**3GPP TSG-RAN WG4 Meeting # 96-e draftR4-2012039**

**Electronic Meeting, 17 – 28 Aug., 2020**

**Agenda item:** 7.1.5.10, 7.1.5.11 and 7.1.5.13

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

**Title:** Email discussion summary for [96e Bis][208]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:

7.1.5.10 – Measurement requirements

7.1.5.11 – Measurement capability

7.1.5.13 – Other requirements maintenance

The following topics and sub-topics are treated in this summary:

Topic #1: Remaining issues intra and inter-frequency measurements and measurement capability

Sub-topic 1-1: Monitoring of QCL beams in NR-U

Sub-topic 1-2: UE behavior in RRC\_CONNECTED mode when serving cell is unavailable for consecutive SSB bursts

Sub-topic 1-3: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements

Sub-topic 1-4: Scheduling restrictions during SS-RSRP, SS-RSRQ and SS-SINR measurements

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

Sub-topic 1-6: Measurement capability

Topic #2: RSSI and CO measurements

Sub-topic 2-1: Intra-frequency measurement definition and the use of measurement gaps

Sub-topic 2-2: RSSI measurement bandwidth

Sub-topic 2-3: RSSI measurement period

Sub-topic 2-4: Scheduling restriction during RSSI measurements

Guidance to first round discussions:

* Companies to provide comments on the open issues and CRs in this document.

Guidance to second round discussions:

* Companies to provide comments on the open issues in this document.
* The discussion on the WF and revised CRs will be done in the e-mail reflector, in separate e-mail threads, as in the previous meetings. These discussions need to be kicked off by the responsible companies.

# Topic #1: Remaining issues intra and inter-frequency measurements and measurement capability

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2009871 | Qualcomm | Observation 1. UE can signal capability to support only semi-static channel access mode, only dynamic channel access mode, or both.  Observation 2. In semi-static channel access mode, UE can assume that unavailability of DL due to LBT in a fixed frame period leads to unavailability of all consecutive SSBs within the same fixed frame period (FFP).  Observation 3. Per agreed UE feature list, default mode in semi-static channel access is when SMTC window is not larger than FFP.  Proposal 1. For UE’s supporting semi-static channel access, monitoring multiple QCL’ed SSB’s within an SMTC occasion is irrelevant. Effectively, N2=1 per agreements in RAN1 UE feature list.  Proposal 2. For dynamic channel access mode, UE is required to monitor the first N2 = 2 SSBs that are QCL’ed within an SMTC window regardless of the value of Q.  Observation 4. At least from MAC (RAN2) layer perspective, UE follows the actions related to MAC-CE activation/deactivation command immediately after decoding the MAC-CE command regardless of whether UE is able to send HARQ-ACK feedback or not.  Proposal 3. After N unsuccessful measurement attempts of an already identified cell due to exceeding max number of unavailable SMTC occasions, the UE shall perform the detection procedure again like for any other SSB.  Proposal 4. 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.  Proposal 5. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRP or SS-SINR measurement  - 5a: The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, and on 1 data symbol before each consecutive SSB symbols configured to be measured and 1 data symbol after each consecutive SSB symbols configured to be measured within SMTC window duration if deriveSSB\_IndexFromCell is enabled. If the high layer in TS 38.331 signalling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.  - 5b: The UE is not expected to transmit PUCCH/PUSCH/SRS within the SMTC window to be measured, and on 1 data symbol before the start of the SMTC window be measured and 1 data symbol after the end of SMTC window to be measured if deriveSSB\_IndexFromCell is not enabled. If the high layer in TS 38.331 signalling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise 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.  Proposal 6. When the UE performs intra-frequency measurements in unlicensed spectrum, the following restrictions apply due to SS-RSRQ measurement  - 6a: The UE is not expected to transmit PUCCH/PUSCH/SRS on SSB symbols configured to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB configured to be measured/RSSI symbols and 1 data symbol after each consecutive SSB configured to be measured/RSSI symbols within SMTC window duration if deriveSSB\_IndexFromCell is enabled.. If the high layer signalling of smtc2 is configured(in TS 38.331), the SMTC periodicity follows smtc2; Otherwise the SMTC periodicity follows smtc1.  - 6b: The UE is not expected to transmit PUCCH/PUSCH/SRS with the SMTC window to be measured, RSSI measurement symbols, and on 1 data symbol before the start of the SMTC window to be measured measured/RSSI symbols and 1 data symbol after the end of the SMTC window to be measured/RSSI symbols if deriveSSB\_IndexFromCell is not enabled.. If the high layer signalling of smtc2 is configured(in TS 38.331), 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. |
| R4-2009910 | Apple | Proposal 1: agree on 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.  Proposal 2: in RRC\_CONNECTED mode,  - when the s-MeasureConfig is configured and PCell measurement does not need MG, UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the PCell 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 PCell measurement needs MG, UE shall initiate measurements on neighbour cells indicated by the PCell 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. |
| R4-2010082 | ZTE | Proposal 1: For UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts, keep current UE behavior as Option 2 and further study the feasibility of Option 1 as a possible enhancement to NR-U in Rel-17 phase.  Proposal 2: Signaling of smtc2 is applicable to unlicensed band.  Proposal 3: 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. |
| R4-2010215 | MediaTek Inc. | Proposal 1: In a given discovery burst transmission window, UE is required to monitor at least one candidate SBI corresponding to the same SBI.  Proposal 2: Capture the number of candidate SBIs corresponding to the same SBI UE should monitor to in the terminology for unavailable SSB/SMTC occasions.  Proposal 3: In FR1 inter-band CA, the scheduling restriction due to one CC shall not apply to other CCs on the other bands.  Proposal 4: If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration. |
| R4-2011083 | Huawei, HiSilicon | Proposal 1: Upon successively exceeding the maximum number of DL LBT failure during measurement, UE shall: restart from detection stage like for any other SSB.  Observation 1: The benefits of initiating the neighbour cell measurement is clear that UE could handover to other cells before RLF to avoid long time interruption.  Observation 2: The similar behavior in IDLE mode has been defined in NR-U.  Proposal 2: 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. |
| R4-2011353 | Ericsson | • Proposal 1: 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.  • 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  o The UE cannot measure this SSB again without first detecting it  o The UE performs the detection procedure like for any other SSB  o N is not explicitly specified and 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: Signaling of smtc2 is applicable to unlicensed band.  • Proposal 4 (Proposal 4 in [6]): Define the core NR-U requirements transparent to the number of SSBs to monitor.  • Proposal 5 (Proposal 5 in [6]): Design test cases with two candidate SSB positions.  • Proposal 6: Agree on the same approach to address the number of SSBs to monitor for all relevant NR-U requirements, including measurements, RLM, BM, etc. |
| R4-2010592 | Nokia | Observation 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.  Observation 2: 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 the gNB is expected to always transmit the first Q candidate SSB indexes.  Proposal 1: RAN4 not to specify N2 values for FBE mode.  Observation 3: The duration of the DRS transmission window is configurable by the gNB, from 0.5 to 5 ms.  Observation 4: 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.  Observation 5: In high interference conditions, the DRS transmission window might be longer, but that is precisely the scenario for which the RAN1 enhancement was introduced.  Observation 6: In the reply LS from RAN1, it was stated that if there are no different performance requirements for different N1/N2 capabilities, the introduction of N1/N2 UE capabilities is not necessary.  Proposal 2: RAN4 not to specify a UE capability with N2 values for LBE networks.  Observation 7: If the UE is not required to monitor all the candidate positions within the DRS transmission window for a given SSB index, there are two reasons for a given SSB index not being available at the UE, which will affect the probability of detecting the SSB:  3. The SSB index was not sent within the entire duration of the DRS transmission window, i.e. all candidate positions were blocked by LBT failure.  4. The monitored candidate positions were blocked by LBT failure.  Observation 8: The fact that the UE might not monitor all the SSB candidate positions with the DRS transmission window can significantly impact the probability of SSB detection in LBE, resulting in an unnecessary extension of the measurement periods.  Observation 9: 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.  Observation 10: During cell detection, the UE needs to measure all Q SSBs, i.e., the UE needs to search all candidate positions.  Proposal 3: For cell detection, UE is required to monitor all candidate positions within the DRS transmission window.  Proposal 4: For RRM measurements, UEs shall be capable of monitoring the configured SSB index, no matter in which candidate position the SSB index is sent within the DRS transmission window. RAN4 can consider the options below to ensure proper UE behavior:  1) Define that UEs shall monitor all candidate positions corresponding to a given SSB index within the DRS transmission window in LBE, until the detection of the SSB index.  2) Define that it is up to UE implementation to define for each measurement period how many candidate positions are monitored during the DRS transmission window, as long as the UE is able to detect a SSB within the monitored candidate positions. In case the UE fails to detect any SSB within the monitored candidate positions in at least [20%] of the expected DRS transmission windows in a given measurement period, the UE shall monitor all candidate positions during the remaining DRS transmission windows in this measurement period.  Proposal 5: The RRM performance tests shall ensure proper UE behavior in different LBT scenarios: scenarios in which the LBT failure blocks the transmission of all candidate positions in a SSB burst, and scenarios in which the LBT failures block only some candidate positions. |
| R4-2011082 | Huawei, HiSilicon | Observation 1: The number of candidate SSB positions that UE is required to monitor within a SSB set shall not be defined as a UE capability, and shall not be differentiated for LBE and FBE.  Observation 2: Option 2 and option 2a could be the as option 4 that UE is required to monitor all candidate SSB positions without restriction.  Observation 3: Under the condition that the measurement capability of NR-U is same as that of R15, the number of cell that UE could measure will greatly decreased.  Proposal 1: For L3 measurement, UE shall monitor one additional candidate SSB positions which is QCL-ed with the detected one and the number of cells and SSB index the UE is required to measure shall be scaled accordingly.  Proposal 2: For RLM and L1-RSRP, UE shall monitor one additional candidate SSB position which is QCL-ed with the configured SSB index, and the number of SSB for RLM and the number of SSB resource for L1-RSRP shall be scaled accordingly.  Proposal 3: At least one SSB positions shall remain detectable during the whole detection stage |
| R4-2009908 | Apple | Proposal 1: Same as licensed MO merging requirement on same NR carrier frequency layer, the principle to merge MOs on same NR-U carrier frequency layer is that those MOs would not need different measurement efforts from UE.  Proposal 2: UE won’t merge NR-U MOs on the same frequency layer from PCell and PSCell if any of the following conditions is met,  - different RSSI measurement resources or  - different deriveSSB-IndexFromCell indications or  - different SMTC configurations or,  - different ssb-PositionQCL-Common-r16 indications or cell list of ssb-PositionQCL or,  - different rmtc-Config-r16 indication. |

## 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 1-1: Monitoring of QCL beams in NR-U

**Background:** In the last meeting, this discussion was postponed, since RAN4 was waiting for RAN1 reply. RAN4 got the following LS (R1-2004992):

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| RAN1 would like to thank RAN4 for their LS [1] related to NR-U SSB monitoring capabilities.  Related to the four questions asked by RAN4, RAN1 feedback is as follows.  **[Question 1]** Provide feedback whether monitoring within a given discovery burst transmission window all candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index is mandatory for UEs.  **[RAN1 answer]** During RAN1 discussion, we did not reach consensus on how to set N1 and N2 values. However, it is RAN1 understanding that RAN4 may choose not to define different RLM/RRM performance requirements corresponding to different N1/N2 capabilities. Hence, assuming a single RLM/RRM performance requirement, the introduction of N1/N2 UE capabilities is not necessary. It is RAN1 understanding that how many candidate SS/PBCH block indexes corresponding to the same SS/PBCH block index the UE should monitor in a given discovery burst transmission window can be left as UE implementation, as long as the single RLM/RRM performance requirement is met.  As a consequence, RAN1 has agreed that from RAN1 perspective, N1 and N2 should not be defined as UE capabilities.  **[Question 2]** Provide feedback on the values of N1 and N2, considering the impact on the network performance if UEs are not monitoring all candidate positions.  **[RAN1 answer]** See answer to question 1 (N1 and N2 should not be defined as UE capabilities).  **[Question 3]** Provide feedback on whether differentiation is needed for UEs operating in FBE and LBE modes.  **[RAN1 answer]** See answer to question 1 (N1 and N2 should not be defined as UE capabilities).  **[Question 4]** Provide feedback for the case when Q is not provided to the UE  **[RAN1 answer]** For both RRM and RLM/BFD/CBD measurements, Q is always provided to the UE. More details of the indication of Q can be found in R1-2003044 [2]. |

#### Issue 1-1-1: Monitoring of QCL beams during cell detection in NR-U

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| **Issue 1-1-1: Monitoring of QCL beams during measurements in NR-U**   * Proposals   + Option 1: At least one SSB positions shall remain detectable during the whole detection stage     - Huawei, HiSilicon R4-2011082, Proposal 3   + Option 2: For cell detection, UE is required to monitor all candidate positions within the DRS transmission window     - Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 3.   + Option 3: Define the core NR-U requirements transparent to the number of SSBs to monitor. Design test cases with two candidate SSB positions. Agree on the same approach to address the number of SSBs to monitor for all relevant NR-U requirements, including measurements/detection, RLM, BM, etc. - see also topic #1 in email thread [96e][206]     - Ericsson * Recommended WF   **More discussion is needed.** |

#### Issue 1-1-2: Monitoring of QCL beams during measurements in NR-U

Diverse proposals were presented in this topic. In general, they can be grouped in the following options:

**Option 1:** **Define the core NR-U requirements transparent to the number of SSBs to monitor, and design test cases with two candidate SSB positions.**

Ericsson, R4-2011353, proposals 4-6:

* + - Proposal 4 (Proposal 4 in [6]): Define the core NR-U requirements transparent to the number of SSBs to monitor.
    - Proposal 5 (Proposal 5 in [6]): Design test cases with two candidate SSB positions.
    - Proposal 6: Agree on the same approach to address the number of SSBs to monitor for all relevant NR-U requirements, including measurements, RLM, BM, etc

**Option 2:** **Do not define N2 for FBE.** **For LBE, leave the number of SSBs to be monitored for UE implementation, as long as it is ensured that SSBs are detected within the discovery transmission window. If the UE fails to detect SSBs in at least [20%] of the expected DRS transmission windows in this measurement period, the UE shall monitor all candidate positions in the remaining DRS transmission windows in this measurement period. Capture the behavior in the tests.**

Nokia, R4-2010592, proposals 1, 2, 4 and 5

* Proposal 1: RAN4 not to specify N2 values for FBE mode.
* RAN4 not to specify a UE capability with N2 values for LBE networks.
* Proposal 4: For RRM measurements, UEs shall be capable of monitoring the configured SSB index, no matter in which candidate position the SSB index is sent within the DRS transmission window. RAN4 can consider the options below to ensure proper UE behavior:
  + 1)     Define that UEs shall monitor all candidate positions corresponding to a given SSB index within the DRS transmission window in LBE, until the detection of the SSB index.
  + 2)     Define that it is up to UE implementation to define for each measurement period how many candidate positions are monitored during the DRS transmission window, as long as the UE is able to detect a SSB within the monitored candidate positions. In case the UE fails to detect any SSB within the monitored candidate positions in at least [20%] of the expected DRS transmission windows in a given measurement period, the UE shall monitor all candidate positions during the remaining DRS transmission windows in this measurement period.
* Proposal 5: The RRM performance tests shall ensure proper UE behavior in different LBT scenarios: scenarios in which the LBT failure blocks the transmission of all candidate positions in a SSB burst, and scenarios in which the LBT failures block only some candidate positions.

**Option 3:** **Specify N2=2 for LBE, for FBE N2 is irrelevant.**

1. Qualcomm, R4-2009871, proposals 1 and 2

* Proposal 1: For UE’s supporting semi-static channel access, monitoring multiple QCL’ed SSB’s within an SMTC occasion is irrelevant. Effectively, N2=1 per agreements in RAN1 UE feature list.
* Proposal 2: For dynamic channel access mode, UE is required to monitor the first N2 = 2 SSBs that are QCL’ed within an SMTC window regardless of the value of Q.

**Option 4: Specify N2 values, N2 = 2, and scale the number of cells and SSB index the UE is required to measure accordingly. For L1-RSRP the number of SSB resource shall be scaled accordingly.**

1. Huawei, HiSilicon R4-2011082, proposals 1, 2 and 3

* Proposal 1: For L3 measurement, UE shall monitor one additional candidate SSB positions which is QCL-ed with the detected one and the number of cells and SSB index the UE is required to measure shall be scaled accordingly.
* Proposal 2: For RLM and L1-RSRP, UE shall monitor one additional candidate SSB position which is QCL-ed with the configured SSB index, and the number of SSB for RLM and the number of SSB resource for L1-RSRP shall be scaled accordingly.
  1. Note from the moderator: The RLM part of this proposal should be discussed in another summary.

**Option 5: In a given discovery burst transmission window, UE is required to monitor at least one candidate SBI corresponding to the same SBI. Capture the number of candidate SBIs corresponding to the same SBI UE should monitor to in the terminology for unavailable SSB/SMTC occasions.**

1. MediaTek, R4-2010215, proposals 1 and 2

* In a given discovery burst transmission window, UE is required to monitor at least one candidate SBI corresponding to the same SBI.
* Capture the number of candidate SBIs corresponding to the same SBI UE should monitor to in the terminology for unavailable SSB/SMTC occasions.

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| **Issue 1-1-2: Monitoring of QCL beams during measurements in NR-U**   * Proposals   + Option 1: Define the core NR-U requirements transparent to the number of SSBs to monitor. Design test cases with two candidate SSB positions. Agree on the same approach to address the number of SSBs to monitor for all relevant NR-U requirements, including measurements, RLM, BM, etc. - see also topic #1 in email thread [96e][206]     - Ericsson   + Option 2: Do not define N2 for FBE. For LBE, leave the number of SSBs to be monitored for UE implementation, as long as it is ensured that SSBs are detected within the discovery transmission window. If the UE fails to detect SSBs in at least [20%] of the expected DRS transmission windows in this measurement period, the UE shall monitor all candidate positions in the remaining DRS transmission windows in this measurement period. Capture the behavior in the tests.     - Nokia, Nokia Shanghai Bell   + Option 3: Specify N2=2 for LBE, for FBE N2 is irrelevant.     - Qualcomm   + Option 4: Specify N2 values, N2 = 2, and scale the number of cells and SSB index the UE is required to measure accordingly. For L1-RSRP the number of SSB resource shall be scaled accordingly.     - Huawei, HiSilicon   + Option 5: In a given discovery burst transmission window, UE is required to monitor at least one candidate SBI corresponding to the same SBI. Capture the number of candidate SBIs corresponding to the same SBI UE should monitor to in the terminology for unavailable SSB/SMTC occasions.     - MediaTek * Recommended WF   **More discussion is needed.**  In your comments, please address:   1. Should RAN4 define N2 values, or define CORE requirements transparent to N2? 2. Should N2 be defined only for LBE? 3. Should RAN4 consider the number of candidate positions to be monitored in the test cases? 4. If RAN4 defines N2, what value of N2 should be used?    1. N2 = 2    2. N2 = at least 1    3. Other? |

### Sub-topic 1-2: UE behavior in RRC\_CONNECTED mode when serving cell is unavailable for consecutive SSB bursts

In the last RAN4 meeting, the following was discussed:

* *UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts*
* *Candidate options:*
  + *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.*
  + *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.*

In this sub-topic, the following issues are discussed:

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

Issue 1-2-2: Consecutive number of SSB bursts not available before UE is required to measure neighbour cells

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

In this meeting, the following option is discussed:

**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, R4-2009871, Proposal 1: agree on 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.
* Huawei, HiSilicon, R4-2011083, Proposal 2: 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.

**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.**

* ZTE, R4-2010082, Proposal 1: For UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts, keep current UE behavior as Option 2 and further study the feasibility of Option 1 as a possible enhancement to NR-U in Rel-17 phase.
* Ericsson, R4-2011353, Proposal 1: 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.
* Qualcomm, R4-2009871, Proposal 4: 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.

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| **Issue 1-2-1: UE behavior in RRC\_CONNECTED mode when 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.     - Huawei, HiSilicon, Apple   + 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.     - ZTE, Ericsson, Qualcomm.   + Option 2b: No other UE behavior or requirement on the consecutive SSBs in the serving cell is needed for R16, further study Option 1 in R17 as possible enhancement to NR-U.     - ZTE * Recommended WF   + **More discussion is needed.** |

#### Issue 1-2-2: Consecutive number of SSB bursts not available before UE is required to measure neighbour cells

This issue depends on the conclusion of issue 1-2-2.

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| **Issue 1-2-2: Consecutive number of SSB bursts not available before UE is required to measure neighbour cells**   * Proposals   + Option 1 (Apple, R4-2009910, Proposal 2): in RRC\_CONNECTED mode,   - when the s-MeasureConfig is configured and PCell measurement does not need MG, UE shall initiate measurements on neighbour cells indicated by the serving cell if it is unable to measure on the PCell 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 PCell measurement needs MG, UE shall initiate measurements on neighbour cells indicated by the PCell 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.   * Recommended WF   + **More discussion is needed.**     - This issue depends on the conclusion of issue 1-2-1. |

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

In the last RAN4 meeting, the following was discussed:

* *Issue 2-1-1: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements*
  1. *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.* 
     + *The UE cannot measure this SSB again without first detecting it.*
     + *FFS: whether UE shall restart directly from detection stage again for this SSB or the UE performs the detection procedure like for any other SSB.*

In this sub-topic, the following issues are discussed:

Issue 1-3-1: UE behavior in RRC\_CONNECTED mode when serving cell is unavailable for consecutive SSB bursts

Issue 1-3-2: Value of N

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

In this meeting, the following option is discussed:

**Option 1: After N unsuccessful measurement attempts of an already identified cell due to exceeding max number of unavailable SMTC occasions, the UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.**

* Qualcomm, R4-2009871, Proposal 3: After N unsuccessful measurement attempts of an already identified cell due to exceeding max number of unavailable SMTC occasions, the UE shall perform the detection procedure again like for any other SSB.
* Huawei, HiSilicon, R4-2011083, Proposal 1: Upon successively exceeding the maximum number of DL LBT failure during measurement, UE shall: restart from detection stage like for any other SSB.
* Ericsson, R4-2011353, 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

o The UE cannot measure this SSB again without first detecting it

o The UE performs the detection procedure like for any other SSB

o N is not explicitly specified and 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.

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| **Issue 1-3-1: UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements**   * Proposals   + Option 1: After N unsuccessful measurement attempts of an already identified cell due to exceeding max number of unavailable SMTC occasions, the UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.     - Huawei, HiSilicon, Qualcomm, Ericsson * Recommended WF   + **After N unsuccessful measurement attempts of an already identified cell due to exceeding max number of unavailable SMTC occasions, the UE shall stop the measurement attempts on this SSB and perform the detection procedure again like for any other SSB.** |

#### Issue 1-3-2: Value of N

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| **Issue 1-3-2: Value of N**   * Proposals   + Option 1 (Ericsson, R4-2011353, Proposal 2): N is not explicitly specified and 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 known) expires. * Recommended WF   + **Option 1 was agreed on last meeting (slide 11, R4-2009249). Do not discuss this issue in this meeting.** |

### Sub-topic 1-4: Scheduling restrictions during SS-RSRP, SS-RSRQ and SS-SINR measurements

In the last RAN4 meeting, the following was discussed:

* *Issue 2-4-1: To define scheduling restrictions during SS-RSRP, SS-SINR and SS-RSRQ measurement*
  1. *RAN4 to define scheduling restrictions during SS-RSRP, SS-SINR and SS-RSRQ measurements in NR-U*
* *Issue 2-4-2: Applicability of the signaling of SMTC2 to NR-U*
  1. *Candidate Options*
     + *Option 1: The signaling of smtc2 is not applicable in unlicensed band.*
     + *Option 2: Signaling of smtc2 is applicable to unlicensed band.*
     + *Option 3: Send a LS to RAN1/RAN2 about this issue.*
* *Issue 2-4-3: Different scheduling restriction when deriveSSB\_IndexFromCell is enabled, or not enabled, during SS-RSRQ measurements and Issue 2-4-4:Different scheduling restriction when deriveSSB\_IndexFromCell is enabled during SS-RSRP and SS-SINR measurements*
  1. *In NR-U, scheduling restriction should depend on the signaling of deriveSSB\_IndexFromCell.*
* *Issue 2-4-5: Scheduling restriction of UE performing measurements with a different subcarrier spacing than PDSCH/PDCCH****.***
  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.*
  2. *FFS: scheduling restriction to intra-band and inter-band CA.*

In this meeting, the following issues are discussed:

Issue 1-4-1: Applicability of SMTC2 signaling to NR-U

Issue 1-4-2: Scheduling restriction during SS-RSRP, SS-RSRQ and SS-SINR when deriveSSB\_IndexFromCell is not enabled.

Issue 1-4-3: Scheduling restrictions during SS-RSRP and SS-SINR measurements

Issue 1-4-4: Scheduling restrictions during SS-RSRQ

Issue 1-4-5: Scheduling restrictions in inter-band CA

#### Issue 1-4-1: Applicability of SMTC2 signaling to NR-U

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| **Issue 1-4-1: Applicability of SMTC2 signaling to NR-U**   * Proposals   + Option 1: Signaling of smtc2 is applicable to unlicensed band.     - ZTE (proposal 2 in R4-2010082), Ericsson (proposal 3 in R4-2011353). * Recommended WF   + **Signaling of smtc2 is applicable to unlicensed band.** |

#### Issue 1-4-2: Scheduling restriction during SS-RSRP, SS-RSRQ and SS-SINR when deriveSSB\_IndexFromCell is not enabled.

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| **Issue 1-4-2: Scheduling restriction during SS-RSRP, SS-RSRQ and SS-SINR when deriveSSB\_IndexFromCell is not enabled.**   * Proposals   + Option 1: If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration     - MediaTek (proposal 4 in R4-2010215) * Recommended WF   + **If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within DRS window duration** |

#### Issue 1-4-3: Scheduling restrictions during SS-RSRP and SS-SINR measurements

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| **Issue 1-4-3: Definition of scheduling restrictions during SS-RSRP and SS-SINR measurements**   * Proposals   + 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 configured to be measured, and on 1 data symbol before each consecutive SSB symbols configured to be measured and 1 data symbol after each consecutive SSB symbols configured to be measured within SMTC window duration if deriveSSB\_IndexFromCell is enabled. If the high layer in TS 38.331 signalling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise SMTC periodicity follows smtc1.  - The UE is not expected to transmit PUCCH/PUSCH/SRS within the SMTC window to be measured, and on 1 data symbol before the start of the SMTC window be measured and 1 data symbol after the end of SMTC window to be measured if deriveSSB\_IndexFromCell is not enabled. If the high layer in TS 38.331 signalling of smtc2 is configured, the SMTC periodicity follows smtc2; Otherwise 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.   * + - Qualcomm (proposal 5 in R4-2009871) * Recommended WF   + **Agree on Option 1.** |

#### Issue 1-4-4: Scheduling restrictions during SS-RSRQ

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| **Issue 1-4-4: Definition of scheduling restrictions during SS-RSRQ measurements**   * Proposals   + 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 configured to be measured, RSSI measurement symbols, and on 1 data symbol before each consecutive SSB configured to be measured/RSSI symbols and 1 data symbol after each consecutive SSB configured to be measured/RSSI symbols within SMTC window duration if deriveSSB\_IndexFromCell is enabled.. If the high layer signalling of smtc2 is configured(in TS 38.331), the SMTC periodicity follows smtc2; Otherwise the SMTC periodicity follows smtc1.  - The UE is not expected to transmit PUCCH/PUSCH/SRS with the SMTC window to be measured, RSSI measurement symbols, and on 1 data symbol before the start of the SMTC window to be measured measured/RSSI symbols and 1 data symbol after the end of the SMTC window to be measured/RSSI symbols if deriveSSB\_IndexFromCell is not enabled.. If the high layer signalling of smtc2 is configured(in TS 38.331), 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.   * Qualcomm (proposal 6 in R4-2009871) * Recommended WF   + **Agree on Option 1.** |

#### Issue 1-4-5: Scheduling restrictions in inter-band CA

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| **Issue 1-4-5: Definition of scheduling restrictions during SS-RSRQ measurements**   * Proposals   + Option 1: In FR1 inter-band CA, the scheduling restriction due to one CC shall not apply to other CCs on the other bands.     - MediaTek (proposal 3 in R4-2010215) * Recommended WF   + **Agree on Option 1.** |

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

In the last RAN4 meeting, the following was discussed:

* ***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***
  1. *Candidate Options:* 
     + *Option 1: 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*
     + *Option 2: UE should stop the semi-persistent CSI reporting when UE cannot transmit HARQ-ACK for MAC CE deactivation command.*

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

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| **Issue 1-5-1: 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   + Option 1 (Qualcomm, Observation 4 in R4-2009871): At least from MAC (RAN2) layer perspective, UE follows the actions related to MAC-CE activation/deactivation command immediately after decoding the MAC-CE command regardless of whether UE is able to send HARQ-ACK feedback or not.   + Option 2 (ZTE, Proposal 3 in R4-2010082): 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. * Recommended WF   + **Wait for the RAN1 response to the LS sent last meeting (R4-2008576).** |

### Sub-topic 1-6: Measurement capability

In last RAN4 meeting, the draft CR of R4-2006183 has been technically endorsed, but there are still some remaining issues in the UE measurement capability requirement:

Editor note: the MO merging requirement is FFS

#### Issue 1-6-1: MO merging for NR-U

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| **Issue 1-5-1: MO merging for NR-U**   * Proposals   + Option 1 (Apple, Proposals 1 and 2 in R4-2009908):   + Proposal 1: Same as licensed MO merging requirement on same NR carrier frequency layer, the principle to merge MOs on same NR-U carrier frequency layer is that those MOs would not need different measurement efforts from UE.   + Proposal 2: UE won’t merge NR-U MOs on the same frequency layer from PCell and PSCell if any of the following conditions is met,   - different RSSI measurement resources or  - different deriveSSB-IndexFromCell indications or  - different SMTC configurations or,  - different ssb-PositionQCL-Common-r16 indications or cell list of ssb-PositionQCL or,  - different rmtc-Config-r16 indication.   * Recommended WF   + **Agree with:**     - **Same as licensed MO merging requirement on same NR carrier frequency layer, the principle to merge MOs on same NR-U carrier frequency layer is that those MOs would not need different measurement efforts from UE.**     - **UE won’t merge NR-U MOs on the same frequency layer from PCell and PSCell if any of the following conditions is met,**     - **- different RSSI measurement resources or**     - **- different deriveSSB-IndexFromCell indications or**     - **- different SMTC configurations or,**     - **- different ssb-PositionQCL-Common-r16 indications or cell list of ssb-PositionQCL or,**     - **- different rmtc-Config-r16 indication.** |

## Companies views’ collection for 1st round

### Open issues

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

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2009911 | Draft CR on serving cell evaluation in RRC connected mode for NR-U, Apple |
| Company A |
| Company B |
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| R4-2010594 | CR to TS 38.133 to address NR-U inter-frequency measurements, Nokia, Nokia Shanghai Bell |
| Company A |
| Company B |
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| R4-2010595 | CR to TS 36.133 to address NR-U inter-RAT measurements, Nokia, Nokia Shanghai Bell |
| Company A |
| Company B |
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| R4-2011074 | CR on introduction of intra-frequency measurement requirements in NR-U, Huawei, Hisilicon |
| Company A |
| Company B |
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| R4-2010667 | CR 36.133 (8.17.2.2.a) Clarification of UE behavior, Ericsson |
| Company A |
| Company B |
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| R4-2009909 | On UE measurement capability of NR-U for R16 - Apple |
| 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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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations 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 provides recommendation on CRs/TPs Status update*

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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)

## 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 #2: RSSI and CO measurements

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2009871 | Qualcomm | Proposal 7. No additional condition is needed for the definition of intra-frequency RSSI/CO measurement.  Proposal 8. Measurement gaps are needed for RSSI/CO measurements when RSSI BW is not fully within the active DL BWP of the UE.  Observation 5. 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 9. 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 10. 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 11. 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 configured by RMTC, and on 1 data symbol before the first RSSI measurement symbol configured by RMTC, and 1 data symbol after the last RSSI measurement symbol configured by RMTC  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. |
| R4-2011086 | Huawei, HiSilicon | Observation 1: UE shall use the same SCS as active DL BWP when the RSSI measurement is confined with in the active DL BWP.  Observation 2: For the case when the RSSI measurement is not confined within the active DL BWP, UE shall use the SCS equal or larger than the configured reference SCS for RSSI measurement.  Proposal 1: SCS condition is not needed for the definition of intra-frequency measurement.  Proposal 2: Gap is only needed when the RSSI measurement BW is not fully within the active DL BWP.  Proposal 3: The RSSI measurement is LBT bandwidth.  Proposal 4: Define scheduling restriction during RSSI/CO measurements and do not differentiate the cases in which deriveSSB\_IndexFromCell is enabled or not for the definition of scheduling restriction. |
| R4-2010215 | MediaTek Inc. | Proposal 5: An intra-frequency RSSI measurement shall meet the condition that the RMTC configured SCS is the same as the SCS of active BWP (Option 2a).  Proposal 6: For a RSSI measurement outside measurement gap, measurement period is scaled up by CSSFoutside\_gap  Proposal 7: No requirement for the RMTC which is overlapping with SMTC.  Proposal 8: If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within RMTC window duration.  Proposal 9: Scheduling restriction shall apply on the RMTC window duration if the SCS configured in RMTC is different from the SCS of data. |
| R4-2011353 | Ericsson | • Proposal 7: Measurement gaps are not needed when the RSSI channel BW is fully inside the active BWP.  • Proposal 8: SCS is taken into account in the intra-/inter-frequency definition for RSSI and CO measurements, e.g.,  o RSSI/CO is inter-frequency if SCS configured for RSSI is different from the SCS of the active BWP  • Proposal 9: RSSI measurement bandwidth is the LBT bandwidth (which is already decided by RAN1 and specified in TS 38.215).  • Proposal 10: No need to define scheduling restrictions for RSSI measurements in NR-U.  • Proposal 11: The RSSI and CO measurement periods depend on:  o max(reportInterval, rmtc-Period, CSSFoutside\_gap,i) in non-DRX when measurement gaps are not required,  o max(reportInterval, rmtc-Period, DRX, , CSSFoutside\_gap,i) in DRX when measurement gaps are not required, or  o max(reportInterval, rmtc-Period, MGRP, CSSFwithin\_gap,i) in DRX when measurement gaps are required.  • Proposal 12: CSSF outside measurement gaps needs also to be adapted to account for RSSI/CO measurements. |
| R4-2010592 | Nokia, Nokia Shanghai Bell | Observation 11: RAN1 has agreed that  ·       The RSSI measurement duration is based on the: measDuration-r16, which is given by the number of symbols regarding the reference SCS in the RSSI measurement configuration  The agreement contains a note that for RSSI measurement confined within the active DL BWP, UE performs RSSI measurement using the numerology of the DL bandwidth part, and that for RSSI measurements within the active DL BWP, the UE does not expect a non-integer number of symbols.  Proposal 6: No additional condition is needed in the definition of an intra-frequency RSSI measurement.  Proposal 7: An inter-frequency RSSI measurement is defined when the RSSI measurement BW is not fully within the channel/carrier BW of the UE.  Proposal 8: For RSSI, measurement gaps are used for inter-frequency measurements and for intra-frequency measurements when the measurement BW is not fully within the active DL BWP.  Observation 12: The RSSI measurement is an absolute power measurement, that is independent on any network signals, so the scheduling restriction should not depend on deriveSSB\_IndexFromCell being enabled or not.  Proposal 9: The scheduling restriction for RSSI measurements does not depend on deriveSSB\_IndexFromCell being enabled or not.  Proposal 10: Define the scheduling restriction for RSSI measurements as: 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  Proposal 11: For RSSI measurements, do not use the scaling factor of 1.5 when DRX ≤ 320ms. |

## 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: Intra-frequency measurement definition and the use of measurement gaps

Issues discussed in this sub-topic

* + Issue 2-1-1 Intra-frequency RSSI measurement definition
  + Issue 2-1-2 Need for measurement gaps in RSSI measurements

#### Issue 2-1-1 Intra-frequency RSSI measurement definition

In the last meeting, the following was agreed:

* *Intra-frequency measurement definition*
  + *An intra-frequency RSSI measurement is defined when:*
    - *RSSI channel BW is contained within the channel/carrier BW of the UE.*
  + *Further study whether to include SCS conditions into the definition and how to handle RSSI measurements under assumption of different SCS in RSSI, active BWP, etc.*
  + *Options discussed in RAN4 95:*
    - *Option 2a: RMTC configured SCS is the same as the SCS of active BWP*
    - *Option 2b: the SCS of the RSSI measurement is the same as the SCS of an intra-frequency SSB or CSI-RS*
    - *Option 2c: No additional condition is needed.*
    - *Option 2d: the SCS configured for the RSSI measurement is the same as the SCS of a serving cell, where the SCS of a serving cell is FFS.*

In this meeting, the following options are discussed:

**Option 1: No additional condition is needed for the intra-frequency measurement definition**

* Qualcomm, R4-2009871: Proposal 7. No additional condition is needed for the definition of intra-frequency RSSI/CO measurement.
* Huawei, HiSilicon: R4-2011086: Proposal 1: SCS condition is not needed for the definition of intra-frequency measurement.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 6: No additional condition is needed in the definition of an intra-frequency RSSI measurement.

**Option 2: RMTC configured SCS is the same as the SCS of active BWP**

* Mediatek, R4-2010215: Proposal 5: An intra-frequency RSSI measurement shall meet the condition that the RMTC configured SCS is the same as the SCS of active BWP (Option 2a).
* Ericsson, R4-2011353: Proposal 8: SCS is taken into account in the intra-/inter-frequency definition for RSSI and CO measurements, e.g., RSSI/CO is inter-frequency if SCS configured for RSSI is different from the SCS of the active BWP

**Further information:**

RAN1 has sent a LS to RAN2, with the following agreement (R4-2009506):

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| The set of values for the parameter *measDuration-r16* is {sym1, sym14or12, sym28or24, sym42or36, sym70or60} which is in units of the reference numerology configured by *ref-SCS-CP-r16*   * “sym14or12” refers to 14 symbols of the reference numerology for NCP and 12 symbols for ECP, respectively, and so on * Notes (Can be captured in specifications as needed):   + The UE derives the RSSI measurement duration from a combination of *measDuration-r16* and *ref-SCS-CP-r16*   + At least for RSSI measurement confined within the active DL BWP, UE performs RSSI measurement using the numerology of the active DL bandwidth part during the derived measurement duration. Otherwise, the numerology used by the UE for measurements is up to UE implementation.   + For RSSI measurements within the active DL BWP, the UE does not expect a non-integer number of symbol(s) with respect to the numerology of the active DL BWP. * Inform RAN2 of this decision and cc RAN4 |

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| **Issue 2-1-1: Intra-frequency RSSI measurement definition**   * Proposals   + Option 1: No additional condition is needed for the intra-frequency measurement definition     - Qualcomm, Nokia, Nokia Shanghai Bell, Huawei, HiSilicon   + Option 2: RMTC configured SCS is the same as the SCS of active DL BWP     - Ericsson, MediaTek * Recommended WF * **No additional condition is needed for the intra-frequency measurement definition**   + Considering the LS from RAN1, it is the moderator understanding that if the measurement bandwidth is within the active DL BWP, the measurement will always be performed using the numerology of the active DL BWP. Outside the active BWP, the numerology is up to UE implementation. Therefore, the condition would not be needed in the intra-frequency measurement definition. |

#### Issue 2-1-2 Need for measurement gaps in RSSI measurements

In the last meeting, the following was agreed:

* *Need of measurement Gaps during RSSI measurements*
  + *Measurement gaps are needed at least when:*
    - *RSSI BW is not fully within the active BWP of the UE.*
      * *FFS: if another condition is needed.*

In this meeting, the following option is discussed:

**Option 1:** **Measurement gaps are needed for RSSI/CO measurements when RSSI BW is not fully within the active DL BWP of the UE.**

* Qualcomm, R4-2009871: Proposal 8. Measurement gaps are needed for RSSI/CO measurements when RSSI BW is not fully within the active DL BWP of the UE.
* Huawei, HiSilicon: R4-2011086: Proposal 2: Gap is only needed when the RSSI measurement BW is not fully within the active DL BWP.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 8: For RSSI, measurement gaps are used for inter-frequency measurements and for intra-frequency measurements when the measurement BW is not fully within the active DL BWP.
* Ericsson, R4-2011353, Proposal 7: Measurement gaps are not needed when the RSSI channel BW is fully inside the active BWP.

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| **Issue 2-1-2: Need for measurement gaps in RSSI measurements**   * Proposals   + Option 1: Measurement gaps are needed for RSSI/CO measurements when RSSI BW is not fully within the active DL BWP of the UE.     - Qualcomm, Nokia, Nokia Shanghai Bell, Huawei, HiSilicon, Ericsson * Recommended WF   + **Measurement gaps are needed for RSSI/CO measurements when RSSI BW is not fully within the active DL BWP of the UE.** |

### Sub-topic 2-2: RSSI measurement bandwidth

#### Issue 2-2-1 RSSI measurement BW

In the last meeting, the following was agreed:

* *RSSI measurement bandwidth*
  + *Candidate options:*
    - *Option 1: RSSI measurement bandwidth is the LBT bandwidth (which is already decided by RAN1 and specified in TS 38.215).*
    - *Option 2: RAN4 discuss this in the performance requirements.*

In this meeting, the following option is discussed:

**Option 1: The RSSI measurement is LBT bandwidth.**

* Huawei, HiSilicon, R4-2011086, Proposal 3: The RSSI measurement is LBT bandwidth.
* Ericsson, R4-2011353, Proposal 9: RSSI measurement bandwidth is the LBT bandwidth (which is already decided by RAN1 and specified in TS 38.215).

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| **Issue 2-2-1: RSSI measurement BW**   * Proposals   + Option 1: RSSI measurement bandwidth is the LBT bandwidth     - Huawei, HiSilicon, Ericsson * Recommended WF   + **The RSSI measurement bandwidth is the LBT bandwidth.** |

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

In the last meeting, the following was agreed:

* + *RSSI measurement period* 
    - *The RSSI and CO measurement period depends at least 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.*
    - *For RSSI measurement within measurement gap, measurement period is scaled with CSSFwithin\_gap,i*
    - *For RSSI measurement outside measurement gap, measurement period is scaled with CSSFoutside\_gap,i*
    - *FFS: 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, CCA*
    - *FFS: Whether the scaling factor of 1.5 shall be used if DRX* *≤ 320ms*

In this sub-topic, the following issues are discussed:

* + Issue 2-3-1 RSSI measurement period when measurement gaps are not required
  + Issue 2-3-2 RSSI measurement period when measurement gaps are required
  + Issue 2-3-3 Scaling factor for DRX ≤ 320ms
  + Issue 2-3-4 CSSF definition

#### Issue 2-3-1 RSSI measurement period when measurement gaps are not required

In this meeting, the following options are discussed:

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| **Issue 2-3-1: RSSI measurement period when measurement gaps are not required**   * Proposals   + Option 1 (Qualcomm, R4-2009871, Proposal 9): When measurement gap is not required, RSSI/CO measurement period is scaled with Nintra-MO, and 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.   + Option 2 (Ericsson , R4-2011353, Proposal 11): The RSSI and CO measurement periods depend on:     - max(reportInterval, rmtc-Period, CSSFoutside\_gap,i) in non-DRX when measurement gaps are not required,     - max(reportInterval, rmtc-Period, DRX, , CSSFoutside\_gap,i) in DRX when measurement gaps are not required,   + Option 3 (MediaTek, R4-2010215, Proposal 6 and 7) For a RSSI measurement outside measurement gap, measurement period is scaled up by CSSFoutside\_gap, if RMTC is allowed to be overlapped with SMTC. CSSFoutside\_gap is not required if RMTC is not allowed to be overlapped with SMTC.     - No requirement for the RMTC which is overlapping with SMTC. * Recommended WF   + **More discussion is needed.**   + In the discussion, address the following:     - Should RAN4 specify requirements for the case in which RMTC and SMTC are overlapping?     - Should the measurement period be scaled by CSSFoutside\_gap or Nintra-MO ? |

#### Issue 2-3-2 RSSI measurement period when measurement gaps are required

In this meeting, the following options are discussed:

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| **Issue 2-3-2: RSSI measurement period when measurement gaps are required**   * Proposals   + Option 1 (Qualcomm, R4-2009871, Proposal 10): 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."   * + Option 2 (Ericsson , R4-2011353, Proposal 11): The RSSI and CO measurement periods depend on.     - max(reportInterval, rmtc-Period, MGRP, CSSFwithin\_gap,i) in DRX when measurement gaps are required * Recommended WF   + **More discussion is needed.** |

#### Issue 2-3-3 Scaling factor for DRX ≤ 320ms

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| **Issue 2-3-3: RSSI measurement period when measurement gaps are required**   * Proposals   + Option 1 (Nokia, R4-2010592, Proposal 11): For RSSI measurements, do not use the scaling factor of 1.5 when DRX ≤ 320ms. * Recommended WF   + **For RSSI Measurements, do not use the scaling factor of 1.5 when DRX ≤ 320ms.** |

#### Issue 2-3-4 CSSF outside measurement gaps

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| **Issue 2-3-4: CSSF definition outside measurement gaps**   * Proposals   + Option 1 (Ericsson, R4-2010592, Proposal 12): CSSF outside measurement gaps needs also to be adapted to account for RSSI/CO measurements. * Recommended WF   + **Discussion is needed, this issue depends on issue 2-3-1.** |

### Sub-topic 2-4: Scheduling restriction during RSSI measurements

In the last meeting, the following was agreed:

* ***Issue 2-4-6: Scheduling restriction during RSSI/CO measurements***
* *Candidate Options:* 
  + *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.*
  + *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*
  + *Option 3: No need to define scheduling restrictions for RSSI measurements in NR-U.*

The issues discussed in this sub-topic are:

Issue 2-4-1 RAN4 to define scheduling restrictions during RSSI/CO measurements

Issue 2-4-2 Differentiate the scheduling restriction during RSSI measurements when deriveSSB\_indexFromCell is enabled or not

Issue 2-4-3 Exact definition of scheduling restriction during RSSI/CO measurements

Issue 2-4-4 Define scheduling restriction during RSSI measurements when the configured SCS in RMTC is different from the data SCS

#### Issue 2-4-1 RAN4 to define scheduling restrictions during RSSI/CO measurements

**Option 1: Yes**

* Huawei, HiSilicon, R4-2011086, Proposal 4: Define scheduling restrictions during RSSI/CO measurements and do not differentiate the cases in which deriveSSB\_indexFromCell is enabled or not for the definition of the scheduling restriction.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 9: The scheduling restriction for RSSI measurements does not depend on deriveSSB\_IndexFromCell being enabled or not.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 10: Define the scheduling restriction for RSSI measurements as: 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
* Qualcomm, R4-2009871, Proposal 11: 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 configured by RMTC, and on 1 data symbol before the first RSSI measurement symbol configured by RMTC, and 1 data symbol after the last RSSI measurement symbol configured by RMTC
  + 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.
* MediaTek, R4-2010215, Proposal 8: If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within RMTC window duration.
* MediaTek, R4-2010215, Proposal 9: Scheduling restriction shall apply on the RMTC window duration if the SCS configured in RMTC is different from the SCS of data.

**Option 2: No**

* Ericsson, R4-2011353, Proposal 10: No need to define scheduling restrictions for RSSI measurements in NR-U.

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| **Issue 2-4-1: RAN4 to define scheduling restrictions during RSSI/CO measurements**   * Proposals   + Option 1: Yes     - Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Qualcomm, MediaTek   + Option 2: No     - Ericsson * Recommended WF   + **RAN 4 to define scheduling restrictions during RSSI/CO measurements**     - The majority of companies support defining scheduling restrictions during RSSI/CO measurements. |

#### Issue 2-4-2 Differentiate the scheduling restriction during RSSI measurements when deriveSSB\_indexFromCell is enabled or not

**Option 1: No**

* Huawei, HiSilicon, R4-2011086, Proposal 4: Define scheduling restrictions during RSSI/CO measurements and do not differentiate the cases in which deriveSSB\_indexFromCell is enabled or not for the definition of the scheduling restriction.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 9: The scheduling restriction for RSSI measurements does not depend on deriveSSB\_IndexFromCell being enabled or not.
* Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 10: Define the scheduling restriction for RSSI measurements as: 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
* Qualcomm, R4-2009871, Proposal 11: 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 configured by RMTC, and on 1 data symbol before the first RSSI measurement symbol configured by RMTC, and 1 data symbol after the last RSSI measurement symbol configured by RMTC
  + 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 2: Yes**

* MediaTek, R4-2010215, Proposal 8: If deriveSSB\_IndexFromCell is not enabled the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols within RMTC window duration.

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| **Issue 2-4-2: Differentiate the scheduling restriction during RSSI measurements when deriveSSB\_indexFromCell is enabled or not**   * Proposals   + Option 1: No     - Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Qualcomm   + Option 2: Yes     - MediaTek * Recommended WF   + **For scheduling restrictions during RSSI/CO measurements, do not differentiate the cases in which deriveSSB\_indexFromCell is enabled or not**     - The majority of companies support not differentiating cases in which deriveSSB\_indexFromCell is enabled or not |

#### Issue 2-4-3 Exact definition of scheduling restriction during RSSI/CO measurements

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| **Issue 2-4-3: Exact definition of scheduling restriction during RSSI/CO measurements**   * Proposals   + Option 1 (Nokia, Nokia Shanghai Bell, R4-2010592, Proposal 10): Define the scheduling restriction for RSSI measurements as: 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   + Option 2 (Qualcomm, R4-2009871, Proposal 11) 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 configured by RMTC, and on 1 data symbol before the first RSSI measurement symbol configured by RMTC, and 1 data symbol after the last RSSI measurement symbol configured by RMTC   + 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   + Both proposals are similar, varying only on the text. Companies could indicate the preferred option, or if they have concerns with these proposals. |

#### Issue 2-4-4 Define scheduling restriction during RSSI measurements when the configured SCS in RMTC is different from the data SCS

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| **Issue 2-4-4: Define scheduling restriction during RSSI measurements when the configured SCS in RMTC is different from the data SCS**   * Proposals   + Option 1 (MediaTek, R4-2010215, Proposal 9): Scheduling restriction shall apply on the RMTC window duration if the SCS configured in RMTC is different from the SCS of data. * Recommended WF   + Discuss the proposal. |

## Companies views’ collection for 1st round

### Open issues

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

### CRs/TPs comments collection

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

|  |  |
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| **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.*

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| 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*

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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”* |