**3GPP TSG-RAN WG4 Meeting # 94-e-Bis R4-200XXXX**

**Electronic Meeting, 20 – 30 Apr., 2020**

**Agenda item:** 7.1.7.1, 7.1.7.2, 7.1.7.3

**Source:** Qualcomm

**Title:** Email discussion summary for [98e][316]\_NR\_unlic\_Demod\_UE

**Document for:** Discussion

# Introduction

Email discussion for contributions submitted under agenda item 7.1.7 for defining NR-unlicensed performance tests.

List of candidate target of email discussion for 1st round and 2nd round

* 1st round: Agree on Downlink Transmission Model, PDSCH and CQI Test Definition details;
* 2nd round: Discuss Simulation Assumptions and CR Work Split;

# Topic #1: Work Plan

## Open issues summary

* + 1. Sub-topic 1-1: Work Plan

**Issue 1-1-1: CR work split**

* Proposal:
	+ Moderator asks companies to volunteer for the work split filling the table here below and add their comments if anything is missing or wrong;

|  |  |  |
| --- | --- | --- |
| **Item List** | **Description** | **Company** |
| 1 - CR Work  | PDSCH Performance Requirements for Scenario A(Can be split in 2/4 RX if needed) |  |
| 2 - CR Work | PDSCH Performance Requirements for Scenario C(Can be split in 2/4 RX if needed) |  |
| 3 - CR Work | [CQI Requirements for Scenario A if agreed] |  |
| 4 - CR Work | [CQI Requirements for Scenario C if agreed] |  |
| 5 - CR Work | Introduction of new Fixed Reference Channel and TDD Pattern |  |
| 6 - CR Work | Introduction of new Downlink Transmission Model |  |
| 7 – Simulation Work  | Collect and Organize Simulation results. |  |

* Recommended WF
	+ **Agree on the CR work split;**

## Companies views’ collection for 1st round

### Open issues

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

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #2: General and Downlink Transmission Model

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| R4-2100995 | Ericsson | Observation 1: Rel-16 NR CA requirements seem more suitable for LAA PCell PDSCH requirement than Rel-15 NR SA requirement.Proposal 1: Take 3 pre-conditions for unlicensed carrier DL demodulation.* The gNB transmit DCI/CSI-RS for unlicensed carrier only when LBT is successful.
* For any cases, UL LBT failure should no be considered for DL demodulation test.
* For any cases, all HARQ-ACK will be received during one burst.

Observation 2: The UE behaviour for PDSCH/CSI-RS demodulation is same for both licensed carrier and unlicensed carrier. The difference is only the TDD pattern, fixed or burst.Observation 3: For unlicensed carrier in scenario A and scenario C, PDSCH with burst transmission could be considered if we want to introduce new requirements.Proposal 2: It is practical to define only one set of new PDSCH requirement with burst transmission for both scenario A SCell and scenario C PCell. Reuse Rel-16 NR CA requirement for scenario A PCell.Observation 4: There is up to 20MHz component carrier bandwidth in wideband operation CA mode.Proposal 3: Define requirements including 20MHz.Observation 5: The current test applicability rules for eLAA PDSCH CA or Rel-16 NR PDSCH CA is “Largest aggregated CA bandwidth combination”.Observation 6: A huge simulation effort is needed if we follow the same applicability rule for bandwidth as eLAA PDSCH and Rel-16 NR PDSCH CA.Observation 7: New applicability rule will be needed for different bandwidth if we want to reduce simulation effort.Observation 8: DRS window duration is agreed to 1ms and Japan have regional limitation that maximum duration on unlicensed band is 4ms.Proposal 4: Agree with fixed 2ms COT with slot patten as DDSU.Observation 9: There will be no uplink feedback scheduling for NR-U TDD standalone scenario if the DL symbol length is 12 or 14 in the last slot. Proposal 5: Define fixed symbol pattern as 10D2G2U for special slot. Proposal 6: Use fixed TDD pattern DDSU (S=10D2G2U) with LBT failure for DL demodulation test.Proposal 7: DL transmission model

|  |  |  |  |
| --- | --- | --- | --- |
| DL Transmission Model  | Maximum COT Duration  | ms | 2 |
| Slot pattern (Note 1) |  | DDSU |
| Special slot DL burst symbol length |  | 10 symbols |
| Probability of LBT Failure pLBT |   | 0.5 |
| Guard Symbols in Special slot |   | 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 |
|  |

Observation 10: It is agreed not to define additional test cases dedicated to FBE/LBE devices in the last meeting.Proposal 8: Do not define a sperate LBT model for FBE and LBE.Proposal 9: Define probability of LBT failure as 0.5 for both scenario A and scenario C. |
| R4-2101343 | Huawei | Proposal 1: No need to define LBT model for FBE and LBE separately.Proposal 2: S1 and TDD pattern should be designed to satisfy following conditions:a) Each transmission burst has at least one ’S’ slot or 'UL' slot to ensure that the feedback delay is not very long.b) Number of slots between PDSCH and corresponding HARQ information (k1) should be definite.Proposal 3: Set S1 to {4, 6, 10, 16} slots, TDD pattern to DDDSU, DL transmission duration to 10ms. The transmission slots format is randomly selected from {DDDS, DDDSUD, DDDSUDDDSU, DDDSUDDDSUDDDSUD}. For scenario C: use Figure 3~6 and Table 1~4 as HARQ feedback procedure. For scenario A, use Figure 7~10 as HARQ feedback procedure.Proposal 4: For scenario A, set probability of LBT failure to 0.5. For scenario C: Set probability of LBT failure to 0Proposal5: For Length of the last Slot in the burst (S2), reuse it from LAA, {6,9,12,14} symbols with the first 2 symbols allocated for PDCCH transmission. |
| R4-2102082 | MediaTek | Proposal 1: Define test cases with one CBW, either 40MHz or 20 MHz.Proposal 2: For CQI testing, use DCI format 2\_0 to indicate UE the COT information. Proposal 3: Define fixed DL transmission duration as 2ms. Proposal 4: Define values for random COT as S1 = {2, 3, 4}.Proposal 5: Define format for random COT as {DS, DDS, DDDS}.Proposal 6: Define S2 = {9, 12, 14}, with the first two symbols allocated for PDCCH transmission.Proposal 7: Define nonzero and the same probability of LBT failure p = 0.5 for both Scenario A and Scenario C.Proposal 8: Define test cases for PDSCH mapping type B only for UE with capability, Type A otherwise.Proposal 9: For PDSCH mapping Type B:* For all slots except the last slot: Start in symbol 2 and the duration of PDSCH is 12.
* For the last slot: Start in symbol 2 and the duration of PDSCH depends on the length of the last slot.

Proposal 10: Do not need DCI format 2\_0 for PDSCH simulation. |

## Open issues summary

### Details of NR-U Demodulation Perfomance Tests

**Issue 2-1-1: Whether to consider UL LBT Failure in DL demodulation tests;**

* Proposals
	+ Option 1: No (Ericsson);
	+ Option 2: Yes
* Recommended WF
	+ **Do not consider UL LBT failure;**

**Issue 2-1-2: Whether to schedule UL in every COT, to receive HARQ-ACK;**

* Proposals
	+ Option 1: Yes (Ericsson);
		- Option 1a: With definite number of slots between PDSCH and HARQ feedback (k1) (Huawei);
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 2-1-3: Whether to a define a single set of PDSCH Requirements for the unlicensed cell, for both scenario A and C.**

* Proposals
	+ Option 1: Yes, starting from Rel-15 NR PDSCH Requirements (Ericsson, Apple);
* Recommended WF
	+ TBA

**Issue 2-1-4: Whether to define Scenario A PDSCH requirements based on Rel-16 NR CA requirements:**

* Proposals
	+ Option 1: Reuse Rel-16 NR CA requirements (Ericsson);
	+ Option 2: Use Rel-16 NR CA requirements as starting point (Apple);
* Recommended WF
	+ TBA

**Issue 2-1-5: Whether to define Scenario C PDSCH requirements using Rel-15 NR PDSCH Requirements as a starting point**

* Proposals
	+ Option 1: Yes (Apple, Ericsson);
* Recommended WF
	+ TBA

**Issue 2-1-6: Bandwidth to be used for the definition of the requirements;**

* Proposals
	+ Option 1: Define requirements including 20 MHz (Ericsson);
	+ Option 2: Choose between 20 MHz and 40 MHz (MediaTek);
	+ Option 3: 40 MHz (Apple);
	+ Option 4: {20,40,60,80} MHz to cover all combinations(Huawei);
	+ Option 5: {20,40} MHz, test only the largest BW supported (Qualcomm);
* Recommended WF
	+ TBA

### Details of the LBT Model

**Issue 2-2-1: Whether to define separate LBT models, depending on Channel Access Type**

* Proposals
	+ Option 1: No (Ericsson, Huawei, Apple);
* Recommended WF
	+ **Define a single LBT model, to be used for both ‘dynamic’ and ‘semi-static’ Channel Access;**

**Issue 2-2-2: LBT Probabilities (PLBT)to be used in the tests for Scenario A**

* Proposals
	+ Option 1: 0.5 (Ericsson, Huawei, MediaTek);
	+ Option 2: 0.25 (Apple)
	+ Option 3: 0.20 (Qualcomm);
* Recommended WF
	+ TBA

**Issue 2-2-3: LBT Probabilities (PLBT)to be used in the tests for Scenario C**

* Proposals
	+ Option 1: Same as scenario C
		- Option 1a: 0.5 (Ericsson, MediaTek);
		- Option 1b: 0.25 (Apple);
	+ Option 2: 0 (Huawei)
	+ Option 3: 0.01 (Qualcomm);
* Recommended WF
	+ TBA

### Details of the Downlink Transmission Model

**Issue 2-3-1: Fixed Downlink Transmission Periodicity (equivalent to FFP in semi-static channel access);**

* Proposals
	+ Option 1: 2ms (Ericsson, MediaTek, Qualcomm);
	+ Option 2: 4ms (Apple);
	+ Option 3: 10ms (Huawei, Intel);
* Recommended WF
	+ TBA

**Issue 2-3-2: Whether to use a fixed COT duration inside the Downlink Transmission Periodicity;**

* Proposals
	+ Option 1: Yes (Ericsson);
	+ Option 2: No, random COT (Huawei, MediaTek, Apple, Intel, Qualcomm);
* Recommended WF
	+ **Can Ericsson agree to using a Random COT duration inside the Downlink Transmission Periodicity?**

**Issue 2-3-3: Random COT duration;**

* Proposals
	+ Option 1: {4,6,10,16} Slots (Huawei);
	+ Option 2: {2,3,4} Slots (MediaTek, Qualcomm);
	+ Option 3: {2,3,5,8} Slots (Apple);
	+ Option 4: {1,6,10,16} Slots (Intel);
* Recommended WF
	+ TBA

**Issue 2-3-4: Whether to revise current agreement for 1ms DRS window duration**

* Proposals
	+ Option 1: Yes, change it to 0.5ms (=1 Slot) (Intel);
	+ Option 2: No;
* Recommended WF
	+ **Keep current agreement**

**Issue 2-3-5: PDCCH Allocation;**

* Proposals
	+ Option 1: Symbols {0,1} in every slot (Huawei, MediaTek, Apple, Qualcomm);
	+ Option 2: Randomly, depending on slot symbol start (Intel);
* Recommended WF
	+ **Can Intel agree to allocate PDCCH in Symbols {0, 1} in every slot?**

**Issue 2-3-6: Length of PDSCH Allocation for all slots except the last slot in the COT;**

* Proposals
	+ Option 1: 12 Symbols (Huawei, MediaTek);
	+ Option 2: Random, depending on slot symbol start (Intel);
* Recommended WF
	+ **Can Intel agree to a fixed length of 12 Symbols?**

**Issue 2-3-7: Overall duration of the last slot in the COT:**

* Proposals
	+ Option 1: Fixed Length
		- Option 1a: 14 Symbols (Slot Pattern:10D2G2U) (Ericsson);
		- Option 2a: 7 Symbols (Apple);
	+ Option 2: Random Length
		- Option 2a: {6,9,12,14} Symbols (Huawei)
		- Option 2b: {9,12,14} Symbols (MediaTek);
		- Option 2c: {5-14} Symbols if Random COT<Maximum COT, {5-7} Symbols if COT = Maximum COT (Qualcomm);
* Recommended WF
	+ TBA

*Moderator comment: If the last slot in the COT coincides with the last slot in the FFP, some options above do not allow for enough idle time at the end of the COT to fulfil the semi-static channel access requirements.*

*Idle Time is at least 100ns (rounded to 3 Symbols) for 2ms DL Transmission Periodicity, 200ns (rounded to 6 Symbols) for 4ms DL Transmission Periodicity;*

**Issue 2-3-8: TDD Pattern to be used in DL demodulation Tests**

* Proposals
	+ Option 1: Fixed TDD Pattern
		- Option 1a: DDSU (S=10D2G2U) with LBT failure (Ericsson);
	+ Option 2: Random TDD Pattern
		- Option 2a {DS, DDS, DDDS} (MediaTek);
		- Option 2b: {DDDS, DDDSUD, DDDSUDDDSU, DDDSUDDDSUDDDSUD} (Huawei);
* Recommended WF
	+ TBA

**Issue 2-3-9: DL Transmission Model Parameters**

* Proposals
	+ Option 1: Ericsson

|  |  |  |  |
| --- | --- | --- | --- |
| DL Transmission Model  | Maximum COT Duration  | ms | 2 |
| Slot pattern (Note 1) |  | DDSU |
| Special slot DL burst symbol length |  | 10 symbols |
| Probability of LBT Failure pLBT |   | 0.5 |
| Guard Symbols in Special slot |   | 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 |
|  |

* + Option 2: Qualcomm

|  |  |  |  |
| --- | --- | --- | --- |
| DL Transmission Model | Maximum COT Duration  | ms | 1.9 |
| Minimum Idle Time after COT  | ms | 0.1 |
| DL Transmission Model Period/Fixed Frame Period (Note 1) | 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 |
| Duration of the COT  | Slots | Random, uniformly distributed, subject to conditions (Note 2) |
| PDSCH Allocation in the last Slot of the COT | Symbols | Random, uniformly distributed, subject to conditions (Note 3) |
| Notes:1. The Fixed Frame Period denomination applies only for *ChannelAccessType-r16 = ‘semistatic’.* For *ChannelAccessType-r16 = ‘dynamic’* this parameter is identified only as DL Transmission Model Period.
2. The random COT Duration cannot exceed the Maximum COT Duration, and cannot be smaller than the DRS duration.
3. The duration of the PDSCH Allocation in the last Slot of the COT must account for Idle Time, Guard Symbols and UL Symbols, all transmitted at the end of the COT. If the duration of the random COT (in slots) coincides with the Maximum COT duration (in slots), the maximum PDSCH Allocation duration must be reduced accordingly.
 |

* 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”* |

# Topic #3: PDSCH Demodulation

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| R4-2100197 | Apple | Test ScopeProposal #1: Introduce demodulation requirements with 40MHz channel bandwidth.Downlink Transmission ModelProposal #2: Define fixed DL transmission duration of 4ms.Proposal #3: Define set of random COT (S1) as {2, 3, 5, 8} slots.Proposal #4: Define fixed duration for last slot of transmission of 7 symbols.LBT ParametersProposal #5: Do not define separate LBT model for LBE and FBE devices.Proposal #6: Define same probability of LBT failure for Scenario A and Scenario C.Proposal #7: Define probability of LBT failure as 0.25.Simulation Parameters for PDSCH RequirementsProposal #8: Use Rel-15 NR PDSCH requirements as a starting point for Scenario C and Rel-16 Normal CA requirements as a starting point for Scenario A requirementsProposal #9: Define the same requirements for NR-U carrier for Scenario A and Scenario C.Proposal #10: Define requirements with PDSCH Type A only.Proposal #11: Configure PDCCH monitoring on Format 2-0 with *CO-DurationPerCell-r16* at the beginning of the fixed frame duration. |
| R4-2100996 | Ericsson | Issue 1: Test designProposal 1: Use same setup as Rel-15 NR for unlicensed carrier in scenario A or C;Issue 2: PDSCH TypeProposal 3: Only define requirement for PDSCH type AIssue 3: PDCCH Format to be used*Proposal 3: Do not configure DCI format 2-0 for PDSCH demodulation requirement*Issue 4: Detailed simulation parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex mode |  | TDD |
| Bandwidth | MHz | 20, [40, 60, 80] |
| SCS | kHz | 30 |
| Active DL BWP index |  | 1 |
| Slot Pattern  |  | DDSU, S=10D2G2U |
| LBT failure probability |  | 0.5 |
| Common serving cell parameters | Physical Cell ID |  | 0 |
| SSB position in burst |  | The first SSB |
| SSB Q factor |  | 8 |
| 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 |
| Test metric |  | 70% throughput |

 |
| R4-2101264 | Intel | Proposal 1: We propose to define CCA period (or Fixed DL transmission duration in the agreed downlink transmission model) equal to 10msProposal 2: For the DL burst duration we propose to select the number of slots randomly from a given set S1 - {1,6,10,16} slots.Proposal 3: We propose to reconsider agreement for DRS duration window and to change it to 0.5ms (1 slot)Proposal 4: 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 is used for all slots in the burst. If symbol 7 was selected – PDSCH Type-B mapping with the duration equal to 4 symbols is used for the first slot and, PDSCH Type-A mapping is used for all remaining slots in the burstProposal 5: For NR-U demodulation test, define dedicated test to verify typeB-PDSCH-length-r16 capability with corresponding applicability rule. |
| R4-2101344 | Huawei | Proposal 1: Introduce two test cases. One case is only for type A and all UEs should be tested, another is for type B-PDSCH-Rel-16 and only UEs with capability should be tested. Proposal 2: For type B test, set {S, L} to {2,12} for slots except last slot of transmission burst and set S to 2, L to random value derived from {4,7,10,12} for last slot of transmission burstProposal 3: Define the performance requirements for bandwidth with 20, 40, 60 and 80 MHz to cover all bandwidth combination specified on band n47Proposal 4: Do not use DCI Format 2-0; |
| R4-2102585 | Qualcomm | On the topic of the Downlink Transmission Model:Proposal 1: Define the Downlink Transmission Model with a fixed Downlink Transmission Model Period. Proposal 2: For SCS 30 kHz Performance tests, define a Downlink Transmission Model Period of 2ms, equal to 4 slots.On the topic of COT Duration:Observation : The current agreed DRS Duration is 1ms, thus limiting the minimum number of slots in COT duration to 2.Proposal 3: For the Downlink Transmission Model, define a random COT duration uniformly distributed, lower bounded by the DRS Duration Parameter, and upper bounded by the Maximum COT duration Parameter.Proposal 4: For SCS 30 kHz Performance tests, define a random COT duration uniformly distributed in {2,3,4} slots.Observation : If the COT duration equals the maximum COT duration, the maximum PDSCH allocation length in the last slot of the COT has to accommodate for Guard Symbols, UL Symbols and Idle Time.Proposal 5: For the Downlink Transmission Model, define a random length of the PDSCH allocation in the last Slot of the COT. If the COT Duration equals Maximum COT Duration in number of slots, the maximum duration of the PDSCH allocation in the last slot must be reduced to fit the Guard Symbols, UL Symbols and Idle Time.Proposal 6: For SCS 30 kHz Performance tests, define the random duration of the PDSCH allocation in the last slot of the COT to be uniformly distributed between [3, 12] if COT < Maximum COT, and to be uniformly distributed between [3, 5] if COT = Maximum COT.On the topic of LBT Failure probabilities:Proposal 7: Use different LBT Failure probabilities for Scenario A and C, to reflect different deployment scenarios and diversify the tests introduced.Proposal 8: Use LBT Failure probabilities of 20% for Scenario A and of 1% for Scenario C.On the topic of PDSCH Performance test scope:Observation: With the agreed LBT model, in some cases scheduled periodic CSI-RS Transmission can not be transmitted due to LBT failure.Observation: Defining a test based on the assumption on DCI 2-0 support is expected to cover only a limited set of UEs.Observation: UEs that do not support DCI 2-0 might support CSI-RS validation based on the optional capability using RRC Parameter ‘csi-RS-ValidationWith-DCI’.Observation: The performance impact in case of missing instances of CSI-RS with no validation assumption is undetermined.Proposal 9: RAN4 to discuss which of the 3 approaches, summarized as {Always TRS, No TRS, UE Validation}, is more appropriate for PDSCH Performance testing of a UE with no optional capabilities support related to periodic CSI-RS transmission validation.Proposal 10: If ‘Always TRS’ or ‘No TRS’ are chosen as approaches for the testing of UEs with no dedicated capabilities support related to periodic CSI-RS transmission validation, discuss adding an additional PDSCH Demodulation test for UEs that support ‘csi-RS-ValidationWith-DCI’, with the LBT Model as discussed and including scheduling of periodic TRS.Proposal 11: With lower priority, discuss additional PDSCH Demodulation tests with DCI 2-0, for UEs that support this capability.On the topic of PDSCH Simulation Assumptions:Proposal 12: Specify PDSCH Requirements using PDSCH Type A.Proposal 13: Specify PDSCH Requirements using PDCCH Allocation in Symbols [0,1] for every slot.Proposal 14: Specify PDSCH requirements for UEs with {2, 4} RX, with an applicability condition to test the largest number of supported RX only.Proposal 15: Specify PDSCH requirements for UEs with Rank=2.Proposal 16: Specify PDSCH requirements for Bandwidth {20, 40} MHz, with an applicability condition to test the largest bandwidth supported only.Proposal 17: Specify PDSCH Requirements using MCS 13 (16 QAM, 0.48).Proposal 18: Specify PDSCH Requirements using the channel TDLA30-10 for propagation.Proposal 19: Specify PDSCH Requirements assuming 6% EVM at the Base Station side.Proposal 20: Use the parameters in Table 2.2 2: Test Definition for 2 RX, Table 2.2 2: Test Definition for 2 RX, Table 2.2 3: Test Parameters as reference for the simulation assumptions. |

## Open issues summary

A few open issues impact the final number of tests to be defined, so it would be good to address those in the 1st round, in particular the ones related to optional capabilities.

### PDSCH Test Definition

**Issue 3-1-1: Discuss how to define PDSCH requirements for UEs with no support for optional capabilities related to CSI-RS validation (DCI 2-0, csi-RS-ValidationWith-DCI);**

* Proposals
	+ Option 1: RAN4 to choose between proposed schemes {Always TRS, No TRS or UE Validation} (Qualcomm);
* Recommended WF
	+ TBA

**Issue 3-1-2: Whether to define a requirement based on the optional capability *‘csi-RS-ValidationWith-DCI’:***

* Proposals
	+ Option 1: Yes, if Always TRS or No TRS are chosen the Issue 3-1-1 (Qualcomm);
* Recommended WF
	+ TBA

**Issue 3-1-3: Include PDCCH DCI 2-0 in PDSCH Simulations;**

* Proposals
	+ Option 1: No (MediaTek, Ericsson, Huawei);
		- Option 1a: No, define PDSCH tests with DCI 2-0 with lower priority (Qualcomm);
	+ Option 2: Yes (Apple);
* Recommended WF
	+ TBA

**Issue 3-1-4: Introduce dedicated requirements for** **typeB-PDSCH-length-r16 capability**

* Proposals
	+ Option 1: Yes, with applicability rule (Intel, Huawei, MediaTek?);
* Recommended WF
	+ TBA

**Issue 3-1-5: PDSCH Mapping Type**

* Proposals
	+ Option 1: Type B if UEs has capability, Type A otherwise (MediaTek);
	+ Option 2: Type A Only (Apple, Ericsson, Qualcomm);
	+ Option 3: Randomly Type B in the first slot, Type A for the rest if the UE does not support typeB-PDSCH-length-r16. All Type B if the UE supports it (Intel);
	+ Option 3: Type B if the UE supports typeB-PDSCH-length-r16, Type A otherwise (Huawei);
* Recommended WF
	+ TBA

### PDSCH Test Requirements and Simulation Assumptions

**Issue 3-2-1: PDSCH Requirements, Number of RX;**

* Proposals
	+ Option 1: {2,4}, test only the largest number of supported RX only (Qualcomm);
* Recommended WF

**Issue 3-2-2: PDSCH Requirements, Rank:**

* Proposals
	+ Option 1: 2 (Qualcomm);
* Recommended WF

**Issue 3-2-3: PDSCH Requirements, Channel:**

* Proposals
	+ Option 1: TDLA30-10 (Qualcomm);
* Recommended WF

**Issue 3-2-4: PDSCH Requirements, MCS:**

* Proposals
	+ Option 1: 13 (Qualcomm);
* Recommended WF

**Issue 3-2-5: PDSCH Simulation Assumptions, TX EVM:**

* Proposals
	+ Option 1: 6% (Qualcomm);
* Recommended WF

**Issue 3-2-6: Detailed PDSCH Simulation Assumptions:**

* Proposals
	+ Option 1: Ericsson

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| Duplex mode |  | TDD |
| Bandwidth | MHz | 20, [40, 60, 80] |
| SCS | kHz | 30 |
| Active DL BWP index |  | 1 |
| Slot Pattern  |  | DDSU, S=10D2G2U |
| LBT failure probability |  | 0.5 |
| Common serving cell parameters | Physical Cell ID |  | 0 |
| SSB position in burst |  | The first SSB |
| SSB Q factor |  | 8 |
| 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 |
| Test metric |  | 70% throughput |

* + 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 | NR-U DL Transmission Model [2] | 20 / 30 | 16 QAM, 0.48 | According to NR-U DL Transmission Model [2] | TDLA30-10 | 2x2, ULA Low | 70 | [TBD] |
| 1-2 | NR-U DL Transmission Model [2] | 40 / 30 | 16 QAM, 0.48 | According to NR-U DL Transmission Model [2] | TDLA30-10 | 2x2, ULA Low | 70 | [TBD] |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | NR-U DL Transmission Model [2] | 20 / 30 | 16 QAM, 0.48 | According to NR-U DL Transmission Model [2] | TDLA30-10 | 2x4, ULA Low | 70 | [TBD] |
| 1-2 | NR-U DL Transmission Model [2] | 40 / 30 | 16 QAM, 0.48 | According to NR-U DL Transmission Model [2] | TDLA30-10 | 2x4, ULA Low | 70 | [TBD] |

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| Duplex mode |  | TDD |
| Active DL BWP index |  | 1 |
| Slot Pattern  |  |  | According to the parameter specified in Table 3.3‑4: 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 |

* Recommended WF

## Companies views’ collection for 1st round

### Open issues

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

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #4: CSI Requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| R4-2100997 | Ericsson | Observation 1: UE will follow Rel-15 behaviour if RRC parameters CO-DurationPerCell-r16, SlotFormatIndicator or CSI-RS-ValidationWith-DCI-r16 are not signalled.Observation 2: For periodic CSI resource configuration for unlicensed carrier, UE measurement could be predicted by gNB when higher layer parameters are configured. It makes sense to verify the CQI definition test with burst transmission and DL LBT applied only for CSI-RS measurement.Observation 3: For aperiodic CSI-RS resource configuration for unlicensed carrier, the same UE behaviour as periodic CSI configuration (higher parameters are configured) is expected. Proposal 1: Define CQI definition test with DL burst transmission and LBT failure for CSI-RS measurement. The corresponding minimum requirement could be: a) The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time. CSI-RS is transmitted during burst transmission with LBT failure.b) If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1. When UE measure PDSCH BLER, no LBT failure is applied. |
| R4-2101345 | Huawei | *Proposal 1: The purpose of CQI test is to verify the following UE behaviours:** *UE does not average the channel measurement across the different transmission bursts*
* *UE should perform correct CQI measure on each transmission burst.*

*Proposal 2: Set feasible period and offset of CSI-RS and set probability of LBT failure to 0 to make all CSI-RS transmission occasions in COT duration to avoid unless CQI reporting.**Proposal 3: 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*
 |
| R4-2102586 | Qualcomm | Proposal 1: Discuss tests definition for CQI Performances based on the expected UE behaviour and capabilities related to CSI-RS validation in case of LBT failure, in parallel with the discussion of the same issue for PDSCH Performances. Proposal 2: For NR-U CQI Performance Testing, TE is expected to disregard a UE reporting which comes following a scheduled CSI-RS transmission that did not happen due to LBT failure, and it is expected to continue scheduling according to the last valid reporting.Proposal 3: For NR-U CQI Performance Testing, CQIs reported by the UE following a CSI-RS occasion that was not transmitted due to LBT failure will be ignored for the purposes of computing test pass/fail statistics. |

## Open issues summary

### CQI Performance Tests

**Issue 4-1-1: Whether to define CQI Tests**

* Proposals
	+ Option 1: Yes, with LBT failure for CSI-RS measurements; (Ericsson);
	+ Option 2: Yes, to test whether the UE does not average channel measurements across different transmission butsts and performs correct CQI measurements, with probability of LBT failure set to 0 (Huawei);
	+ Option 3: Discuss introduction of CQI requirements, based on UE capabilities related to CSI-RS Validation (Qualcomm);
* Recommended WF
	+ TBA

**Issue 4-1-2: Include PDCCH DCI 2-0 in CQI Simulations;**

* Proposals
	+ Option 1: Yes (MediaTek);
* Recommended WF

**Issue 4-1-3: Test Equipment Behaviour with respect to UE reporting, following a scheduled CSI-RS transmission was cancelled due LBT failure CQI Tests**

* Proposals
	+ Option 1: TE is expected to disregard the reporting and continue scheduling according to the last valid reporting; This reporting is ignored for test pass/fail statistics. (Qualcomm)
* Recommended WF
	+ TBA

**Issue 4-1-4: CQI Test Setup Details**

* Proposals
	+ Option 1 (Huawei)
		- 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.
* Recommended WF
	+ TBA

**Issue 4-1-5: Whether to use aperiodic CSI reporting as baseline**

* Proposals
	+ Option 1: Yes (Huawei);
		- PCell (license band) is used for HARQ ACK/NACK feedback and aperiodic CSI triggering/reporting.
* Recommended WF
	+ TBA

*Moderator comment: The proposal above does not seem to be applicable to scenario C (standalone NR-U Cell)*

**Issue 4-1-6: CQI Test Metrics**

* Proposals
	+ Option 1 (Ericsson):
		- The reported CQI value according to the reference channel shall be in the range of ±1 of the reported median more than 90% of the time. CSI-RS is transmitted during burst transmission with LBT failure.
		- If the PDSCH BLER using the transport format indicated by median CQI is less than or equal to 0.1, then the BLER using the transport format indicated by the (median CQI+1) shall be greater than 0.1. If the PDSCH BLER using the transport format indicated by the median CQI is greater than 0.1, then the BLER using transport format indicated by (median CQI-1) shall be less than or equal to 0.1. When UE measure PDSCH BLER, no LBT failure is applied;
	+ Option 2: CQI Distribution criterion and BLER criterion (Huawei):
* 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”* |