**3GPP TSG-RAN WG4 Meeting # 97-e R4-201XXXX**

**Electronic Meeting, 2 – 13 Nov, 2020**

**Agenda item:**  7.1.8.1, 7.1.8.2, 7.1.8.3

**Source:** Qualcomm

**Title:** Email discussion summary for [97e][315] NR\_unlic\_Demod\_UE

**Document for:** Information

# Introduction

Email discussion for contributions submitted under agenda item 7.1.8.1, 7.1.8.2, 7.1.8.3 for defining NR-unlicensed performance tests.

# General UE Demodulation

*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** |
| R4-2014240 | Apple Inc.  | Test ScopeProposal #1: Do not define additional tests for FBE and LBE devices separately.Proposal #2: Define requirements with randomly chosen COT duration and fixed DRS window duration.Proposal #3: Define requirements for both Scenario A and Scenario C and define applicability rules.Proposal #4: Do not define requirements for PDCCH with DCI format 2-0.Proposal #5: Introduce CQI reporting requirements in static channel conditions for NR-U.Simulation Assumptions Proposal #6: Do not model LBT failure separately in addition to the burst transmission model.Proposal #7: Burst transmission model shall also be applied to SSB slots.Proposal #8: COT duration shall be randomly chosen from a set during the simulation.Proposal #9: Define requirements with PDSCH mapping Type A alone.Proposal #10: Configure PDCCH monitoring on Format 2-0 with *CO-DurationPerCell-r16* and indicate the randomly chosen COT duration |
| R4-2014940 | Nokia | * No UE related Observations/Proposals
 |
| R4-2015130 | MediaTek Inc. | Proposal 1: Define same test cases for both FBE and LBE devices.Proposal 2: Support option 1. To define test cases for carrier aggregation between licensed band NR (PCell) and NR-U (SCell).Proposal 3: Support option 2. Do not define test case for PDCCH format 2\_0.Proposal 4: Support option 3 to define test case for both PDSCH mapping Type A and Type B.Proposal 5: We propose using a subset of fixed values for PDSCH Type B duration and starting position, for example, [starting position, duration] = [2, 4], [2, 12], can be selected.Proposal 6: Support to model LBT failure for data and SSB.  |
| R4-2015851 | Ericsson | Proposal 8: Define PDSCH demodulation requirements with Type A mapping.Observation 1: with 30kHz SCS we are limited to a maximum of 2 slots given the 1ms COT. Proposal 9: Consider 2ms COT in order to adapt the LTE burst transmission model with suitable number of possible slot length configurationsObservation 2: No need to adapt the first step, only agree on the number of slots in the burst set (S1).Proposal 10: Agree to reuse the LTE values for S2 configurationProposal 11: Define PDCCH, and CQI requirements with adaptations to the burst transmission model. |
| R4-2015986 | Intel | Proposal 1: Do not introduce COT duration in the RAN4 demodulation testsProposal 2: RAN4 to define demodulation requirements for Scenario C and make them applicable for other NR-U scenariosProposal 3: Do not define NR-U PDCCH demodulation requirementsObservation 1: To define requirements for the specific mode of wideband operation LBT failure model is requiredProposal 4: RAN4 to define demodulation requirements for the wideband operation which are agnostic to the mode of wideband operation **Proposal 5: RAN4 to define PUSCH requirements for bandwidth equal to 80MHz.****Proposal 6: RAN4 to define PDSCH requirements for bandwidth equal to 80MHz.** |
| R4-2016063 | Qualcomm Inc. | Observation 1: NR Unlicensed tests only need to cover Duplex mode TDD.Observation 2: Most of the TDD PDSCH Demod tests in NR licensed used SCS 30kHz only.Observation 3: The LBT model proposed in this paper is analogous to the LBT model used in LAA Performance tests.Observation 4: The LBT model proposed in this paper is set according to Test Parameter pLBT. When pLBT = 0, then LBT is considered always successful;Proposal 1: Specify the DL Transmission Model for NR Unlicensed for SCS30kHz only. Proposal 2: Define the DL Transmission Model for NR Unlicensed as specified in this paper in Section 2.2, Steps 1)-7). The model is summarized here for clarity:• Compute COT and Unoccupied duration as specified by Test Parameters, then repeat it periodically for the entire test;• Fully allocate PDCCH and PDSCH in COT, except for Guard and UL Symbols at the end of COT as specified by Test Parameters;• Use a threshold pLBT to control randomized LBT failures; Proposal 3: Use the base Slot Pattern shown in Figure 2.3 1, created according to the Model presented in this paper, for NR Unlicensed Demod Performance Tests for 30kHz SCS. Proposal 4: Specify a single LBT model that covers Data and SSB.Proposal 5: Model LBT as described by the model presented in this paper, section 2.3. Use pLBT = 0 (always clear channel) for Scenario C Tests and pLBT = [TBD>0] (some probability of occupied channel) for Scenario A Tests. |

## Open issues summary

### Test Scope

**Issue 1-1-1: Define additional separate tests for FBE and LBE**

* Proposals
	+ Option 1: No (Apple, MediaTek)
	+ Option 2: Yes
* Recommended WF
	+ TBA

**Issue 1-1-2: Define requirements with Fixed COT duration**

* Proposals
	+ Option 1: No, use random COT from a set of values (Apple, Huawei, Intel);
	+ Option 2: Yes (Ericsson, Qualcomm);
* Recommended WF
	+ TBA

**Issue 1-1-3: Values for Random COT (if agreed to Option 1 in Issue 1-1-2)**

* Proposals
	+ Option 1: {2, 6, 10, 16} Slots (Huawei);
	+ Option 2: {1,3,5,8} for SCS 15kHz, {1,6,10,16} for SCS 30kHz (Intel);
* Recommended WF
	+ TBA

**Issue 1-1-4: Values for Fixed COT/Burst Transmission duration (if agreed to Option 2 in Issue 1-1-2)**

* Proposals
	+ Option 1: 2 ms (Ericsson, Qualcomm);
* Recommended WF
	+ TBA

**Issue 1-1-5: Define requirements with Fixed DRS duration**

* Proposals
	+ Option 1: No;
	+ Option 2: Yes (Apple, Huawei);
* Recommended WF
	+ TBA

**Issue 1-1-6: Values for Fixed DRS duration**

* Proposals
	+ Option 1: 1ms (Huawei);
* Recommended WF
	+ TBA

**Issue 1-1-7: Test Scenarios for Demodulation requirements;**

* Proposals
	+ Option 1: Only Scenario A (MediaTek, Huawei);
	+ Option 2: Only Scenario C
		- Option 2-1: Defined only for Scenario C, applicable to other scenarios (Intel);
	+ Option 3: Both Scenario A and Scenario C (Apple, Ericsson);
* Recommended WF
	+ TBA

**Issue 1-1-8: Define PDCCH requirements**

* Proposals
	+ Option 1: Yes, with adapted burst transmission model (Ericsson);
	+ Option 2: No (Apple, MediaTek, Intel, Huawei);
* Recommended WF
	+ TBA

**Issue 1-1-9: Define CQI reporting requirements**

* Proposals
	+ Option 1: Yes (Huawei)
		- Option 1-1: For static channel conditions (Apple);
		- Option 1-2: With adapted burst transmission model (Ericsson);
	+ Option 2: No
* Recommended WF
	+ TBA

**Issue 1-1-10: Bandwidth to be used for requirements definition**

* Proposals
	+ Option 1: 20 and 80 MHz (Intel);
	+ Option 2: 20, 40, 60 and 80 MHz (Huawei);
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
| Apple | **Issue 1-1-2: Define requirements with Fixed COT duration** We proposed option 1 in our paper based on model used in LAA, but we are fine with simplifying the burst transmission model as proposed by Qualcomm and Ericsson.**Issue 1-1-3: Values for Random COT (if agreed to Option 1 in Issue 1-1-2)**Option 1 for 30KHz SCS**Issue 1-1-4: Values for Fixed COT/Burst Transmission duration (if agreed to Option 2 in Issue 1-1-2)**We are fine with option 1.**Issue 1-1-7: Test Scenarios for Demodulation requirements;**Option 3. The test scenarios should be decided first. The test cases can be duplicated for different scenarios as applicable.**Issue 1-1-9: Define CQI reporting requirements**We propose to define CQI reporting in static channel with the assumption that burst transmission model agreed for PDSCH demod requirements will be applicable for CQI reporting. **Issue 1-1-10: Bandwidth to be used for requirements definition**We don’t see the purpose of defining requirements for multiple CBWs. We propose to define requirements with 40MHz CBW similar to Rel-15 demod requirements for TDD.  |
| MediaTek | **Issue 1-1-2: Define requirements with Fixed COT duration** Fine with option 2. From the perspective of demodulation, we think the most important factor to influence the performance of demodulation is the behaviour of LBT failure. Hence, for simplification, we are fine with the fixed COT duration. Besides, to avoid ambiguity, it may better to use the term fixed burst transmission duration instead of fixed COT duration. Illustration here….**Issue 1-1-4: Values for Fixed COT/Burst Transmission duration (if agreed to Option 2 in Issue 1-1-2)**OK with option 1 for 2ms burst transmission duration.**Issue 1-1-5: Define requirements with Fixed DRS duration** OK with option 2. We think it is simpler to design test cases with a fixed DRS duration.**Issue 1-1-6: Values for Fixed DRS duration** We are fine with option 1.**Issue 1-1-7: Test Scenarios for Demodulation requirements;**Support option 1. From the perspective of UE demodulation performance requirements, we do not see much difference between scenario A and scenario C. Besides, UE needs capability to support scenario C. If companies would like to discuss both scenario A and C, we can prioritize the discussion for scenario A which is similar to LTE-LAA.**Issue 1-1-8: Define PDCCH requirements** Support option 2. From the perspective of demodulation, there is no physical layer enhancements and no any change of demodulation algorithm to decode DCI format 2\_0 compared to other DCI formats. It is not necessary to introduce requirement for DCI 2\_0 only for testing larger payload size. Besides, DCI format 2\_0 is an optional feature. Hence, we propose not to define PDCCH requirements. **Issue 1-1-9: Define CQI reporting requirements**CSI-RS behaviour is not well defined. According to RAN1 agreement in R1-2006195,

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| If none of the RRC parameters CO-DurationPerCell-r16, SlotFormatIndicator, and CSI-RS-ValidationWith-DCI-r16 is configured on a cell with shared spectrum access, and P/SP CSI-RS is configured, for reception/cancellation of SP/P CSI-RS the behavior in 11.1 of TS38.213 applies as per agreement.  |

If none of the validation mechanism is enabled (CO-DurationPerCell-r16, SlotFormatIndicator, and CSI-RS-ValidationWith-DCI-r16) what is the expected UE behaviour on CSI-RS report. One possibility is that UE will drop all DL CSI-RS signals. Another possibility is that UE will naively measure the CSI-RS to report useless CQI. We prefer to trigger RAN4 discussion about UE behaviour without validation to clarify CSI-RS assumption. **Issue 1-1-10: Bandwidth to be used for requirements definition**We propose 40MHz, which is the commonly used bandwidth configuration in TDD mode.  |
| Qualcomm | **Issue 1-1-1:** Option 1, do not add separated tests and rely on channel-access agnostic;**Issue 1-1-2:** Option 2. Also, I agree with MTK's comment, in our contribution we referred to what was burst transmission duration as 'Downlink Transmission duration' and kept the COT duration specific to the actual COT;**Issue 1-1-5:** Option 2, fixed DRS;**Issue 1-1-6:** Option 1, 2ms;**Issue 1-1-7:** Option 3, but a single NR-U Test scenario can be defined for scenario C and paired with an existing licensed NR test to cover scenario A;**Issue 1-1-8:** Option 2, don’t define PDCCH requirements;**Issue 1-1-9:** Further discussions are required. MTK observation is poses the reasonable question that if the UE might report useless CQI, how is the test setup going to behave in this case? Also, if we assume static channel condition does this test provide additional coverage compared with already existing CQI tests?**Issue 1-1-10:** Support 40 MHz only as proposed in the discussion |

### Downlink Transmission Model

**Issue 1-2-1: Downlink Data Transmission Model**

* Proposals
	+ Option 1( Huawei):
		- Select the number of slots randomly from a given set of the number of slots {2, 6, 10, 16} with equal probability as the total length of burst transmission format. The length includes both occupied OFDM symbols and non-occupied OFDM symbols within the burst format.
		- The starting position for the first slot is randomly selected from OFDM symbol S1 :{0, 7} with equal probability.
			* For PDSCH type A test: if 0 is selected, the PDSCH type A is transmitted from symbol 2 of the first slot. If 7 is selected, the PDSCH type A is transmitted from OFDM symbol 2 of second slot.
			* For PDSCH type B test: if 0 is selected, the PDSCH type B is transmitted from symbol 2 of the first slot. If 7 is selected, the PDSCH type B is transmitted from symbol 7 of the first slot.
		- In the last slot, PDSCH is transmitted ending with position of OFDM symbol randomly selected from OFDM symbol S2: {5,8,11,13} with equal probability
		- A uniform random variable from [0, 1] is generated. If the random variable is less than p which is given per test case,
			* If both the last slot of previous burst and first slot of new burst format are fully occupied, start burst transmission after deferring one slot from the last slot of previous burst. Otherwise, start burst transmission at the end of last slot of previous burst.
		- Otherwise, the burst transmission is muted and the muting duration is the same as the number of slots for determined burst format.
	+ Option 2 (Qualcomm):
		- Compute COT and Unoccupied duration as specified by Test Parameters, then repeat it periodically for the entire test;
		- Fully allocate PDCCH and PDSCH in COT, except for Guard and UL Symbols at the end of COT as specified by Test Parameters;
		- Use a threshold *pLBT* to control randomized LBT failures;
* Recommended WF
	+ TBA

**Issue 1-2-2: Slot Format proposed**

* Proposals
	+ Option 1: For 30kHz, 2ms Duration, DDDS (S=7D:2G:2U) according to presented model in R4-2016063 (Qualcomm);
* Recommended WF
	+ TBA

**Issue 1-2-3: Downlink Model Parameters**

* Proposals
	+ Option 1 (Qualcomm):

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| --- | --- | --- | --- |
| DL Transmission Model (Note 1) | Maximum COT Duration  | ms | 1.9 |
| Minimum Idle Time after COT  | ms | 0.1 |
| Fixed Frame Period (Note 2) | ms | 2 |
| Probability of LBT Failure pLBT |  | [TBD] |
| Guard Symbols |  | 2 Symbols |
| UL Symbols |  | 2 Symbols |
| Number of slots between PDSCH and corresponding HARQ-ACK information  |  | 3 if mod(i,4) = 02 if mod(i,4) = 15 if mod(i,4) = 24 if mod(i,4) = 3 |
| Notes:1. According to the definition proposed in [2]
2. This Parameter applies only for *ChannelAccessType-r16 = ‘semistatic’.*
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* Recommended WF
	+ TBA

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| **Company** | **Comments** |
| Apple | **Issue 1-2-1: Downlink Data Transmission Model**We support to simplify the model as proposed by Qualcomm and support option 2. There is no impact of demod performance by introducing a random COT and partial slot format for NR.**Issue 1-2-2: Slot Format proposed**This needs further discussion. Why isn’t there a UL slot configured in the proposed format? **Issue 1-2-3: Downlink Model Parameters**We need to agree on burst transmission model first to decide on parameters. The proposed is a good starting point is option 2 is agreed for Issue 1-2-1. |
| MediaTek | **Issue 1-2-1: Downlink Data Transmission Model**Slightly prefer option 2 but more details must be discussed. For example, how to compute the number of occupied OFDM symbols in the fixed frame period? Besides, is the pattern changing for every frame period or is the pattern fixed for every frame period? Is the testing coverage sufficient with the fixed pattern? Which one align with the group’s understanding with option 2.cid:image001.png@01D6B2C9.19DDB860**Issue 1-2-2: Slot Format proposed**Need more discussion about the uplink. For simplicity, we may consider to transmit uplink ACK/NACK on the licensed band in CA scenario.**Issue 1-2-3: Downlink Model Parameters**As Issue 1-2-1, it is not clear that how to determine the occupied OFDM symbols with the maximum COT duration. From the table, only the value for maximum COT duration is provided. For simplification, we can define a fixed pattern for occupied and unoccupied OFDM symbols for each LBT passed fixed frame period. For example, we can define three slots with fully occupied OFDM symbols and the last symbol with partial occupied OFDM symbols. |
| Qualcomm | **Issue 1-2-1:** Option 2; Additional details can be found in the related contribution, but given the simulation parameters: - Fixed Frame Period/Downlink transmission duration; - COT duration; - Idle period;the pattern is the same for the entire duration of the transmission, periodically repeated. The only difference is for SSB slots every SSB period, which do not contain Data.In the example from MTK, option a) is the right understanding, with the remark that transmission happens only if the random LBT is successful;**Issue 1-2-2:** Option 1. Using the model parameters as presented in the contributions, the last slot (or more) can be fully allocated to UL if needed. The settings chosen for PDSCH test aimed at maximizing PDSCH allocation, and only 2 symbols were reserved for HARQ feedback. This should be sufficient for the 3/4 slots to be reported;**Issue 1-2-3:** The number of occupied symbols is described in the contribution that contains the model, section 2.2, please see here below number 2. Also, number 3 specifies that first COT is transmitted, then unoccupied symbols follow;*2) Compute the duration in symbols for:* *· COT duration, as the largest number of Symbols that does not exceed the ‘Maximum COT’ duration in time, as specified in the Test Parameters;* *· Idle Period duration, as the smallest number of Symbols that is not less than the ‘Minimum Idle Period’ duration in time, as specified in the Test Parameters;**3) Depending on the test parameters, the single DL Transmission will consist in one or more slots included in the COT, and at maximum one slot partially included in the COT followed by unoccupied symbols.* |

### LBT Parameters for Simulation Assumptions

**Issue 1-3-1: LBT Model in Demod Performance Tests**

* Proposals
	+ Option 1: Model LBT failure ();
		- Option 1-1: As part of the burst transmission model (Apple, Qualcomm, Huawei, MediaTek);
	+ Option 2: No LBT modelling (Intel);
* Recommended WF
	+ TBA

**Issue 1-3-2: Applicability of LBT Model to SSB Transmission**

* Proposals
	+ Option 1: Same LBT model as for Data (MediaTek, Apple, Qualcomm);
	+ Option 2: Don’t model LBT failure for SSB slot additionally (Huawei);
* Recommended WF
	+ TBA

**Issue 1-3-3: Consider QSSB factor**

* Proposals
	+ Option 1: No (Huawei);
	+ Option 2: Yes
* Recommended WF
	+ TBA

**Issue 1-3-4: Probability of LBT Failure for Scenario C**

* Proposals
	+ Option 1: 0 (always clear channel) (Qualcomm);
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 1-3-5: Probability of LBT Failure for Scenario A**

* Proposals
	+ Option 1: TBD>0 (probability of occupied channel) (Qualcomm);
	+ Option 2: TBA
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
| Apple | **Issue 1-3-4: Probability of LBT Failure for Scenario C**We don’t understand the rationale of always clear channel and no LBT failure for Scenario C. We should use the same value for Scenario A and C in our understanding.  |
| MediaTek | **Issue 1-3-3: Consider QSSB factor**We do not fully understand what it means to not consider QSSB. Anyway, QSSB should be known by UE. We suggest the default value of QSSB = 8.**Issue 1-3-4: Probability of LBT Failure for Scenario C**Need more clarification about no LBT failure for scenario C.  |
| Qualcomm | **Issue 1-3-3:** Qssb can be set to 8;**Issue 1-3-4 and 1-3-5:** Proposal of always clear channel in scenario C was a tentative compromise in view of previous discussions that veered towards no LBT at all; We are not against having the same value for LBT on both scenarios; |
| Ericsson | **Issue 1-3-1: LBT Model in Demod Performance Tests**Support Option 1 and Option 1-1.**Issue 1-3-2: Applicability of LBT Model to SSB Transmission**Option 2**Issue 1-3-3: Consider QSSB factor**Option 1**Issue 1-3-4: Probability of LBT Failure for Scenario C**LBT failure according to the burst transmission model should be considered for Scenario C as well. |

## 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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|  | **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”* |

# PDSCH Performance Requirements

*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** |
| R4-2015634 | Huawei | *Proposal 1: Verify the performance requirements only for LBE with following frame structure** *Random COT time*
* *Partial slot + full slot + partial*
* *TDD with 30kHz SCS*

*Proposal 2: Define the performance requirements only for scenario A. For the performance requirement of PCell, reuse it from NR Rel-15. For the performance requirement of SCell, define the case with bandwidth of 10MHz, 20MHz, 40MHz, 60MHz and 80MHz.**Proposal 3: Not consider SSB failure, Q factor for SSB. Set DRS window duration to 1ms. Consider LBT failure and burst transmission model for LAA (36.101, B.8) can be used as baseline**Proposal 4: Define two cases for PDSCH performance requirements:** *Case A: PDSCH type A (Baseline)*
* *Case B: PDSCH type B (With capability signaling)*
* *Set one burst for two cases. Starting position of OFDM symbol set in the first slot of burst can be S1*: *{0, 7} and ending position of OFDM symbol set in the last slot can be S2* :*{5, 8, 11,13}.*
* *For PDSCH type A test:*
	+ - * *For the first slot of the burst, the starting position of OFDM symbol in the first slot is randomly selected from S1, if it is 0, the PDSCH type A is transmitted from symbol 2 to symbol 13 of the first slot. If it is 7, the PDSCH type A is transmitted from second slot.*
			* *For the last slot of the burst, PDSCH type A is transmitted from symbol 2 to x, x is randomly selected from set S*2*:{5, 8, 11, 13}*
			* *For the other slots of the burst, PDSCH type A is transmitted from symbol 2 to 13*
* *For PDSCH type B test:*
	+ - * *For the first slot of the burst, the starting position of OFDM symbol in the first slot is randomly selected from S1, if it is 0, the PDSCH type B is transmitted from symbol 2 to symbol 13. If it is 7, the PDSCH type B is transmitted from symbol 7 to symbol 13.*
			* *For the last slot of the burst, PDSCH type B is transmitted from symbol 2 to x, x is randomly selected from set S2:{5, 8, 11, 13}*
			* *For the other slots of the burst, PDSCH type B is transmitted from symbol 2 to 13*

*Proposal 5: Use following transmission burst model for LBT* 1. *Select the number of slots* $N$ *randomly from a given set of the number of slots {2, 6, 10, 16} with equal probability as the total length of burst transmission format. The length includes both occupied OFDM symbols and non-occupied OFDM symbols within the burst format.*
2. *The starting position for the first slot is randomly selected from OFDM symbol S1 :{0, 7} with equal probability.*

*- For PDSCH type A test: if 0 is selected, the PDSCH type A is transmitted from symbol 2 of the first slot. If 7 is selected, the PDSCH type A is transmitted from OFDM symbol 2 of second slot.**- For PDSCH type B test: if 0 is selected, the PDSCH type B is transmitted from symbol 2 of the first slot. If 7 is selected, the PDSCH type B is transmitted from symbol 7 of the first slot.*1. *In the last slot, PDSCH is transmitted ending with position of OFDM symbol randomly selected from OFDM symbol S2: {5,8,11,13} with equal probability*

*A uniform random variable from [0, 1] is generated. If the random variable is less than p which is given per test case,* *- If both the last slot of previous burst and first slot of new burst format are fully occupied, start burst transmission after deferring one slot from the last slot of previous burst. Otherwise, start burst transmission at the end of last slot of previous burst.**Otherwise, the burst transmission is muted and the muting duration is the same as the number of slots for determined burst format*. |
| R4-2015987 | Intel Inc. | Proposal 1: For NR-U demodulation tests, burst length shall be defined as the number of slots rather than the number of subframes. We propose to use fixed S1 in units of slots for each SCS: {1, 3, 5, 8} for 15MHz SCS and {1, 6, 10, 16} for 30MHz SCSProposal 2: For NR-U demodulation test, the starting position for the first slot is randomly selected from OFDM symbol 0 and OFDM symbol 7 with equal probability. If symbol 0 was selected PDSCH Type-A mapping should be used for all slots in the burst. If symbol 7 was selected – PDSCH Type-B mapping with the duration equal to 4 symbols should be used for the first slot and, PDSCH Type-A mapping should be used for all remaining slots in the burstProposal 3: For NR-U demodulation test, PDSCH Type-B mapping with corresponding durations to be used for all slots in case if UE supports typeB-PDSCH-length-r16Proposal 4: For NR-U demodulation tests, we propose to define fixed S2 – {6, 9, 12, 14}Proposal 5: Do not model LBT failureProposal 6: Consider COT duration equal to single burst transmission duration |
| R4-2016064 | Qualcomm Inc. | Observation 1: In the previous meeting, it was agreed to prioritize the definition of a PDSCH Demodulation Performance tests agnostic to channel access typology.Proposal 1: For NR-U PDSCH Demod Performance Tests use the common test parameters from licensed NR PDSCH Demod Performance as a starting point.Proposal 2: To define NR-U PDSCH Demod Performance Tests, use the DL Transmission model Parameters in Table 2.2-4 in the Simulation Assumptions. Proposal 3: To define the prioritized test for NR-U PDSCH Demod Performance Tests, for both Channel Access parameters ’ChannelAccessType-r16’=semistatic and ’ChannelAccessType-r16’=dynamic, use the simulation assumptions listed in this paper, in Tables 2.1-1, 2.2-2, 2.2-3 and Table 2.2-4. |
| R4-2016089 | Ericsson | Observation 1: LTE LAA performance requirements considers time, and frequency offset from LTE licensed PCell.Proposal 1: Define PDSCH demodulation test cases for both Scenario A, and Scenario CProposal 2: Adapt the test setup from LTE LAA for Scenario AProposal 3: Use 30kHz numerology as baseline for NR-U demodulation test cases.Proposal 4: Use low delay spread and doppler speeds for propagation channels e.g. TDLA30 Proposal 5: Use Table 1 parameters as starting point for NR-U PDSCH simulation assumptions |

## Open issues summary

### Simulation Assumptions

**Issue 2-1-1: Define PDSCH performance requirements for**

* Proposals
	+ Option 1: LBE Only (Huawei);
	+ Option 2: Agnostic to FBE and LBE devices (previous agreement)
* Recommended WF
	+ Option 2 since we already had an agreement in the previous meeting.

**Issue 2-1-2: Duplex Type to be used**

* Proposals
	+ Option 1: TDD (Huawei, Qualcomm);
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 2-1-3: SCS to be used in the Tests**

* Proposals
	+ Option 1: 30kHz (Huawei, Ericsson, Qualcomm);
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 2-1-4: Test Design**

* Proposals
	+ Option 1: Use NR PDSCH Demod Performance Tests as a starting point (Qualcomm);
	+ Option 2: Use LTE LAA Demod Performance Test setup as a starting point for scenario A (Ericsson)
* Recommended WF
	+ TBA

**Issue 2-1-5: Propagation Channels to be used**

* Proposals
	+ Option 1: Low delay spread and low doppler speed (Ericsson);
* Recommended WF
	+ TBA

**Issue 2-1-6: PDSCH Mapping Type for PDSCH Performance Tests**

* Proposals
	+ Option 1: Type A only (Apple, Ericsson, Qualcomm);
	+ Option 2: Type B only for UE with capability, Type A otherwise (MediaTek, Huawei);
	+ Option 3: Type A plus Rel-15 Type B for partial slots, dedicated test to verify *typeB-PDSCH-length-r16* capability with corresponding applicability rule (Intel)
* Recommended WF
	+ TBA

**Issue 2-1-7: PDSCH Type B Start and Length for PDSCH Performance Tests (if agreed to use PDSCH mapping Type B)**

* Proposals
	+ Option 1: Subset of fixed [start, length] values: [2,4], [2,12] (MediaTek);
	+ Option 2: Random start in Symbol {0, 7} and length {7, 14} for first slot of burst. Start in Symbol 2 and length {4, 7, 10, 12} for last slot of burst. Start in Symbol 2 and length 12 for other slots.(Huawei);
	+ Option 3: Start in Symbol {7} and length {4} symbols (Intel);
* Recommended WF
	+ TBA

**Issue 2-1-8: Length of the last Slot in the burst**

* Proposals
	+ Option 1: Random length
		- {4,7, 10, 12} Symbols (Huawei);
		- {6, 9, 12, 14} Symbols (Intel, Ericsson);
	+ Option 2: Fixed length according to proposed model (Qualcomm);
* Recommended WF
	+ TBA

**Issue 2-1-9: PDCCH Format to be used in PDSCH Simulation**

* Proposals
	+ Option 1: Format 2-0, using *CO-DurationPerCell-r16* to indicate the COT duration (Apple);
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 2-1-10: Summarized simulation assumptions (discuss in 2nd round)**

* Proposals
	+ Option 1 (Ericsson):

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Test scenario | Scenario A | Scenario C |
| Channel Bandwidth | 20MHz |
| Subcarrier spacing | 30kHz as Baseline |
| Propagation model | TDLA30-10 as Baseline |
| Antenna configuration | 2x2 ULA Low |
| Scheduling | Type A mapping |
| LBT modelling | Adapted LTE burst transmission model for NR Type A mapping [2] |
| COT  | 2ms |
| The number of slots set (S1) in the burst model | {1, 2, 3, 4} |
| Uniform random number (ρ) in the burst model | 0.5 |
| Occupied OFDM symbols set in the last slot | {6, 9, 12, 14} |
| Timing error relative of NR-U SCell to PCell NR | 0µs as Baseline | N/A |
| Frequency offset of the i-th NR-U SCell relative to NR PCell | 200Hz as Baseline  | N/A |

* + Option 2 (Qualcomm):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test num.** | **Reference channel** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Modulation format and code rate** | **Slot Pattern** | **Propagation condition** | **Correlation matrix and antenna configuration** | **Reference value** |
| **Fraction of maximum throughput (%)** | **SNR (dB)** |
| 1-1 | According to NR-U DL Transmission Model [2] | [20,40] / 30 | [TBD] | According to NR-U DL Transmission Model [2] | [TBD] | [TDB] | [TBD] | [TBD] |

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | TDD |
| Active DL BWP index |  | 1 |
| Slot Pattern  |  |  | According to the parameter specified in Table 2.2‑2: DL Transmission Model Parameters |
| PDSCH configuration | Mapping type |  | Type A |
| k0 |  | 0 |
| Starting symbol (S)  |  | 2 |
| Length (L) |  | According to DL Transmission Model |
| PDSCH aggregation factor |  | 1 |
| PRB bundling type |  | Static |
| PRB bundling size |  | 2 |
| Resource allocation type |  | Type 0 |
| RBG size |  | Config2 |
| VRB-to-PRB mapping type |  | Non-interleaved |
| VRB-to-PRB mapping interleaver bundle size |  | N/A |
| PDSCH DMRS configuration | DMRS Type |  | Type 1 |
| Number of additional DMRS |  | 1 |
| Maximum number of OFDM symbols for DL front loaded DMRS |  | 1 |
| Number of HARQ Processes |  | 8 |

* + Option 3 (Huawei):
* *Set one burst for two cases. Starting position of OFDM symbol set in the first slot of burst can be S1*: *{0, 7} and ending position of OFDM symbol set in the last slot can be S2* :*{5, 8, 11,13}.*
* *For PDSCH type A test:*
	+ *For the first slot of the burst, the starting position of OFDM symbol in the first slot is randomly selected from S1, if it is 0, the PDSCH type A is transmitted from symbol 2 to symbol 13 of the first slot. If it is 7, the PDSCH type A is transmitted from second slot.*
	+ *For the last slot of the burst, PDSCH type A is transmitted from symbol 2 to x, x is randomly selected from set S*2*:{5, 8, 11, 13}*
	+ *For the other slots of the burst, PDSCH type A is transmitted from symbol 2 to 13*
* *For PDSCH type B test:*
	+ *For the first slot of the burst, the starting position of OFDM symbol in the first slot is randomly selected from S1, if it is 0, the PDSCH type B is transmitted from symbol 2 to symbol 13. If it is 7, the PDSCH type B is transmitted from symbol 7 to symbol 13.*
	+ *For the last slot of the burst, PDSCH type B is transmitted from symbol 2 to x, x is randomly selected from set S2:{5, 8, 11, 13}*
	+ *For the other slots of the burst, PDSCH type B is transmitted from symbol 2 to 13*
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | **Issue 2-1-1: Define PDSCH performance requirements for** We prefer to keep agreement from last meeting – Option 2**Issue 2-1-2: Duplex Type to be used** Option 1**Issue 2-1-3: SCS to be used in the Tests**Option 1**Issue 2-1-4: Test Design**For Scenario A we would need to define tests for CA scenario, we could use Rel-16 NR CA requirements as a baseline. For Scenario C we would need single CC tests and we could use Rel-15 PDSCH demod tests as baseline.**Issue 2-1-5: Propagation Channels to be used**We are OK with option 1**Issue 2-1-8: Length of the last Slot in the burst**Pending decision on issue 1-2-2**Issue 2-1-9: PDCCH Format to be used in PDSCH Simulation**In addition to DCI format 1-1 for PDSCH scheduling, we also need to configure DCI format 2-0 using *CO-DurationPerCell-r16* to indicate the COT duration. We propose to capture this in test parameters and need to configure this for both PDSCH demod and CQI reporting tests |
| Qualcomm | **Issue 2-1-1:** Option 2, do not review agreement;**Issue 2-1-5:** Ok with Option 1, low delay and low doppler;**Issue 2-1-6:** Option 1, the test can be covered with Type A PDSCH without introducing applicability rules or more complication in the test; **Issue 2-1-9:** DCI 2-0 would require UE capability with no effect on demod performance, propose to stick to DCI format 1-1; |
| Ericsson | **Issue 2-1-1: Define PDSCH performance requirements for** Option 2**Issue 2-1-2: Duplex Type to be used** Option 1**Issue 2-1-3: SCS to be used in the Tests**Option 1.**Issue 2-1-4: Test Design**Given that we have the LBT 20MHz bandwidth for the unlicensed band, the starting point should be 20MHz but also based on the NR PDSCH performance tests. i.e., 20MHz/30kHz BW/SCS.**Issue 2-1-6: PDSCH Mapping Type for PDSCH Performance Tests**We are open to Type B requirements with UEs with capability. But then we’d need to create separate requirements and as such not exclude UEs only supporting Type A mapping.**Issue 2-1-7: PDSCH Type B Start and Length for PDSCH Performance Tests (if agreed to use PDSCH mapping Type B)**Ok with Option 2 **Issue 2-1-8: Length of the last Slot in the burst**The last slot length being the one we propose to reuse from LTE, i.e., {6, 9, 12, 4} which corresponds to the {4, 7, 10, 12} propsed by Huawei. There is a clarification needed here since LTE considers the full subframe as 14 whereas in this scenario we are discussing length of transmission without PDDCH in the first 2 symbols.In this case we support Huawei Option 1.**Issue 2-1-9: PDCCH Format to be used in PDSCH Simulation**Do not consider DCI format 2\_0 for PDSCH requirements. Use DCI format 2\_0 for PDCCH test. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# PDCCH Performance Requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015635 | Huawei | Proposal 1: No PDCCH demodulation requirements are needed to define for Rel-16 NR-U.  |
| R4-2016090 | Ericsson | Observation 1: PDCCH performance requirements from Rel-15 have not been verified under burst-like transmissionObservation 2: Probability of missed scheduling grant is not captured by Rel-15 eMBB PDCCH requirements.Proposal 1: Use the simulation assumptions from Table 1 as baseline for PDCCH NR-U demodulation requirements |

## Open issues summary

### Simulation Assumptions

**Issue 3-1-1: PDCCH Demodulation Requirements Simulation Assumptions (if agreed to define PDCCH requirements)**

* Proposals
	+ Option 1 (Ericsson):

|  |  |
| --- | --- |
| Parameter | Value |
| Scenario | Scenario A | Scenario C |
| Bandwidth | 20MHz |
| Subcarrier spacing | 30kHz |
| Propagation condition | TDLA30-10 |
| Antenna configuration | 2x2 ULA Low |
| LBT modelling | Adapted LTE burst transmission model for NR Type A mapping [2] |
| COT | 2ms |
| The number of slots set (S1) in the burst model | {1, 2, 3, 4} |
| Uniform random number (ρ) in the burst model | 0.5 |
| Occupied OFDM symbols set in the last slot | {6, 9, 12, 14} |
| CORESET RB | 48 |
| CORESET duration | 1, 2 |
| Aggregation level | 4 |
| Timing error relative of NR-U SCell to NR PCell | 15µs as baseline | N/A |
| Frequency offset of the i-th NR-U SCell relative to NR PCell | 200Hz as baseline | N/A |

* + Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# CQI Reporting Requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015636 | Huawei | Proposal 1: Introduce CQI requirements for NR-U for following UE behavior:* UE does not average the channel measurement across the different transmission bursts;
* UE does the CSI measurement by using the valid slots when the transmission varies burst by burst;

Proposal 2: Set two sets of burst transmissions, each with distinct transmission power level and keeping the interference level constant during the test. The SNR is quite different.* Use aperiodic CSI reporting;
* CA scenario can be used as baseline. PCell (license band) is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting;
* CQI distribute criterion and BLER criterion can be used as test metric;
 |
| R4-2016091 | Ericsson | Observation: Scenario A share similarities with CA CQI requirements, and Scenario C share similarities with SA CQI requirements.Proposal: Use the simulation assumptions from Table 1 as baseline for NR-U CQI performance requirements |

## Open issues summary

### Simulation Assumptions

**Issue 4-1-1: Simulation Assumptions for CQI reporting requirements**

* Proposals
	+ Option 1 (Ericsson):

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Test Scenario | Scenario A | Scenario C |
| Bandwidth | 20MHz |
| Subcarrier spacing | 30kHz |
| Propagation model | AWGN |
| Antenna configuration | 2x2  |
| Scheduling | Type A mapping |
| LBT modelling | Adapted LTE burst transmission model for NR Type A mapping [2] |
| COT | 2ms |
| The number of slots set (S1) per burst | {1, 4} |
| Random variable ρ defined in B.8 (36.101) | 0.5 |

* + Option 2: TBA
* Recommended WF
	+ TBA

**Issue 4-1-2: Type of CQI Reporting**

* Proposals
	+ Option 1: Aperiodic (Huawei);
	+ Option 2: Periodic
* Recommended WF
	+ TBA

**Issue 4-1-3: UE averaging of channel measurements across slots**

* Proposals
	+ Option 1: No, channel measurements done only if LBT successful (Huawei);
	+ Option 2: Yes
* Recommended WF
	+ TBA

**Issue 4-1-4: Use Scenario A as a baseline**

* Proposals
	+ Option 1: Yes (Huawei);
	+ Option 2: No
* Recommended WF
	+ TBA

**Issue 4-1-5: Test Metric for CQI Reporting tests**

* Proposals
	+ Option 1: CQI distribution, BLER (Huawei);
	+ Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | **Issue 4-1-1: Simulation Assumptions for CQI reporting requirements**The burst transmission model still needs to be agreed in order to agree on simulation assumptions for CQI reporting. We propose to keep it open and propose to agree on define requirements based on CA CQI requirements for Scenario A and Rel-15 CQI reporting for Scenario. Other parameters that can be agreed are only to define tests in static channel. We also propose to capture configuring PDCCH with DCI format 2-0 using *CO-DurationPerCell-r16* to indicate the COT duration for CQI reporting tests. |
| Qualcomm | **Issue 4-1-1:** Clarify on Issue 1-1-9 first if we need CQI tests; |
| Ericsson | **Issue 4-1-2: Type of CQI Reporting**Ok with option 1.**Issue 4-1-3: UE averaging of channel measurements across slots**Ok with option 1.**Issue 4-1-4: Use Scenario A as a baseline**Option 2**Issue 4-1-5: Test Metric for CQI Reporting tests**Option 1. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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