If deriveSSB\_IndexFromCell is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols to be measured, and on 1 data symbol before each consecutive SSB symbols to be measured and 1 data symbol after each consecutive SSB symbols to be measured within DRS window duration. (similar to Option 1 in RAN4-94-e-Bis)

- If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration.

* + Option 2: No differentiation on the scheduling restriction for when deriveSSB\_IndexFromCell is enabled or not. Implied from (Qualcomm, Proposal 7 in R4-2006159)
    - (Qualcomm, Proposal 7 in R4-2006159):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.
* **Recommended WF**
  + Discussion is needed. This issue depends on issue 2-4-1 (and 2-4-2), but companies are encouraged to provide their views on both cases. Do companies see the need to differentiate the scheduling restriction depending on the configuration of deriveSSB\_IndexFromCell?
  + Companies are also encouraged to provide feedback on the exact text on the different proposals.

#### Issue 2-4-5: Scheduling restriction of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH

* **Proposals in this meeting**
  + Option 1: In NR-U, the scheduling restriction of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH (clause 9.2.5.3.2 in TS 38.133) is applicable.
    - (MediaTek, Proposal 6 in R4-2006860)
* **Recommended WF**
  + Discussion is needed.

#### Issue 2-4-6: Scheduling restriction during RSSI/CO measurements

* **Proposals in this meeting**
  + Option 1: Define scheduling restriction during RSSI/CO measurements and differentiate the cases where deriveSSB\_IndexFromCell is enabled or not for the definition of scheduling restrictions during RSSI/CO measurements.
    - (MediaTek, Proposal 5 in R4-2006860): The text proposal for scheduling restriction during RSSI/CO measurement:
      * When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to RSSI/CO measurement
      * If deriveSSB\_IndexFromCell is enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on RSSI symbols, and on 1 data symbol before RSSI symbols and 1 data symbol after RSSI symbols within RMTC window duration. (Similar to Option 1 in RAN4-94-e-Bis)
      * If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within RMTC window duration.
  + Option 2: Define scheduling restriction during RSSI/CO measurements and do not define differentiation between the cases in which deriveSSB\_IndexFromCell is enabled or not for the definition of scheduling restrictions during RSSI/CO measurements
    - (Qualcomm, Proposal 5 in R4-2006160) 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.
  + Option 3: No need to define scheduling restrictions for RSSI measurements in NR-U.
    - (Ericsson, Proposal 8 in R4-2007967)
* **Recommended WF**
  + Discussion is needed.

### Sub-topic 2-5 L1-RSRP measurements

In the last RAN4 meeting, the following was discussed:

* *Issue 4-1-1: UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK*
  + *Candidate options:*
    - 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 measurements but delay the L1-RSRP reporting. If UE does not receive deactivation command during the delay period, UE restarts to transmit L1-RSRP reporting. FFS how to extend the delay.
    - Option 3: It is preferred to delay the L1-RSRP reporting when the HARQ feedback cannot be transmitted after receiving the MAC CE deactivation command. A time limit shall be defined when the L1-RSRP reporting is delayed. When exceeding the time limits, UE shall abandon the stored measurement results, where the time limit is FFS. The UE shall also abandon the measurement results when the HARQ feedback is retransmitted for the deactivation command
* *Issue 4-1-2: Semi-persistent L1-RSRP reporting delay*
* *Issue 4-1-3: Semi-persistent CSI reporting delay*
  + *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

#### Issue 2-5-1: UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK

* **Proposals in this meeting**
  + Option 1: 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
    - 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
      * Qualcomm, Proposal 4 in R4-2006159
      * ZTE, Proposal 1 in R4-2006021
      * Nokia, Nokia Shanghai Bell, proposal 1 in R4-2007268
    - Following RAN1 procedure in TS38.214 5.2.1.5.2, UE should stop the semi-persistent CSI reporting when UE cannot transmit HARQ-ACK for MAC CE deactivation command.
      * (Ericsson, Observed within proposal 3 in R4-2007389)
* **Recommended WF (TBD)**

#### Issue 2-5-2: L1-RSRP reporting delay for semi-persistent CSI reporting with PUSCH

* **Proposals in this meeting**
  + Option 1: Reuse the Rel-15 semi-persistent CSI (L1-RSRP) reporting delay for NR-U
    - (Ericsson, proposal 3 in R4-2007389:) Reuse the Rel-15 semi-persistent CSI (L1-RSRP) reporting delay for NR-U even if UE cannot transmit the reporting due to the UL LBT failure.
    - (Nokia, Nokia Shanghai Bell, Proposal 2, in R4-2007269)
    - (Qualcomm, Proposals 1 and 2 in R4-2006159)
    - ZTE, Proposal 2 in R4-2006021
* **Recommended WF**

For semi-persistent CSI (L1-RSRP) reporting, reuse the Rel-15 reporting delay.

#### Issue 2-5-3: L1-RSRP reporting delay for semi-persistent CSI reporting with PUCCH

* **Proposals in this meeting**
  + Option 1: 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 delays the CSI reporting.

- If UE does not receive the deactivation command during the delay period, UE restarts to transmit the delayed CSI reporting. FFS how to extend the delay.

- If UE receive the deactivation command and can transmit HARQ-ACK, the UE abandon the stored CSI.

* + - * (Ericsson, proposal 4 in R4-2007389:)
  + Option 2: For semi-persistent CSI reporting using PUCCH, the reporting delay reuses Rel15 reporting delay.
    - (Nokia, Nokia Shanghai Bell, Proposal 3, in R4-2007269)
    - Other companies do not differentiate between reporting on PUCCH or PUSCH reporting, so the moderator assumption is that the proposals are valid for both cases:
      * (Qualcomm, Proposals 1 and 2 in R4-2006159)
      * ZTE, Proposal 2 in R4-2006021
* **Recommended WF (TBD)**

#### Issue 2-5-4: CSI-RS based L1-RSRP measurement

This issue depends on the LS sent to RAN1 last meeting. One of the companies propose (Ericsson, Proposal 1 in R4-2007389):

* **Proposals in this meeting**
  + Option 1: (Ericsson, Proposal 1 in R4-2007389):
    - If RAN1 agree with the mechanism of CSI-RS validation, 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. | |

* **Recommended WF** 
  + The topic is under discussion in RAN1, and the proponent also proposes that RAN4 should wait for the conclusion of CSI-RS validation discussed in RAN1. Companies are, of course, allowed to provide their feedback and register their comments.

### Sub-topic 2-6 UL LBT failures during measurement reporting

In the last RAN4 meeting, the following was discussed:

* Issue 2-8-1: Event Triggered reporting delay
  + Modified Option 1: *This measurement reporting delay excludes a delay, which is caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL LBT failures until the successfull transmission of the report.”*
  + *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
* Issue 2-8-2: Event Triggered periodic and periodic reporting delay
  + Candidate Options:
    - Option 1: For event-triggered periodic and periodic reporting delay, the same definition shall be adopted as in Rel-15.
    - Option 2: For event-triggered and event-triggered periodic measurement reporting, the UE measurement reporting delay is extended due to UL LBT failure, until the time point of the successful reporting attempt, according to [TBD RAN2 specification]. No extension for UL channel access category 1
    - Option 3: same as option 1 in issue 2-8-1
* **Recommended WF (TBD)**

#### Issue 2-6-1: Event triggered reporting delay

* **Proposals in this meeting**
  + Option 1:For event triggered delay:*Reuse Rel-15 delay, clarifying that this measurement reporting delay excludes a delay, which is caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL LBT failures until the successfull transmission of the report.”*
    - (Qualcomm, Proposal 4 in R4-2006159) Adopt modified option 1 for event-triggered (periodic) and periodic reporting delay
    - (Nokia, Nokia Shanghai Bell, proposal 1 in R4-2007267)
    - (ZTE, Proposals 1 in R4-2006775)
* **Recommended WF (TBD)**

#### Issue 2-6-2: Event triggered periodic, and periodic reporting delay

* **Proposals in this meeting**
  + Option 1:For event triggered delay:*Reuse Rel-15 delay, clarifying that this measurement reporting delay excludes a delay, which is caused by no UL resources being available for UE to send the measurement report on, and all delays due to UL LBT failures until the successful transmission of the report.”*
    - (Qualcomm, Proposal 4 in R4-2006159) Adopt modified option 1 for event-triggered (periodic) and periodic reporting delay
    - (Nokia, Nokia Shanghai Bell, proposal 1 in R4-2007267)
  + Option 2: for event-triggered periodic and periodic reporting delay, the same definition shall be adopted as in Rel-15.
    - (ZTE, Proposal 2 in R4-2006775)
* **Recommended WF (TBD)**

### Sub-topic 2-7 Measurement and Monitoring of QCLed SSBs

The following was agreed in the last meeting:

* Issue 2-1-1, Issue 2-1-2, Issue 2-1-3 and Issue 2-1-4:
  + Define the following UE capabilities
    - For RLM/BFD/CBD UE is required to monitor at least **N1** candidate SSB positions from the set of SSBs that are QCLed with each other within the set of configured resources
    - For intra and inter-frequency measurements UE is required to monitor at least **N2** candidate SSB positions from the set of SSBs that are QCLed with each other within SMTC
      * FFS for the case Q is not provided to the UE
      * FFS how to handle IDLE mode capabilities
    - Candidate N1 and N2 values are [1, 2, …]
    - FFS whether N1 = N2
    - FFS whether to have different capabilities for FBE and LBE modes
  + Send LS to RAN1 to ask for feedback on candidate values N1 and N2 taking into account impact on the overall system performance
  + Further discuss other cases

The answer of this LS was not received in RAN4 yet, so this topic can wait until RAN1 feedback is received, if it is received in this meeting. Otherwise, the recommendation is to not discuss this topic in RAN4 95.

#### Issue 2-7-1: Different requirements for LBE (dynamic channel access) and FBE (semi static channel access)

* **Proposals in this meeting**
  + Option 1: RAN4 to specify different requirements for LBE and FBE modes. RAN4 not to specify N2 values for FBE mode. For FBE there is only one candidate position per Q.
    - Nokia, Nokia Shanghai Bell, Proposal 1 and 2 in R4-2007266.
* **Recommended WF** 
  + **Do not discuss this topic until receiving the LS from RAN1.**

#### Issue 2-7-2: Number of candidate SSBs the UE is required to monitor during intra and inter-frequency measurements

* **Proposals in this meeting**
  + Option 1: RAN4 to wait for RAN1 feedback before agreeing on any value of N2 for intra and inter-frequency measurements.
    - Nokia, Nokia Shanghai Bell, Proposal 5 in R4-2007266.
* **Recommended WF** 
  + **Do not discuss this topic until receiving the LS from RAN1.**

#### Issue 2-7-3: Number of candidate SSBs the UE is required to monitor during intra and inter-frequency cell detection

* **Proposals in this meeting**
  + Option 1: For cell identification, UE is required to monitor all candidate positions within the DRS transmission window.
    - Nokia, Nokia Shanghai Bell, Proposal 4 in R4-2007266.
* **Recommended WF** 
  + **Do not discuss this topic until receiving the LS from RAN1.**

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue 2-1-1** | ***Issue 2-1-1: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-1-2** | ***Issue 2-1-2: Value of N*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-1-3** | ***Issue 2-1-3: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-2-1** | ***Issue 2-2-1: UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-3-1** | ***Issue 2-3-1: Assumption of Q in PBCH reading*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-1** | ***Issue 2-4-1: To define scheduling restrictions during SS-RSRP, SS-SINR and SS-RSRQ measurement*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-2** | ***Issue 2-4-2: Applicability of the signalling of SMTC2 to NR-U*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-3** | ***Issue 2-4-2: Different scheduling restriction when deriveSSB\_IndexFromCell is enabled, or not enabled, during SS-RSRQ measurements.*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-4** | ***Issue 2-4-4:Different scheduling restriction when deriveSSB\_IndexFromCell is enabled during SS-RSRP and SS-SINR measurements.*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-5** | ***Issue 2-4-5: Scheduling restriction of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH.*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-4-6** | ***Issue 2-4-6: Scheduling restriction during RSSI/CO measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-5-1** | ***Issue 2-5-1: UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-5-2** | ***Issue 2-5-2: Issue 2-5-2: L1-RSRP reporting delay for semi-persistent CSI reporting with PUSCH*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-5-3** | ***Issue 2-5-3 Issue 2-5-3: L1-RSRP reporting delay for semi-persistent CSI reporting with PUCCH*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-5-4** | ***Issue 2-5-4 CSI-RS based L1-RSRP measurement*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-6-1** | ***Issue 2-6-1 Event triggered reporting delay*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-6-2** | ***Issue 2-6-2 Event triggered periodic, and periodic reporting delay*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-7-1** | ***Issue 2-7-1 Different requirements for LBE (dynamic channel access) and FBE (semi static channel access)*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-7-2** | ***Issue 2-7-2 Number of candidate SSBs the UE is required to monitor during intra and inter-frequency measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 2-7-3** | ***Issue 2-7-3*** ***Number of candidate SSBs the UE is required to monitor during intra and inter-frequency cell detection*** |
| **Company A** | *Comments* |
| **Company B** |  |

### 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** |
| R4-2007261 | Title: CR to TS 38.133: adding NR-U inter-frequency measurements  Source: Nokia, Nokia Shanghai Bell  This CR introduces a new clause to TS 38.133, which captures the NR-U inter-frequency measurement agreements. |
| Company A |
| Company B |
| R4-2007262 | Title: CR to TS 36.133: adding inter-RAT NR-U measurements  Source: Nokia, Nokia Shanghai Bell  This CR introduces new clauses to TS 36.133, to add inter-RAT NR-U measurement requiremetns. |
| Company A |
| Company B |
| R4-2007692 | Title: CR on introduction of intra-frequency measurements requirements for NR-U  Source: Huawei, HiSilicon |
| Company A |
| Company B |
| R4-2006183 | Title: CR on UE measurements capability and reporting criteria for NR-U  Source: Apple  Capture the agreements from RAN4 #92bis on UE measurement capability and reporting criteria for NR-U. |
| Company A |
| Company B |
| R4-2007695 | Title: CR for introduction of reporting criteria for NR-U  Source: Huawei, HiSilicon  Introduce the requirements for reporting criteria for RSSI and CO measurement for NR-U |
| Company A |
| Company B |
| [R4-2007390](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007390.zip) | Title: CR: Introduction of L1-RSRP measurement requirements with CCA  Source: Ericsson  This draft CR introduces the L1-RSRP measurement requirements with CCA. |
| Company A |
| Company B |

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #3: RSSI and CO measurents in NR-U

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2006161 | Qualcomm | Proposal 1. With Ecat = 1, one RSSI/CO report consists of 1 RSSI measurement and 1 CO measurement. |
| R4-2006160 | Qualcomm | Observation 1. With amendments agreed in RAN1 for definition of RSSI in TS 38.215, there will never be an intra-frequency RSSI with option 2b.  Proposal 1. Intra-frequency RSSI measurement is defined when:  • RMTC configured SCS is the same as the SCS of active BWP in the serving cell  • 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.  Proposal 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.  Observation 2. For UE not capable of wideband operation in NR-U, RSSI measurement period scales with the number of MOs not requiring measurement gap according to CSSFoutside-gap,i.  Proposal 3. When measurement gap is not required, RSSI/CO measurement period corresponds to:  • Nintra-MO.max(reportInterval, rmtc-Period) when DRX is not used  • Nintra-MO.max(reportInterval, rmtc-Period, DRXcycle length) when DRX is used  where Nintra-MO , reportInterval, and rmtc-Period is defined as the number of measurement objects that can be measured without gaps, configured reporting interval, and configured RMTC period, respectively.  Proposal 4. When measurement gap is required, RSSI/CO measurement period corresponds to:  • max(reportInterval, rmtc-Period, MGRP).CSSFinter when DRX is not used  • max(reportInterval, rmtc-Period, MGRP, DRXcycle length).CSSFinter when DRX is used  where CSSFinter is determined according to CSSFwithin-gap,i in clause 9.1.5.2 for measurement conducted within measurement gaps.  Proposal 5. 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. |
| R4-2006861 | MediaTek | Observation 1: Gap is needed for RSSI measurement if the subband configured for RSSI measurement is not completely contained within the active BWP of the UE.  Proposal 1: An RSSI measurement is defined as intra-frequency RSSI measurement if the subband configured for RSSI measurement is overlapped with the channel BW of the UE. The UE is not required to perform RSSI measurement outside the active BWP for intra-frequency RSSI measurement.  Proposal 2: An RSSI measurement is defined as inter-frequency measurement if the subband configured for RSSI measurement is non-overlapped with the channel BW of the UE. The UE always requires gap to perform inter-frequency RSSI measurement.  Proposal 3: FFS intra-frequency RSSI measurement on a deactivated SCell.  Proposal 4: The RSSI measurement within measurement gap and the RSSI measurement outside measurement gap should be different requirements.  Proposal 5: For a RSSI measurement within measurement gap, measurement period is scaled up by CSSFwithin\_gap; for a RSSI measurement outside measurement gap, measurement period is scaled up by CSSFoutside\_gap. Where the existing requirement of CSSFwithin\_gap and CSSFoutside\_gap are reused.  Proposal 6: When one MO is configured with both SSB-based measurement and RSSI measurement, the corresponding measurement periods for SSB and RSSI are double. |
| R4-2007265 | Nokia, Nokia Shanghai Bell | Observation 1: The purpose of the RSSI measurement in unlicensed bands is to support the Channel Occupancy measurement, and to assist the gNB in assessing the interference perceived at the UE. In unlicensed bands in the 5GHz band, the channel occupancy/vacancy is assessed by comparing the total energy measured within the channel with an energy detection threshold. This threshold is integrated over the channel bandwidth, as in the ETSI BRAN specification [3].  Observation 2:The purpose of the RSSI measurement in unlicensed bands is to support the channel occupancy measurement. Channel occupancy is determined by comparing the energy measured in the channel, with a channel occupancy threshold. By ETSI regulation, this threshold is integrated in the 20 MHz band.  Observation 3:Narrowband RSSI measurements do not necessarily result in the same outcome as wideband RSSI measurements, even when the power is properly scaled to the measurement bandwidth. It depends on the characteristics of the interference.  Observation 4:In order for the RSSI measurement to correctly provide support for the channel occupancy measurement, both the UEs and gNBs should be aware of the measurement bandwidth.  Observation 5:The definition of RSSI measurement in TS 38.215 is clear: the RSSI is the linear average of the total received power in W observed only in configured OFDM symbol and in the configured measurement bandwidth corresponding to the channel bandwidth [TS 37.213]. A channel is defined in TS 37.213 as: A channel refers to a carrier or a part of a carrier consisting of a contiguous set of resource blocks (RBs) on which a channel access procedure is performed in shared spectrum. In unlicensed bands, the channel access procedure is performed within the LBT sub-bands.  Observation 6:The RSSI measurement does not depend on the transmission of any reference signal. Therefore, the definition of intra or inter-frequency measurements should not depend on the configuration of any reference signal.  Observation 7:The SCS in the configuration of the RMTC is used by the UE for performing the measurements.  Observation 8:By the definition in proposal 3, measurement gaps are required for inter-frequency RSSI measurements only.  Proposal 1:The RSSI report is based on the total received power in [W], received in the channel bandwidth, which is defined in RAN1 as the LBT bandwidth.  Proposal 2:RAN4 to define the RSSI measurement accuracy requirements based on the LBT bandwidth.  Proposal 3:Intra-frequency RSSI measurements in NR-U are defined when the measurement bandwidth is contained within the active BWP and the SCS is the same as the active BWP in the serving cell. Inter-frequency RSSI measurements in NR-U are defined when at least one of these conditions is not satisfied.  Proposal 4: Measurement gaps are used only for inter-frequency RSSI measurements. |
| R4-2007967 | Ericsson | • Proposal 1: Need for gaps for RSSI is determined by the relation between the active BWP and RSSI BW:  o no measurement gaps are needed when RSSI BW is within the active BWP of the UE.  • Proposal 2: There can be intra-frequency RSSI requiring measurement gaps and inter-frequency RSSI without measurement gaps.  • Proposal 3: Intra- and inter-frequency RSSI are defined according to the Table 1 below.  **Table 1: intra-/inter-frequency definitions and need for gaps for RSSI and CO**   |  |  |  |  | | --- | --- | --- | --- | |  | ***Definition*** | ***Need for measurement gaps*** | | | *Intra-frequency RSSI* | * *The center frequency of the RSSI measurement is aligned with the center frequency of an intra-frequency SSB or CSI-RS* * *the SCS of the RSSI measurement is the same as the SCS of an intra-frequency SSB or CSI-RS* | *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 4: RAN4 requirements will be defined for all RMTC configurations.  • Proposal 5: RSSI measurement bandwidth is the LBT bandwidth (which is already decided by RAN1 and specified in TS 38.215).  • Proposal 6: CSSF needs to be adapted for NR-U to account for RSSI measurements in RMTC in addition to other NR-U measurements in SMTC.  • Proposal 7: The RSSI and CO measurement periods depend on:  o max(reportInterval, rmtc-Period) in non-DRX when measurement gaps are not required,  o max(reportInterval, rmtc-Period, DRX) in DRX when measurement gaps are not required, or  o max(reportInterval, rmtc-Period, MGRP and gap sharing) in DRX when measurement gaps are required.  • Proposal 8: No need to define scheduling restrictions for RSSI measurements in NR-U.  • Proposal 9: 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] with CCA. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1: Intra-frequency and inter-frequency definition and use of measurement gaps

In the last RAN4 meeting, the following was discussed:

Issue 3-2-1: Intra-frequency and inter-frequency RSSI definition

*Candidate options (same as last meeting):*

*Condition 1:*

*Option 1a: RMTC configured SCS is the same as the active BWP in the serving cell.*

*Option 1b: RMTC configured SCS is the same as the SCS of the serving cell SSB,*

*Condition 2:*

*Option 2a: Measurement BW is contained within the active BWP of the serving cell*

*Option 2b: The center frequency of the PRB set configured for RSSI measurement is aligned with the center frequency of an intra-frequency SSB.*

Issue 3-2-2: Need for measurement gaps for intra-frequency RSSI measurements

#### Issue 3-1-1: Intra-frequency and inter-frequency RSSI definition

*In this issue, the definition of intra-frequency and inter-frequency RSSI definition is discussed. To aid the discussions, it is worth copying here the most recent definition of the RSSI measurement, as agreed in the last RAN1 meeting, in the following TP:*

|  |  |
| --- | --- |
| **Definition** | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only ~~in~~ per configured OFDM symbol~~s~~ and in the ~~configured~~ measurement bandwidth ~~over~~ *~~N~~* ~~number of resource blocks~~ corresponding to ~~LBT~~ the channel bandwidth [TS 37.213 §4.0] where the channel has ~~with~~ the center frequency ~~of~~ configured by *ARFCN-valueNR*~~ARFCN~~, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.  Higher layers configure the *ARFCN-valueNR*, the reference numerology, and ~~the measurement bandwidth,~~ the measurement duration i.e., ~~and~~ which OFDM symbol(s) should be measured by the UE.  For frequency range 1, the reference point for the RSSI shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported RSSI value shall not be lower than the corresponding RSSI of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED intra-frequency,  RRC\_CONNECTED inter-frequency |

It is also worth making the following observation:

* The LBT bandwidth is the channel bandwidth defined in 37.213.

Additionally, RAN4 (RF) has agreed on the following in RAN4 #92. This agreement is captured in the chairman notes, R4-1910701, page 600:

* Agreement:

RAN4 agreed to place the SSB close to the edge of sub-bands

Finally, it is worth noting that the following is under discussion in RAN1 in this meeting (Agenda item **7.2.2.2.2)**:

For the value ranges for measDuration-r16,

* Alt 1: {sym1, sym14or28or56or48, sym28or56or112or96, sym42or84or168or144, sym70or140or280or240}
  + “sym14or28or56or48” refers to 14 symbols for 15 kHz SCS, 28 symbols for 30 kHz SCS, 56 symbols for 60 kHz SCS with NCP, and 48 symbols for 60 kHz SCS with ECP, respectively, and so on
  + Inform RAN2 of this decision (can be within updated RRC parameter spread sheet that we send to RAN2, not necessarily a separate LS)
* Alt 2: {sym1, sym14or12, sym28or24, sym42or36, sym70or60}
  + “sym14or12” refers to 14 symbols for NCP and 12 symbols for ECP, respectively, and so on
  + Inform RAN2 of this decision (can be within updated RRC parameter spread sheet that we send to RAN2, not necessarily a separate LS)

Note 1: If measured bandwidth of RSSI overlaps with the active DL BWP, UE performs RSSI measurement with the SCS of the active DL bandwidth part during the measurement duration derived from combination of measDuration-r16 and rmtc-ref-SCS-CP.

Note 2: The UE expects an integer number of symbol(s) with respect to the SCS of the active DL BWP to be configured for RSSI measurement.

* **Proposals in this meeting**
  + Option 1: Intra-frequency RSSI measurement is defined when: RMTC configured SCS is the same as the SCS of active BWP in the serving cell and measurement BW is contained within the active BWP of the serving cell. Inter-frequency RSSI measurement is defined when any of the previous conditions is not satisfied.
    - (Qualcomm, Proposal 1 in R4-2006160)
    - (Nokia, Nokia Shanghai Bell, Proposal 3 in R4-2007265)
  + Option 2:
    - An RSSI measurement is defined as intra-frequency RSSI measurement if the subband configured for RSSI measurement is overlapped with the channel BW of the UE. The UE is not required to perform RSSI measurement outside the active BWP for intra-frequency RSSI measurement. (Proposed as Option 2c.)
    - An RSSI measurement is defined as inter-frequency measurement if the subband configured for RSSI measurement is non-overlapped with the channel BW of the UE. The UE always requires gap to perform inter-frequency RSSI measurement.
    - FFS intra-frequency RSSI measurement on a deactivated SCell.
      * (MediaTek, Proposal 1, 2 and 3 in R4-2006861)
  + Option 3: Ericsson, Proposal 3 in R4-2007967.

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|  | ***Definition*** |
| *Intra-frequency RSSI* | * *The center frequency of the RSSI measurement is aligned with the center frequency of an intra-frequency SSB or CSI-RS* * *the SCS of the RSSI measurement is the same as the SCS of an intra-frequency SSB or CSI-RS* |
|
| *Inter-frequency RSSI* | *if at least one of the two conditions above is not met* |
|

* **Recommended WF**
  + Discussion is needed. Delegates, please consider the additional information provided in the description of this issue when justifying the preferred option.
  + Also indicate if the following text agreeable:
    - The UE is not required to perform intra-frequency RSSI measurements outside of the active BWP of the serving cell.
    - Intra-frequency RSSI measurement is defined when:
      * Condition 1: Measurement BW is contained within the active BWP of the serving cell.
      * FFS Condition 2:
        + Option 1: RMTC configured SCS is the same as the SCS of active BWP
        + Option 2: *the SCS of the RSSI measurement is the same as the SCS of an* intra-frequency SSB or CSI-RS
        + Option 3: No additional condition is needed.

#### Issue 3-1-2: Need of measurement Gaps during RSSI measurements

* **Proposals in this meeting**
  + Option 1: intra-frequency RSSI measurement can be performed without the need for measurement gap whereas inter-frequency RSSI measurement requires measurement gap.
    - (Qualcomm, proposal 2 in R4-2006160)
    - (Nokia, proposal 4 in R4-2007265)
  + Option 2: no measurement gaps are needed when RSSI BW is within the active BWP of the UE.
    - (MediaTek, Observation 1 in R4-2006861): Gap is needed for RSSI measurement if the subband configured for RSSI measurement is not completely contained within the active BWP of the UE.
    - (Ericsson, Proposal 1 in R4-2007967): Need for gaps for RSSI is determined by the relation between the active BWP and RSSI BW:
      * no measurement gaps are needed when RSSI BW is within the active BWP of the UE.
  + Option 3: There can be intra-frequency RSSI requiring measurement gaps and inter-frequency RSSI without measurement gaps. Intra- and inter-frequency RSSI are defined according to the Table 1 below.
    - (Ericsson, Proposal 2 and 3 in R4-2007967)

|  |  |  |  |
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|  | ***Definition*** | ***Need for measurement gaps*** | |
| *Intra-frequency RSSI* | * *The center frequency of the RSSI measurement is aligned with the center frequency of an intra-frequency SSB or CSI-RS* * *the SCS of the RSSI measurement is the same as the SCS of an intra-frequency SSB or CSI-RS* | *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* |

* **Recommended WF**
* This topic depends on Issue 3-1-1: Intra-frequency and inter-frequency RSSI definition. Delegates are encouraged to provide their views, and feedback on whether the following is agreeable:
* Measurement gaps are needed at least when:
  + RSSI BW is outside the active BWP of the UE.
  + FFS: if another condition is needed.

### Sub-topic 3-2: RSSI and CO measurement period

In the last RAN4 meeting, the following was discussed (R4-2005375):

* Issue 3-3-2: *RSSI measurement period*
  + *Option 1:* 
    - *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.*
      * *The CSSF definition and how to account it in the RSSI requirements is to be further discussed*
  + *Option 2:* 
    - *The RSSI and CO measurement period is scaled with the number of measurement objects / CSSFinter.*

#### Issue 3-2-1: CSSF definition

* Proposals in this meeting
  + (Ericsson, Proposal 6 in R4-2007967): CSSF needs to be adapted for NR-U to account for RSSI measurements in RMTC in addition to other NR-U measurements in SMTC.

#### Issue 3-2-2: RSSI measurement period

* **Proposals in this meeting**
  + Option 1: The RSSI measurement within measurement gap and the RSSI measurement outside measurement gap should be different requirements
    - (MediaTek, Proposal 4 in R4-2006861)
    - (MediaTek, Proposal 5 in R4-2006861) For a RSSI measurement within measurement gap, measurement period is scaled up by CSSFwithin\_gap; for a RSSI measurement outside measurement gap, measurement period is scaled up by CSSFoutside\_gap. Where the existing requirement of CSSFwithin\_gap and CSSFoutside\_gap are reused.
    - (MediaTek, Proposal 6, in R4-2006861) When one MO is configured with both SSB-based measurement and RSSI measurement, the corresponding measurement periods for SSB and RSSI are double.
  + Option 2: (Ericsson Proposal 7 in 2007967): 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.
  + Option 3:
    - (Qualcomm Observation 2 in R4-2006160). For UE not capable of wideband operation in NR-U, RSSI measurement period scales with the number of MOs not requiring measurement gap according to CSSFoutside-gap,i.
    - (Qualcomm Proposal 3 in R4-2006160). When measurement gap is not required, RSSI/CO measurement period corresponds to:
      * Nintra-MO.max(reportInterval, rmtc-Period) when DRX is not used
      * Nintra-MO.max(reportInterval, rmtc-Period, DRXcycle length) when DRX is used
    - (Qualcomm Proposal 4 in R4-2006160)When measurement gap is required, RSSI/CO measurement period corresponds to:
      * max(reportInterval, rmtc-Period, MGRP).CSSFinter when DRX is not used
      * max(reportInterval, rmtc-Period, MGRP, DRXcycle length).CSSFinter when DRX is used
* **Recommended WF (TBD)**

### Sub-topic 3-3: RSSI reporting criteria

The following was discussed in the last RAN4 meeting: Issue 3-1-3: RSSI measurement reporting criteria

* + *Candidate options:*
    - *Option 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.
    - *Option 2:* 
      * A RSSI/CO report consists of 1 RSSI measurement and 1 CO measurement. RSSI/CO report over multiple sub-bands requires multiple measurement objects.

#### Issue 3-3-1: RSSI Reporting criteria

* **Proposals in this meeting**
  + - Option 1: With Ecat = 1, one RSSI/CO report consists of 1 RSSI measurement and 1 CO measurement.
      * Qualcomm, proposal 1 in R4-2006161, with following observations to option 2 in the last meeting:
        + RSSI/CO measurement on each channel bandwidth corresponds to a separate measurement object. Reporting of separate measurement objects are done separately. As such, the word “minimum” in option 1 is unnecessary. Each RSSI/CO measurement report corresponds to exactly one RSSI and one CO; not more and not less.
        + The RSSI measurement definition in TS 38.215 already refers to the channel bandwidth as defined in TS 37.213. No need to mention this again in the RAN4 reporting criteria definition
        + “Per carrier frequency with CCA” is not necessary in the definition of reporting criteria as it is already reflected in TS 38.215 and TS 37.213 and RAN2 agreements.
    - Option 2: 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] with CCA.
      * Ericsson, proposal 9 in R4-2007967, with the following text: RAN1 agreed on the term “RB set” to be used to denote an LBT bandwidth, with up to N RB sets per cell and a configurable or pre-defined number of available PRBs in each RB set, but this seems to be more relevant for intra-frequency and not for inter-frequency. Therefore, covering both intra- and inter-frequency LBT bandwidth, the term “channel” which is well-defined in TS 37.213 and used in RAN1.
        + Further, the RAN1 agreement that units other than a single LBT bandwidth are not supported for RSSI measurement bandwidth configuration suggests that the RSSI measurements are always configured over a single LBT bandwidth.
* **Recommended WF (TBD)**

### Sub-topic 3-4: RMTC configuration and RSSI measurement BW

**The following was discussed in the last RAN4 meeting:**

* **Issue 3-3-1: RSSI measurement bandwidth and assumed bandwidth for RSSI accuracy**
  + **Option 1: RSSI measurement Bandwdith is the LBT bandwidth**
  + **Option 2: The RSSI measurement bandwidth is less than the LBT bandwidth.**

#### Issue 3-4-1: RSSI measurement bandwidth

* **Proposals in this meeting**

Option 1: RSSI measurement bandwidth is the LBT bandwidth (which is already decided by RAN1 and specified in TS 38.215).

* + - (Ericsson, Proposal 5 in R4-2007967)
    - (Nokia, Proposal 1 in R4-2007265)

Option 2: RAN4 discuss this in the performance requirements.

* **Recommended WF (TBD)**

#### Issue 3-4-2: Requirements for different RMTC configurations

* **Proposals in this meeting** 
  + Ericsson, proposal 4 in R4-2007967): RAN4 requirements will be defined for all RMTC configurations.
* **Recommended WF**

RAN4 requirements will be defined for all RMTC configurations.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue 3-1-1** | ***Issue 3-1-1: Intra-frequency and inter-frequency RSSI definition*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 3-1-2** | ***Issue 3-1-2: Need of measurement Gaps during RSSI measurements*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| **Issue 3-2-1** | ***Issue 3-2-1: CSSF definition*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| --- | --- |
| **Issue 3-2-2** | ***Issue 3-2-2: RSSI measurement period*** |
| **Company A** | *Comments* |
| **Company B** |  |

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| --- | --- |
| **Issue 3-3-1** | ***Issue 3-3-1: RSSI Reporting criteria*** |
| **Company A** | *Comments* |
| **Company B** |  |

|  |  |
| --- | --- |
| **Issue 3-4-1** | ***Issue 3-4-1: RSSI measurement bandwidth*** |
| **Company A** | *Comments* |
| **Company B** |  |

|  |  |
| --- | --- |
| **Issue 3-4-2** | ***Issue 3-4-2: Requirements for different RMTC configurations*** |
| **Company A** | *Comments* |
| **Company B** |  |

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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