**3GPP TSG-RAN WG4 Meeting # 98-e R4-210XXXX**

**Electronic Meeting, Jan. 25th – Feb. 5th, 2021**

**Agenda item:** 7.1.7.4

**Source:** Moderator (Huawei, HiSilicon)

**Title:** Email discussion summary for [98e][317] NR\_unlic\_Demod\_BS

**Document for:** Information

# Introduction

The email discussion is for Rel-16 NR-U BS demodulation performance in Agenda 7.1.7.4. For the information, we focus on the general issues for BS demodulation and specific simulation assumptions for PUSCH, PUCCH and PRACH. In 2nd round discussion, work split for draft CR will be discussed based on agreed test cases in Topic#5.

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

* 1st round:
* Topic#1: Test scopes
	+ Sub-topic 1-1: How to handle Rel-15 test requirements for BS supporting NR-U
	+ Sub-topic 1-2: Specification structure for Rel-16 NR-U BS requirements
* Topic#2: PUSCH requirements
	+ Sub-topic 2-1: Bandwidth
	+ Sub-topic 2-2: PUSCH mapping type
	+ Sub-topic 2-3: MCS
	+ Sub-topic 2-4: RV sequence
	+ Sub-topic 2-5: CG-UCI multiplexed on PUSCH with interlace allocation
	+ Sub-topic 2-6: CG-UCI configuration for PUSCH test.
* Topic#3: PUCCH requirements
	+ Sub-topic 3-1:Propagation condition
	+ Sub-topic 3-2 :PUCCH Format 0
	+ Sub-topic 3-3: PUCCH Format 1
	+ Sub-topic 3-2: PUCCH Format 2
	+ Sub-topic 3-2: PUCCH Format 3
* Topic#4: PRACH requirements
	+ Sub-topic 4-1: Simulation assumptions
* Topic#5: Work split for CR drafting
* Topic#6: Simulation results for information
* 2nd round:
	+ Remaining issues for each topic (Topic#1, #2, #3, and #4) will be further discussed

# Topic #1: General issues

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4- 2100573 | Nokia, Nokia Shanghai Bell  | Observation 1: UEs that do not support interlaced PUSCH/PUCCH and long PRACH formats may also operate in unlicensed bands.Observation 2: The enhanced NR-U formats are used to fulfil minimum occupied bandwidth requirements which are not mandatory in all regions.Proposal 1: Reuse the existing Rel-15 test applicability rules for NR Rel-15 performance requirements testingProposal 2: Use the following table to define the work split of BS demodulation requirements: |
| R4-2100574 | Nokia, Nokia Shanghai Bell | Proposal 6: Specify interlaced PUSCH requirements in separate clauses 8.2.x and 11.2.1.x in 38.104 and 8.2.x in 38.141-1 and 38.141-2.  |
| R4-2100576 | Nokia, Nokia Shanghai Bell | Proposal 9: RAN4 to create new clauses for the performance requirements of interlaced PUCCH formats “Performance requirements for interlaced PUCCH format X” in 38.104, 38.141-1 and 38.141-2.  |
| R4- 2100578 | Nokia, Nokia Shanghai Bell | Proposal 5: RAN4 to adopt a generic naming convention that does not necessarily limit the use of the long PRACH sequences for NR-U.Proposal 6: Create new clauses in 38.104, 38.141-1, and 38.141-2 for PRACH with LRA=1151 and LRA=571 used in NR-U.Proposal 7: Create new clause in 38.104 “8.4.2.4 Minimum requirements for PRACH with LRA=1151 and LRA=571”Proposal 8: Create new clause in 38.141-1 “8.4.1.7 Test requirement for PRACH with LRA=1151 and LRA=571”Proposal 9: Create new clause in 38.141-2 “8.4.1.7 Test requirement for PRACH with LRA=1151 and LRA=571”Proposal 10: Create new declaration field for extended PRACH sequences which includes format, SCS, and LRA. A text proposal for such a declaration is: “Declaration of the supported PRACH format(s) with LRA=1151 and LRA=571 as specified in TS 38.211 [17], i.e., format: A1, A2, A3, B4, C0, C2. Declaration of the supported SCS(s) per supported extended PRACH format with short sequence, as specified in TS 38.211 [17], i.e., 15 kHz, 30 kHz or both, as well as sequence length other than LRA =139, i.e. LRA =1151 for 15 kHz SCS, and LRA =571 for 30 kHz SCS.” |
| R4-2100998 | Ericsson | Observation: Rel-15 requirement seems mandatory for a NR-U BS. To reduce test effort, RAN4 could consider adding applicability rules to skip some Rel-15 tests if a BS passed Rel-16 NR-U requirements.Proposal: Adding separate sections for interlacing PUSCH/PUCCH requirements. Adding new tables in normal mode section for large bandwidth PRACH requirement if Rel-15 assumptions are agreed to be reused. |

## 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: How to handle Rel-15 performance requirements for BS supporting NR-U

**Issue 1-1-1:** **How to handle Rel-15 test requirements for BS supporting NR-U**

* Proposals
	+ Option 1: It is mandatory for gNB operating in unlicensed bands to support the performance requirements defined for NR Rel-15 PUSCH, PUCCH and PRACH formats with the corresponding NR Rel-15 test applicability rules. (Huawei, Ericsson, Nokia, Samsung)
	+ Option 2:
* Recommended WF
	+ Conduct the performance requirements testing for both NR Rel-15 with existing test applicability rule and NR-U.

### Sub-topic 1-2: Specification structure for Rel-16 NR-U BS requirements

**Issue 1-2-1: Specification structure for PUSCH with interlacing structure requirements**

* Proposals
	+ Option 1: Create separate clauses 8.2.x and 11.2.1.x in 38.104 and 8.2.x in 38.141-1 and 38.141-2 for PUSCH and CG-UCI multiplexed on PUSCH performance requirements. (Ericsson, Nokia)
		- Option 1a: Create separate clauses 8.2.1A and 11.2.1.1A in 38.104 and 8.2.1A in 38.141-1 and 38.141-2 for PUSCH , and 8.2.3A and 11.2.1.3A in 38.104 and 8.2.3A in 38.141-1 and 38.141-2 CG-UCI multiplexed on PUSCH performance requirements if it is agreed to be introduced. (Huawei)
		- Option 1b: Create separate clauses 8.2.[9] and 11.2.1.[9] in 38.104 and 8.2.[9] in 38.141-1 and 38.141-2 for PUSCH performance requirements with interlace , and 8.2.[10] and 11.2.1.[9] in 38.104 and 8.2.[9] in 38.141-1 and 38.141-2 CG-UCI multiplexed on PUSCH performance requirements with interlace if it is agreed to be introduced.(Huawei)
	+ Option 2: Create a general clause 8.2A in TS 38.104, TS 38.141-1/2, clause 11.2A for PUSCH with interlace in TS 38.104, then
		- 8.2A.1 and 11.2A.1 for PUSCH and 8.2A.2 and 11.2A.2 for CG-UCI multiplexed on PUSCH in TS 38.104
		- 8.2A.1 for PUSCH and 8.2A.2 for CG-UCI multiplexed on PUSCH in TS 38.141-1/2
* Recommended WF

**Issue 1-2-2: Specification structure for PUCCH with interlacing structure requirements**

* Proposals
	+ Option 1: Specify interlaced PUCCH requirements in separate clauses 8.3.x and 11.3.1.x in 38.104 and 8.3.x in 38.141-1 and 38.141-2. (Ericsson, Nokia)
		- Option 1a: Specify interlaced PUCCH requirements in separate clauses 8.3.xA and 11.3.1.xA in 38.104 and 8.3.xA in 38.141-1 and 38.141-2, where x=2, 3, 4, 5.
	+ Option 2: Create a general clause 8.3A in TS 38.104, TS 38.141-1/2, clause 11.3A for PUSCH with interlace in TS 38.104, then create separate subclause under 8.3A and 11.3A for each agreed PUCCH formats (Huawei)
* Recommended WF

**Issue 1-2-3: Specification structure for PRACH requirements**

* Proposals
	+ Option 1: Adding new tables in normal mode section for large bandwidth PRACH requirement if Rel-15 assumptions are agreed to be reused. (Ericsson)
	+ Option 2: (Nokia, Huawei)
		- Create new clause in 38.104 “8.4.2.4 Minimum requirements for PRACH with LRA=1151 and LRA=571”.
		- Create new clause in 38.141-1 “8.4.1.7 Test requirement for PRACH with LRA=1151 and LRA=571”.
		- Create new clause in 38.141-2 “8.4.1.7 Test requirement for PRACH with LRA=1151 and LRA=571”.
* Recommended WF

**Issue 1-2-4: Declaration field for long sequence PRACH**

* Proposals
	+ Option 1: (Nokia) Create new declaration field for extended PRACH sequences in 38.141-1 which includes format, SCS, and *LRA*.
		- A text proposal for such a declaration is: “Declaration of the supported PRACH format(s) with *LRA*=1151 and *LRA*=571 as specified in TS 38.211 [17], i.e., format: A1, A2, A3, B4, C0, C2. Declaration of the supported SCS(s) per supported extended PRACH format with short sequence, as specified in TS 38.211 [17], i.e., 15 kHz, 30 kHz or both, as well as sequence length other than *LRA* =139, i.e. *LRA*=1151 for 15 kHz SCS, and *LRA* =571 for 30 kHz SCS.”
	+ Other options not precluded
* Recommended WF

**Issue 1-2-5: How to handle the** **long PRACH sequences with *LRA*=1151 and *LRA*=571 introduced for NR-U for other work items.**

* Proposals

Option 1: RAN4 to adopt a generic naming convention that does not necessarily limit the use of the long PRACH sequences for NR-U. (Nokia)

* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub-topic 1-1: How to handle Rel-15 test requirements for BS supporting NR-UIssue 1-1-1: How to handle Rel-15 test requirements for BS supporting NR-USub-topic 1-2: Specification structure for Rel-16 NR-U BS requirementsIssue 1-2-1: Specification structure for PUSCH with interlacing structure requirements Issue 1-2-2: Specification structure for PUCCH with interlacing structure requirements Issue 1-2-3: Specification structure for PRACH requirements Issue 1-2-4: Declaration field for long sequence PRACHIssue 1-2-5: How to handle that long PRACH sequences with *LRA*=1151 and *LRA*=571 introduced for NR-U for other work items. |
|  |  |
| Samsung | Sub-topic 1-1: How to handle Rel-15 test requirements for BS supporting NR-UIssue 1-1-1: How to handle Rel-15 test requirements for BS supporting NR-UWe are ok with option 1Sub-topic 1-2: Specification structure for Rel-16 NR-U BS requirementsIssue 1-2-1: Specification structure for PUSCH with interlacing structure requirements We slightly prefer option 2, considering only the resource allocation structure is different compared with Rel-15 Issue 1-2-2: Specification structure for PUCCH with interlacing structure requirements We slightly prefer option 2, considering only the resource allocation structure is different compared with Rel-15 Issue 1-2-3: Specification structure for PRACH requirements We are fine option 2, since the PRACH length and Ncs configuration is different with Rel-15Issue 1-2-4: Declaration field for long sequence PRACHWe are fine to add declaration, while only A1, B4 and C2 should be included as“Declaration of the supported PRACH format(s) with *LRA*=1151 and *LRA*=571 as specified in TS 38.211 [17], i.e., format: ~~A1,~~ A2, ~~A3,~~ B4, ~~C0,~~ C2. Declaration of the supported SCS(s) per supported extended PRACH format with short sequence, as specified in TS 38.211 [17], i.e., 15 kHz, 30 kHz or both, as well as sequence length other than *LRA* =139, i.e. *LRA*=1151 for 15 kHz SCS, and *LRA* =571 for 30 kHz SCS.” ”Issue 1-2-5: How to handle that long PRACH sequences with *LRA*=1151 and *LRA*=571 introduced for NR-U for other work items.We are fine with option 1. |
| Ericsson | **Sub-topic 1-1: How to handle Rel-15 test requirements for BS supporting NR-U****Issue 1-1-1: How to handle Rel-15 test requirements for BS supporting NR-U**Agree with WF.**Sub-topic 1-2: Specification structure for Rel-16 NR-U BS requirements****Issue 1-2-1: Specification structure for PUSCH with interlacing structure requirements** Tend to Option 1a to introduce new subclause under PUSCH requirement. **Issue 1-2-3: Specification structure for PRACH requirements** We are OK with Option 2. **Issue 1-2-4: Declaration field for long sequence PRACH**OK with Samsung’s proposal that only A2, B4, C2 are included in the declaration. **Issue 1-2-5: How to handle that long PRACH sequences with *LRA*=1151 and *LRA*=571 introduced for NR-U for other work items.**Option 1 is OK. |
| Huawei | **Sub-topic 1-1: How to handle Rel-15 test requirements for BS supporting NR-U****Issue 1-1-1: How to handle Rel-15 test requirements for BS supporting NR-U**OK with recommended WF**Sub-topic 1-2: Specification structure for Rel-16 NR-U BS requirements****Issue 1-2-1: Specification structure for PUSCH with interlacing structure requirements** Option 1a and option 2 are OK.**Issue 1-2-2: Specification structure for PUCCH with interlacing structure requirements** Option 2 are OK.**Issue 1-2-3: Specification structure for PRACH requirements** Option 2.**Issue 1-2-4: Declaration field for long sequence PRACH**OK with Samsung’s proposal. **Issue 1-2-5: How to handle the long PRACH sequences with *LRA*=1151 and *LRA*=571 introduced for NR-U for other work items.**OK with 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:* |

*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: PUSCH requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100574 | Nokia, Nokia Shanghai Bell | Proposal 1: RAN4 to define PUSCH performance requirements for 20MHz,40MHz,60MHz and 80MHz and reuse Rel 15 applicability rule for different channel bandwidths.Observation 1: Existing Rel. 15 NR requirements include mapping types A and B, where if both types are declared to be supported, tests for either type A or type B are performed.Proposal 2: RAN4 to define performance requirements for both mapping types A and B and keep the existing applicability rules for Rel. 15 regarding mapping type.Observation 2: In a standalone scenario the network cannot rely on licensed bands for full cell coverage, and robust MCS would be typically necessary at the cell edge.Observation 3: High SNR on an unlicensed carrier would be typically limited, since there is no control on the interferers.Proposal 3: RAN4 to define parameters for one robust MCS, such as MCS 2.Observation 4: RV sequences {0,2,0,2} is used for scheduling multiple PUSCH using a single DCI in NR-U.Observation 5: Simulation results showed only minor performance difference between RV sequences {0,2,3,1} and {0,2,0,2} with interlaced PUSCH.Proposal 4: RAN4 to adopt {0,2,3,1} as RV sequence.Observation 6: Encoding procedure for GC-UCI is very similar to CSI and HARQ-ACK, with meaningful differences only on the mapping of resource elements.Proposal 5: RAN4 not to define performance requirements for GC-UCI.Proposal 6: Specify interlaced PUSCH requirements in separate clauses 8.2.x and 11.2.1.x in 38.104 and 8.2.x in 38.141-1 and 38.141-2.  |
| R4-2100575 | Nokia, Nokia Shanghai Bell | Provide the simulation results. |
| R4-2100919 | Samsung | Proposal 1: Reuse the existing Rel-15 test applicability rules for performance requirement testing for NR-U.Proposal 2: Only define the demodulation requirement with 20 MHz CBW with test applicability rule.Proposal 3: The test shall apply only for the smallest supported subcarrier spacing if BS declares to support both 15 kHz and 30 kHzObservation 1: Symbol 0 is not the starting position for PUSCH requirement with eLAA operation.Proposal 4: Only define the PUSCH requirement with mapping type B.Proposal 5: Define PUSCH requirement with MCS 20 and RV sequence as {0, 2, 0, 2}.Proposal 6: Do not introduce requirements for GC-UCI multiplexing on PUSCH |
| R4-2100999 | Ericsson | Observation 1: The simulation results of 20MHz and 80MHz interlace PUSCH are very close. Observation 2: Rel-15 only define limited requirements for general bandwidth. Proposal 1: Agree with option 1: Define the requirements for single carrier with 20MHz only with the test applicability rule that a BS only has to perform tests for the largest supported bandwidth based on BS vendor’s declaration. Proposal 2: Agree with option 2 to define requirement for both mapping type A and type B.Proposal 3: Agree with MCS20 for interlace PUSCH demodulation assumptions.Proposal 4: Agree with RV sequence {0,2,3,1}.Observation 3: CG-UCI use the similar coding and resource mapping procedure as long payload HARQ-ACK multiplexing on PUSCH. Observation 4: Rel-15 UCI multiplexing on PUSCH requirements can’t cover CG-UCI case. Observation 5: CG-UCI and HARQ-ACK have the same importance for NR-U cell performance. The test metric BLER might be more stringent for CG-UCI multiplexing demodulation requirement with/without HAQR-ACK.Proposal 5: Introduce requirement for HARQ-ACK multiplexing on interlacing PUSCH with more than 2 bits information, without CSI-1/2, and the test metric use BLER <=1%. |
| R4-2101000 | Ericsson | Provide the simulation results. |
| R4-2101347 | Huawei, HiSilicon | Proposal 1: Only define requirements for 20MHz with following applicability rules:The tests shall be done only for the supported widest supported channel bandwidth. If BS support bandwidth larger than 20MHz, tested RBs for 20MHz shall then be centered in the whole bandwidth.Proposal 2: Only test DMRS type BProposal 3: Use RV {0, 2, 0, 2}Proposal 4: Further discuss whether to configure CG-UCI during PUSCH test.Proposal 5: Introduce performance requirements for CG-UCI multiplexed on PUSCH with interlaced resource allocation and without HARQ-ACK, CSI part 1 and CSI part 2 and use Table 2-1 as simulation assumptions. |

## Open issues summary

### Sub-topic 2-1 Bandwidth

**Issue 2-1-1: Bandwidth(s) for requirement definition and test applicability rules**

* Proposals
	+ Option 1: Define the requirements for single carrier with 20MHz and reuse Rel-15 applicability rule for different channel bandwidths. (Huawei, Samsung, Ericsson)
	+ Option 2: Define PUSCH performance requirements for 20MHz, 40MHz, 60MHz and 80MHz and reuse Rel-15 applicability rule for different channel bandwidths. (Nokia)
* Recommended WF

### Sub-topic 2-2 PUSCH mapping type

**Issue 2-2-1: PUSCH mapping type and test applicability rules**

* Proposals
	+ Option 1: Only type B (Huawei, Samsung)
	+ Option 2: Both type A and type B and reuse Rel-15 applicability rules.(Nokia, Ericsson)
* Recommended WF

### Sub-topic 2-3 MCS

**Issue 2-3-1: MCS**

* Proposals
	+ Option 1: MCS 2 and MCS 20 (Nokia)
	+ Option 2: MCS 20 (Huawei, Ericsson, Samsung)
* Recommended WF

### Sub-topic 2-4 RV sequence

**Issue 2-4-1: RV sequence**

* Proposals
	+ Option 1: {0,2,3,1} (Nokia, Ericsson)
	+ Option 2: {0,2,0,2} (Huawei, Samsung)
* Recommended WF

### Sub-topic 2-5 CG-UCI multiplexed on PUSCH with interlace allocation

**Issue 2-5-1: Whether to introduce the requirements for CG-UCI multiplexed on PUSCH with interlace allocation.**

* Proposals
	+ Option 1: No (Nokia, Samsung)
	+ Option 2: Yes (Huawei, Ericsson)
		- Option 2a: Introduce requirement for HARQ-ACK multiplexed on interlacing PUSCH with more than 2 bits information, without CSI-1/2, and the test metric use BLER <=1%.(Ericsson)
		- Option 2b: Introduce performance requirements for CG-UCI multiplexed on PUSCH with interlaced resource allocation and without HARQ-ACK, CSI part 1 and CSI part 2 and use following Table as assumptions: (Huawei)

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Waveform | CP-OFDM |
| Bandwidth | 20MHz |
| CG-UCI configuration | Payloads | 8 bits |
| $$β\_{offset}^{CG-UCI}$$ | 20 |
| Frequency domain resource allocation | First one interlace |
| Time domain resource allocation | 14 OFDM symbols |
| SCS | 15kHz and 30kHz |
| TDD pattern | 7D2S1U S=6D:4G:4U for 30kHz SCS3D1S1U S=10D:2G:2U for 15kHz SCS |
| DMRS configuration | Type BType 1 with single-symbol and dmrs-AdditionalPosition ‘pos1’ |
| Antenna configuration | 1x2 |
| MCS | 20 |
| Propagation condition | TDLA30-10 Low |
| RV sequence | {0,2,0,2} |
| Test metric | 1% BLER of CG-UCI |
| Note 1: HARQ-NACK, CSI part 1 and CSI part 2 are not transmitted with CS-UCI on PUSCH. |

* Recommended WF

### Sub-topic 2-6 CG-UCI configuration for PUSCH test.

**Issue 2-6-1: Whether to configure CG-UCI for PUSCH test.**

* Proposals
	+ Option 1: Configure CG-UCI for PUSCH test with interlace structure. (Huawei)
	+ Option 2: Not configure CG-UCI for PUSCH test with interlace structure
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1-1: Bandwidth(s) for requirement definition and test applicability rulesIssue 2-2-1: PUSCH mapping type and test applicability rulesIssue 2-3-1: MCSIssue 2-4-1: RV sequenceIssue 2-5-1: Whether to introduce the requirements for CG-UCI multiplexed on PUSCH with interlace allocation.Issue 2-6-1: Whether to configure CG-UCI for PUSCH test. |
| Samsung | Issue 2-1-1: Bandwidth(s) for requirement definition and test applicability rulesWe prefer option1Issue 2-2-1: PUSCH mapping type and test applicability rulesWe prefer only define Type B as option 1For NR-U operation, before PUSCH transmission, LBT should be performed firstly. It cannot guarantee that full slot transmission is always available. Therefore, partial slot transmission should be the typical scenario. During RAN1 discussion, the possible candidates for PUSCH transmission in the partial slot including PUSCH(s) as in Rel-15. Similar as PUSCH requirement for LTE eLAA scenario, the related PUSCH starting position is indicated from the 2nd symbol for the first subframe.Issue 2-3-1: MCSWe are fine with option 2, For NR-U operation, the purpose of defining requirement is to verify the interlace design. There is no need to replicate the test cases. Therefore, only chosen one set of MCS for requirement should be enough. Since RAN4 group has agreed to introduce high modulation order requirement with MCS 20, we prefer to only define requirement with MCS 20, if the related performance can be guaranteed with interlace designIssue 2-4-1: RV sequenceWe are fine with option 2. Option 2 is the simulation assumption for PUSCH requirement in LTE eLAA. We can apply option 1 as starting point.Issue 2-5-1: Whether to introduce the requirements for CG-UCI multiplexed on PUSCH with interlace allocation.We prefer no requirements for GC-UCI multiplexing on PUSCH as option 1From the mapping rule of CG-UCI perspective, there is no different compared with existing Rel-15 UCI type. Compared with Rel-15, interlace allocation was introduced into the NR-U WI. From the receiver process perspective, there should be different behaviourSince it was agreed to introduce PUSCH requirement with interlace allocation, the receiver behaviour for interlace can be verified, there is no need to introduce additional test. Issue 2-6-1: Whether to configure CG-UCI for PUSCH test. |
| Ericsson  | **Issue 2-1-1: Bandwidth(s) for requirement definition and test applicability rules**Prefer Option 1. **Issue 2-2-1: PUSCH mapping type and test applicability rules**Agree with Option 2 to cover different BS implementations, for example type A might be used in FBE. **Issue 2-3-1: MCS**We prefer Option 2 that MCS20 seems feasible based on current simulation and we don’t think coverage issue should be specially considered in tyipical NR-U deployment. **Issue 2-4-1: RV sequence**Prefer Option 1 that our purpose is to test interlace strucutre not multi PUSCH, so it is unnecessary to use special RV. Furthermore, there is no clear difference between {0, 2, 0, 2} and {0, 2, 3, 1} when we test 70% throughput. **Issue 2-5-1: Whether to introduce the requirements for CG-UCI multiplexed on PUSCH with interlace allocation.**We can accept that requirement for CSI multiplexing on interlacing PUSCH is not needed since Rel-15 requirement can cover it. But for CG-UCI, its mapping procedure and coding method are very similar to HARQ-ACK with more than 2 bits information when multiplexing on PUSCH which is different from CSI multiplexing. There is no conclusion in Rel-15 that CSI multiplexing on PUSCH requirement can cover HARQ-ACK multiplexing on PUSCH requirement. They are actually lead to different consequence and need different test metric. That is the motivation we want to introduce requirement for HARQ-ACK or CG-UCI. And HARQ-ACK requirement is more general and can cover CG-UCI case. Prefer Option 2a. **Issue 2-6-1: Whether to configure CG-UCI for PUSCH test.**If we just to test interlace structure, we prefer Option 2. |
| Huawei | **Issue 2-1-1: Bandwidth(s) for requirement definition and test applicability rules**Option 1. From our simulation results, there is small performance difference between different bandwidth.**Issue 2-2-1: PUSCH mapping type and test applicability rules**We can compromise to option 2 to cover BS supporting different PUSCH mapping types.**Issue 2-3-1: MCS**MCS2 and MCS20 have been tested in Rel-15, we propose to only test MCS20. If BS pass the test with MCS20, it can pass case with MCS2. It is not necessary to test all MCSs used for Rel-15.**Issue 2-4-1: RV sequence**Prefer option 2 to keep consistency with LAA.**Issue 2-5-1: Whether to introduce the requirements for CG-UCI multiplexed on PUSCH with interlace allocation.**Option 2b.We think CG-UCI is a new signal multiplexed on PUSCH with interlaced structure. It is transmitted on every CG-PUSCH. For NR-U PUSCH, it contains much important information such as HARQ-ID, RV, NDI and COT sharing information.Considering it is a new signal multiplexed on channels with new structure, we think it is necessary to define requirement to guarantee the related performance. **@Ercssion**: Although HARQ-NACK has the same mapping precedure and coding method with CG-UCI, HARQ-NACK is not always transmitted on PUSCH but CG-UCI is transmitted on every CG-PUSCH. What’s more, CG-UCI is introduced in NR-U WI and sholud be considered as first priority while HARQ-NACK multiplexing on PUSCH is a Rel-15 feature and is out of the scope of the NR-U WI, CG-UCI should be considered rather than HARQ-NACK.**Issue 2-6-1: Whether to configure CG-UCI for PUSCH test.**According to RAN1 agreement, CG-UCI should be transmitted on every CG-PUSCH. CG-PUSCH is an important PUSCH format, one shot transmission for both control information (HARQ-ID, RV, NDI and COT) and PUSCH data with less UL LBT for NR-U.  |

### 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: PUCCH requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100577 | Nokia, Nokia Shanghai Bell | Provide the simulation results |
| R4-2100576 | Nokia, Nokia Shanghai Bell | Proposal 1: Reuse Rel. 15 approach whenever possible and specify interlaced PUCCH requirements with TDLC300-100.Observation 1: For the PUCCH format 0, the SNR using the misdetection metric results in an SNR 1.5 dB larger than for the NACK to ACK metric.Proposal 2: RAN4 to reuse Rel 15 metric for interlaced PUCCH format 0.Observation 2: Rel-15 metric for PUCCH format 1 already includes Prob(ACK miss), Prob(PUCCH DTX→Ack bits), and Prob(NACK→ACK).Proposal 3: RAN4 to reuse Rel-15 metric for PUCCH format 1 with NACK to ACK requirements and ACK missed detection requirements.Observation 3: Tests for PUCCH format 2 with two payload sizes covering both polar code and Reed-Muller are already specified for the Rel. 15 PUCCH format 2.Proposal 4: RAN4 to specify requirements for only one combination of information bits and OFDM symbols for interlaced PUCCH formats 2 and 3.Proposal 5: RAN4 to specify requirements for interlaced PUCCH format 2 with 22 bits.Proposal 6: RAN4 to specify requirements for interlaced PUCCH format 3 with 16 bits and 4 OFDM symbols.Observation 4: OCC lengths n2 and n4 are introduced as an NR-U feature for PUCCH formats 2 and 3 in Rel. 16Observation 5: OCC lengths n2 and n4 are important for efficient resource utilization when using interlaced PUCCH formats 2 and 3.Proposal 7: RAN4 to specify requirements for PUCCH formats 2 and 3 with only 1 OCC configuration.Proposal 8: RAN4 to specify requirements only with OCC length n2 for interlaced PUCCH formats 2 and 3.Proposal 9: RAN4 to create new clauses for the performance requirements of interlaced PUCCH formats “Performance requirements for interlaced PUCCH format X” in 38.104, 38.141-1 and 38.141-2. |
| R4-2101001 | Ericsson | Proposal 1: Agree with option 2 to define interlace PUCCH requirement under TDLC300-100.Observation 1: The ACK miss is the bottleneck metric for interlaced PF0.Proposal 2: To align with Rel-15 PUCCH requirements, define test metric for interlaced PUCCH format as:* The DTX to ACK probability shall not exceed 1% for all interlaced PUCCH formats carrying ACK/NACK bits.
* Interlaced PF0: SNR@Prob(ACK miss)≤10^(−2))
* Interlaced PF1: SNR@Prob(ACK miss)≤10^(−2)) and SNR@Prob(NACK→ACK)≤10^(−3))
* Interlaced PF2: SNR@Prob(UCI block BLER)=10^(−2) .
* Interlaced PF3: SNR@Prob(UCI block BLER)=10^(−2)

Proposal 3: Only add 4 bits information test case for interlacing PF3. Proposal 4: Accept following test cases for interlaced PF3: * 4 information bits with 14 OFDM symbols
* 16 information bits with 4 and 14 OFDM symbols
* Reuse Rel-15 PF3 applicability rule for different DM-RS configuration.

Proposal 5: Configure OCC length as n2 and OCC index as n0 for interlace PF2/3 demodulation requirements to check multi-user multiplexing. |
| R4-2101002 | Ericsson | Provide the simulation results |
| R4-2100920 | Samsung | Proposal 1: Specify the PUCCH requirement for NR-U with TDLA30-10 channel.Proposal 2: Only apply Rel-15 test metric for PUCCH format 0 requirement as* SNR@Prob(ACK miss)≤10^(−2)
* SNR@Prob(PUCCH DTX→Ack bits) ≤ 10^(−2)

Proposal 3: Only apply Rel-15 test metric for PUCCH format 1 requirement as* SNR@Prob(ACK miss)≤10^(−2)
* SNR@Prob(NACK→ACK) ≤ 10^(−3)

Proposal 4: Specify the PUCCH format2 with following test parameters* Information bits: 22
* OCC-Length-r16: Not configured

Observation 1: Both information bits with 4 and 16 are not feasible for PUCCH format 3.Proposal 5: Specify the PUCCH format 3 with following test parameters* Information bits: 42
* Number of OFDM: 4
* OCC length : n2
 |
| R4-2101349 | Huawei, HiSilicon | Proposal 1： Use TDLA-30-10 for NRU PUCCH test.Proposal 2: Reuse Rel-15 PF0 test metric for NR-U PUCCH PF0.Proposal 3: Reuse Rel-15 PF1 test metric for NR-U PUCCH PF1.Proposal 4: Test 4 bits for PF2 and 16 bits for PF3 to cover both polar encoding and RM encodingProposal 5: Not configure OCC for PF2 testingProposal 6: Consider OCC n1 for PF3. |
| R4-2101348 | Huawei, HiSilicon | Provide our simulation results |

## Open issues summary

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

### Sub-topic 3-1: Propagation conditions

**Issue 3-1-1: Propagation condition**

* Proposals
	+ Option 1: TDLC300-100 (Ericsson, Nokia)
	+ Option 2: TDLA30-10 (Huawei, Samsung)
* Recommended WF

### Sub-topic 3-2 PUCCH Format 0

**Issue 3-2-1** **Test metric**

* Proposals :
	+ Option 1: Reuse the test metric of Rel-15 PF0 (Huawei, Nokia, Samsung, Ericsson)
* Recommended WF
	+ Reuse the test metric of Rel-15 PF0:
		- Prob(ACK missed)≤10-2
		- Prob(DTX->ACK)≤10-2

### Sub-topic 3-3 PUCCH Format 1

**Issue 3-3-1 Test metric**

* Proposals:
	+ Option 1: Reuse the test metric of Rel-15 PF1 (Huawei, Nokia, Samsung, Ericsson)
* Recommended WF
	+ Reuse the test metric of Rel-15 PF1:
		- Prob(ACK missed)≤10-2
		- Prob(DTX->ACK)≤10-2
		- Prob(NACK->ACK)≤10-3

### Sub-topic 3-4 PUCCH Format 2

**Issue 3-4-1: Number of information bits**

* Proposals:
	+ Option 1: 4 bits (Huawei)
	+ Option 2: 22 bits (Nokia, Samsung, Ericsson, Huawei)
* Recommended WF

**Issue 3-4-2: OCC configuration**

* Proposals:
	+ Option 1: Not configure (Huawei, Samsung)
	+ Option 2: OCC length n2, OCC index n0. (Ericsson, Nokia)
* Recommended WF

**Issue 3-4-3: Test metric**

* Proposals:
	+ Option 1: SNR @ 10^(−2) of UCI block BLER = (for 22bits information bits ) (Ericsson)
	+ Option 2: SNR@ 10^(-2) probability of ACK missed detection (for 4 bits information bit) (Huawei)
* Recommended WF

### Sub-topic 3-5 PUCCH Format 3

**Issue 3-5-1: Number of information bits**

* Proposals:
	+ Option 1: 4 bits and 16 bits (Ericsson)
	+ Option 2: 16 bits (Huawei, Nokia)
	+ Option 3: 42 bits (Samsung)
	+ Option 4: 4bits (Huawei)
* Recommended WF

**Issue 3-5-2: Number of OFDM symbols:**

* Proposals:
	+ Option 1: 4 (Nokia, Samsung)
	+ Option 2: 4 and 14 (4 information bits with 14 OFDM symbols, 16 information bits with 4 and 14 OFDM symbols) (Ericsson)
* Recommended WF

**Issue 3-5-3: OCC configuration**

* Proposals
	+ Option 1: OCC length n2 and OCC index n0 (Samsung, Ericsson, Nokia)
	+ Option 2: Not configure (Huawei)
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Sub-topic 3-1: Propagation conditions**Issue 3-1-1: Propagation conditions**Sub-topic 3-2 PUCCH Format 0**Issue 3-2-1 Test metric**Sub-topic 3-3 PUCCH Format 1**Issue 3-3-1 Test metric**Sub-topic 3-4 PUCCH Format 2**Issue 3-4-1: Number of information bitsIssue 3-4-2: OCC configuration Issue 3-4-3: Test metric**Sub-topic 3-5 PUCCH Format 3**Issue 3-5-1: Number of information bitsIssue 3-5-2: Number of OFDM symbols:Issue 3-5-3: OCC configuration |
| Samsung | **Sub-topic 3-1: Propagation conditions**Issue 3-1-1: Propagation conditionsWe prefer option 2TDLC300-100 is chosen for exiting PUCCH requirement in Rel-15 for FR1. The purpose of defining PUCCH requirement is to verify the interlace design. It was agreed that only one interlace will be considered. The gap for RB allocation within one interlace as 10 RBs for 15 kHz SCS, and 5 RBs for 30 kHz. Since the basic unit is the one interlace without joint DM-RS optimization, channel with lower delay is more proper for verify the channel estimation. Meanwhile, the purpose of NR-U maybe the offloading, so main use case corresponds to the stationary scenario and small cell, therefore, we prefer to specify PUCCH requirement for NR-U with TDLA30-10 channel.**Sub-topic 3-2 PUCCH Format 0**Issue 3-2-1 Test metricWe are fine with option 1**Sub-topic 3-3 PUCCH Format 1**Issue 3-3-1 Test metricWe are fine with option 1**Sub-topic 3-4 PUCCH Format 2**Issue 3-4-1: Number of information bitsWe prefer option 2.Based on the agreement in the last meeting, only one interlace and one symbol were agreed for PUCCH format 2, where 11 RBs are allocated for 15 kHz and 30 kHz, separately.NR PUCCH can support two kinds of coding scheme. In case of the payload of UCI is less than 11 bits, there is no CRC operation and with RM coding. While in case of the payload of UCI is larger than 11 bits, Polar code is applied, 6 bits CRC and 11 bits CRC can be available. In case of UCI information is 4 bits, the code rate is very small, which is out of RRC configured code-rate.Issue 3-4-2: OCC configuration We prefer to not configure as option 1.The motivation of introducing OCC length is to support multiple UE multiplexing.As indicated in the spec,

|  |
| --- |
| If the higher layer parameter *interlace1* is not configured, and the higher-layer parameter *OCC-Length* is configured,- $N\_{SF}^{PUCCH,2}\in \left\{2,4\right\}$ is given by the higher-layer parameter *OCC-Length*; - $w\_{n}\left(i\right)$ is given by Tables 6.3.2.5A-1 and 6.3.2.5A-2 where $n=\left(n\_{0}+n\_{IRB}\right) mod N\_{SF}^{PUCCH,2}$, the quantity $n\_{0}$ is the index of the orthogonal sequence to use given by the higher-layer parameter *OCC-Index*, and $n\_{IRB}$ is the interlaced resource block number as defined in clause 4.4.4.6 within the interlace given by the higher-layer parameter *Interlace0*.Otherwise $N\_{SF}^{PUCCH,2}=1$ and $w\_{n}\left(i\right)=1.$ |

Since only single UE is considered for specifying the PUCCH requirement, the performance of n2 and n4 should be no different. Therefore, we prefer to not configure the OCC length to simply the test.Issue 3-4-3: Test metricWe prefer option 1**Sub-topic 3-5 PUCCH Format 3**Issue 3-5-1: Number of information bitsWe prefer option 3. Option 1 and Option 2 are not feasible based on the candidate parameters. Different with format 2, only 10 RBs are allocated for format3, considering the DFT-s-OFDM waveform. The following are possible number Res related to different length of OFDM symbolsTable 3: Feasibility checking for different number of information bits

|  |  |  |  |
| --- | --- | --- | --- |
| **Information bit**  | **Payload before code** | **Number bits transmission**  | **Code rate** |
| 4 | 4 | 720 (4 OS) | 0.0056 |
| 2880(14OS) | 0.0014 |
| 16 | 16+6 =22 (6 bits CRC) | 720 (4 OS) | 0.031 |
| 2880 (14OS) | 0.0076 |
| 42 | 53 (11 bits CRC) | 720 (4 OS) | 0.0736 |
| 2880(14OS) | 0.0184 |

Where the number of RB allocated should be satisfied as following condition , if @Samsung: The condition here only includes ACK which is not suitable for PF3. We actually test CSI for PF3/ePF3, and then the condition should be (subclause 9.2.5.2 TS38.213):If a UE is provided a first interlace of 𝑀Interlace,0 PUCCH PRBs by *interlace0* in *InterlaceAllocation-r16*, the UE has HARQ-ACK, SR and sub-band CSI reports to transmit, and the UE determines a PUCCH resource with PUCCH format 3, where - the UE determines the PUCCH resource using the PUCCH resource indicator field in a last of a number of DCI formats that have a value of a PDSCH-to-HARQ\_feedback timing indicator field indicating a same slot for the PUCCH transmission, from a PUCCH resource set provided to the UE for HARQ-ACK transmission, and - the UE determines the PUCCH resource set as described in Clauses 9.2.1 and 9.2.3 for 𝑂UCI UCI bits and - if (𝑂ACK + 𝑂SR + 𝑂CSI + 𝑂CRC) ≤ 𝑀Interlace,0 PUCCH ⋅ 𝑁sc,ctrl RB ⋅ 𝑁symb-UCI PUCCH ⋅ 𝑄𝑚 ⋅ 𝑟, the UE transmits the HARQ-ACK, SR and the 𝑁CSI total CSI report bits in a PUCCH over the first interlaceThere is no lower limit for 𝑂ACK + 𝑂SR + 𝑂CSI + 𝑂CRC is defined.Issue 3-5-2: Number of OFDM symbols:We prefer option 1 as 4OS, based on our calculation.Issue 3-5-3: OCC configurationWe prefer option 1The block-wise spread is introduced to format 3, where spread factor with n2 and n4 can be support for single interlace. Where n2 can support 2 Ues multiplexing, and n4 can support 4 Ues multiplexing. Since only single UE is considered for specifying the PUCCH requirement, the performance with different OCC length should be no different. For simplicity, we prefer to configure the OCC length is n2 same as format 4 in Rel-15We would like to clarify the OCC length n1, based on 331, it seems that only n2 and n4 can be configured, if my understanding is correct.formatExt-v1610 CHOICE { interlace1-v1610 INTEGER (0..9), occ-v1610 SEQUENCE { occ-Length-v1610 ENUMERATED {n2,n4} OPTIONAL, -- Need M occ-Index-v1610 ENUMERATED {n0,n1,n2,n3} OPTIONAL -- Need M }}  |
| Ericsson  | **Sub-topic 3-1: Propagation conditions**Issue 3-1-1: Propagation conditionsTo keep the consistency with Rel-15, we prefer Option 1, but we are open for Option 2.**Sub-topic 3-2 PUCCH Format 0**Issue 3-2-1 Test metricAgree with WF.**Sub-topic 3-3 PUCCH Format 1**Issue 3-3-1 Test metricAgree with WF.**Sub-topic 3-4 PUCCH Format 2**Issue 3-4-1: Number of information bitsIf Rel-15 requirements have to be tested, then 4 bits is unnecessary here. We prefer Option 2.Issue 3-4-2: OCC configuration We are OK with both Option 1 and Option 2. Issue 3-4-3: Test metricOption 1.**Sub-topic 3-5 PUCCH Format 3**Issue 3-5-1: Number of information bitsPrefer Option 1. Some comments are added to the Samsung’s comments section. Issue 3-5-2: Number of OFDM symbols:Prefer Option 2.Issue 3-5-3: OCC configurationPrefer Option 1.  |
| Huawei | **Sub-topic 3-1: Propagation conditions**Issue 3-1-1: Propagation conditionsPrefer Option 2. Considering NR-U is mainly deployed for stationary scenario, TDLA is more applicable. What’s more, we think it’s better to use the same propagation conditions for all test cases (Note that it is agreed to use TDLA for PUSCH). @Ericsson, it is not necessary to keep consistency with Rel-15 considering this is new Rel-16 WI.**Sub-topic 3-2 PUCCH Format 0****Issue 3-2-1 Test metric**OK with recommended WF.**Sub-topic 3-3 PUCCH Format 1**Issue 3-3-1 Test metricOK with recommended WF.**Sub-topic 3-4 PUCCH Format 2**Issue 3-4-1: Number of information bits@Samsung, from our understanding, the restriction for information bits and number of PRBs you extracted from core specification is only applicable for PF2/3 without interlace structure. The PRBs used for PF2/3 is adjustable in Rel-15 as per the formula you pointed out, UE should select the minimum number RBs to satisfy the code rate that is just lower than the RRC configured *maxCodeRate*. For PF2/3 with interlaced structure, the number of PRBs is fixed by following the procedure in TS 38.213:

|  |
| --- |
| If a UE is provided a first interlace of $M\_{Interlace,0}^{PUCCH}$ PRBs by interlace0 in InterlaceAllocation-r16 and transmits a PUCCH with $O\_{ACK}$ HARQ-ACK information bits, $O\_{SR}=\left⌈log\_{2}\left(K+1\right)\right⌉$ SR bits, and $O\_{CRC}$ CRC bits using PUCCH format 2 or PUCCH format 3, the UE transmits the PUCCH over the first interlace if $\left(O\_{ACK}+O\_{SR}+O\_{CRC}\right)\leq M\_{Interlace,0}^{PUCCH}⋅N\_{sc,ctrl}^{RB}⋅N\_{symb-UCI}^{PUCCH}⋅Q\_{m}⋅r$; otherwise, if the UE is provided a second interlace by interlace1 in PUCCH-format2 or PUCCH-format3, the UE transmits the PUCCH over the first and second interlaces. |

Some companies concern that code rate for 4 bits is too low, we can compromise to use 22 bits, but considering the test coverage for both RM coding and polar coding, if RM coding is tested for PF2, polar coding should be tested for PF3.Issue 3-4-2: OCC configuration We support option 1. According to 38.306, supporting OCC for PF2 and PF3 is based on UE capability:

|  |
| --- |
| ***occ-PRB-PF2-PF3-r16*** Indicates whether the UE supports OCC for PRB interface mapping for PUCCH format 2 and 3. If the UE supports this feature, the UE needs to report *pucch-F0-F1-PRB-Interlace-r16*. |

As we discussed in our contribution, there is no performance difference for different OCC length, therefore, we propose to not configure OCC for PF2**Issue 3-4-3: Test metric**If 4 bits is agreed, we support option 2, otherwise we can support option 1.**Sub-topic 3-5 PUCCH Format 3**Issue 3-5-1: Number of information bitsAs we discussed for PF2, if 22 bits is agreed for PF2. 4 bits should be used for PF3 to include RM coding. Meanwhile, for workload, we propose to only test 4 bits.@Samsung: As we discussed for PF2, there is no restriction on information bits for PF2/3 with interlaced structure, considering polar coding has been verified for PF2 test, 4 bits should be used for PF3.Issue 3-5-2: Number of OFDM symbols:Prefer option 1.Issue 3-5-3: OCC configuration@Samsung, from our understanding, there are three cases for OCC configuration for PF3 with interlaced structure: Not configured, OCC n2 and OCC n4 which are respectively corresponding to Nsf=1, Nsf=2 and Nsf=4 as described as follows derived from TS 38.211: In 38.331 and 38.306, it has been specified that supporting OCC is optional and based on UE capability:TS38.331: TS38.306: Considering OCC is optional for UE and has no impact on performance, we propose to not configure OCC for PF3. We updated Option 2 to not configure OCC considering no n1 configuration. |

### 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: PRACH 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- 2100578 | Nokia, Nokia Shanghai Bell | Proposal 1: RAN4 to test NR-U PRACH with NCS=164 for 15 kHz SCS and NCS=190 for 30 kHz SCS.Observation 2: Reducing the PRACH demodulation time error tolerance results in no clear benefit, since current limits for AWGN match the minimum TA command step.Proposal 2: Not to define time error tolerance that is smaller than the minimum possible step for the timing advance command.Proposal 3: RAN4 to maintain the existing time error tolerance defined in 38.104.Observation 3: PRACH performance of NR-U sequences have only small differences when comparing fading models TDLA30 and TDLC300.Observation 4: PRACH time error tolerance are currently only defined for AWGN and TDLC300 channel models.Proposal 4: RAN4 to define NR-U PRACH performance requirements for AWGN and TDLC 300 fading models.Observation 5: Long PRACH sequences designed for NR-U are currently also being considered for other work items. |
| R4- 2100579 | Nokia, Nokia Shanghai Bell | Provide the simulation results |
| R4-2100921 | Samsung | Proposal 1: Specify PRACH requirement with A2, B4, and C2 Proposal 2: Specified PRACH requirement with TDLA30-10 Proposal 3: Specified PRACH requirement with Ncs Configuration as

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Burst format | LRA | SCS (kHz) | Ncs | Logical sequence index | v |
| A2, B4, C2 | 1151 | 15 | 127 | 0 | 0 |
| 571 | 30 | 190 | 0 | 0 |

Proposal 4: Reuse existing test metrics: the false alarm probability shall be less than or equal to 0.1%, the probability of detection shall be equal to or exceed 99% and time error tolerance requirements as

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | LRA | SCS (kHz) | Time tolerance for AWGN | Time tolerance for TDLA30-10 |
| A2, B4, C2 | 1151 | 15 | 0.52 us  | 2.03 us |
| 571 | 30 | 0.26 us | 1.77 us |

 |
| R4-2101003 | Ericsson | Proposal 1: Define wideband PRACH requirement with fading channel TDLC300-100.Proposal 2: Accept Option 2 that Ncs is 164 for LRA=1151 and 190 for LRA=571.Observation 1: Take 0.06us as time error tolerance is feasible for large bandwidth PRACH. Observation 2: Reusing Rel-15 assumptions is also feasible and needs less effort for specification modification. Proposal 3: Reuse Rel-15 assumptions for large bandwidth PRACH requirement. |
| R4-2101265 | Intel | Proposal 1: RAN4 to define performance requirements for NR-U PRACH for TDLC300-100 channel Proposal 2: RAN4 to define performance requirements for NR-U PRACH considering Ncs = 164 for LRA=1151 and Ncs = 190 for LRA=571Proposal 3: RAN4 to reuse Rel-15 time error tolerance requirements given in Table 8.4.2.1-1 of TS38.104 |
| R4-2101351 | Huawei, HiSilicon | Proposal 1: Use TDLA30-10 for PRACH tests.Proposal 2: For Ncs, use 127 for LRA=1151 and 63 for LRA=571Proposal 3: Keep exiting values for time error estimation tolerance. For TDLA-30-10, the time error tolerance can be 0.88 us for 15 kHz and 0.62 us for 30 kHz. |
| R4-2101350 | Huawei, HiSilicon | Provide the simulation results |

## Open issues summary

### Sub-topic 4-1: Simulation assumprions

**Issue 4-1-1: PRACH format**

* Proposals
	+ Option 1: A2, B4, C2 (Samsung)
* Recommended WF
	+ Confirm the agreements made in last meeting: A2, B4, C2

**Issue 4-1-2: Propagation conditions**

* Proposals
	+ Option 1: AWGN and TDLC300-100 (Ericsson, Nokia, Intel)
	+ Option 2: AWGN and TDLA30-10 (Huawei, Samsung)
* Recommended WF

**Issue 4-1-3: Ncs**

* Proposals
	+ Option 1: 164 for *LRA* = 1151 and 190 for *LRA* = 571 (Huawei, Intel, Ericsson, Samsung, Nokia)
* Recommended WF
	+ Use 164 for *LRA* = 1151 and 190 for *LRA* = 571 for *NCS*

**Issue 4-1-4: Time error tolerance for PRACH under AWGN and TDLC-300-100**

* Proposals
	+ Option 1:Reuse the Rel-15 PRACH assumptions as follows: (Huawei, Intel, Ericsson, Samsung, Nokia)

|  |  |  |
| --- | --- | --- |
| PRACH  | PRACH SCS  | Time error tolerance |
| preamble | (kHz) | AWGN | TDLC300-100 |
| A2, B4, C2 | 15 | 0.52 us | 2.03 us |
| 30 | 0.26 us | 1.77 us |

* Recommended WF
	+ Reuse the time error tolerance for Rel-15 PRACH performance requirements under AWGN and TDLC-300-100

**Issue 4-1-5: Time error tolerance for TDLA-30-10**

* Proposals
	+ Option 1: 0.81 us for *LRA*=1151 and 0.55 us for *LRA*=571 (Huawei)
	+ Option 2: 2.03 us for *LRA*=1151 and 1.77 us for *LRA*=571 (Samsung)
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-1-1: PRACH formatIssue 4-1-2: Propagation conditions Issue 4-1-3: NcsIssue 4-1-4: Time error tolerance for PRACH under AWGN and TDLC-300-100Issue 4-1-5: Time error tolerance for TDLA-30-10 |
| Samsung | Issue 4-1-1: PRACH formatWe are fine with option 1 to align the agreement in the last meeting, to correct the typo in the WF 2017468 as A2, B2, C2Issue 4-1-2: Propagation conditions We prefer option 2. During the Rel-15 PRACH discussion, both fading channel with TDLC 300 and TDLA30 are considered for requirement in FR1 and FR2 with short sequencesThe purpose of NR-U maybe the offloading, so main use case corresponds to the stationary scenario and small cell, therefore, we slightly prefer to specify PUCCH requirement for NR-U with TDLA30-10 channel to align with other channelsIssue 4-1-3: NcsWe are fine with option 1 Issue 4-1-4: Time error tolerance for PRACH under AWGN and TDLC-300-100We are fine with option 1Issue 4-1-5: Time error tolerance for TDLA-30-10We slightly prefer to reuse the time error tolerance under TDLC-300-100 for TDLA30-10. During Rel-15 discussion, both TDLC 300 and TDLA30 are considered for FR1 and FR2 where the Time error tolerance for TDLA30 in FR2 is also deriving from TDLC300. As for time error setting, it was agreed with $\frac{0.48}{2^{μ}} $us + Tdelay in Rel-15, where the last tap of TDLC300 is not considered, considering it should not exceed the PUSCH/PUCCH CP duration for 30KHz SCS and the power is very low for the last tap (-16dB TDL300 and -26.2 dB for TDLA30).Option 1 is included the last tap for timing error tolerance deriving. Although it is not exceed the CP length, considering the implementation margin, we suggest to relax it value as Rel-15 |
| Ericsson  | **Issue 4-1-1: PRACH format**Agree with WF.**Issue 4-1-2: Propagation conditions** To keep consistency with Rel-15, we prefer Option 1 but can be open for Option 2. If TDLA30-10 is agreed which is expected for small cell scenario, then the smaller cell range should be considered for Ncs consideration.**Issue 4-1-3: Ncs**Agree with WF. But if we want to consider a smaller cell range compared with Rel-15, then Ncs might be reconsidered. **Issue 4-1-4: Time error tolerance for PRACH under AWGN and TDLC-300-100**Agree with WF. **Issue 4-1-5: Time error tolerance for TDLA-30-10** |
| Huawei | **Issue 4-1-1: PRACH format**OK with recommended WF**Issue 4-1-2: Propagation conditions** As we discussed in PUCCH part, we prefer option 2.@Ercisson: TDLA is not specifically used for small cell. Consideing NR-U is mainly deployed under stationary scenario and indoor scenario, TDLA with low Doppler and low time delay should be considered.**Issue 4-1-3: Ncs**OK with recommended WF**Issue 4-1-4: Time error tolerance for PRACH under AWGN and TDLC-300-100**OK with recommended WF**Issue 4-1-5: Time error tolerance for TDLA-30-10**Prefer Option 1 to keep alignment with Rel-15. |

### 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 #5: Work split for CR drafting

This section will discuss the work split for CR drafting, company can voluntarily take the interesting test cases for CR drafting.

Table 5-1: Work split for CR drafting

|  |  |  |
| --- | --- | --- |
| Spec | Topic | Company |
| 38.104 | Performance requirements for PUSCH with interlace allocation for both conducted and radiated | [Huawei] |
| Performance requirements for CG-UCI multiplexed on PUSCH with interlace allocation (if agreed) |  |
| FRC tables for PUSCH with interlace allocation | [Huawei] |
| Performance requirements for PUCCH format 0 with interlace allocation for both conducted and radiated | [Ericsson]  |
| Performance requirements for PUCCH format 1 with interlace allocation for both conducted and radiated | [Ericsson]  |
| Performance requirements for PUCCH format 2 with interlace allocation for both conducted and radiated | [Ericsson][Samsung] |
| Performance requirements for PUCCH format 3 with interlace allocation for both conducted and radiated | [Ericsson][Samsung] |
| Performance requirements and Annex for PRACH with LRA=1151 and LRA=571 for both conducted and radiated | [Nokia] |
| 38.141-1 | Manufacture declarations and test applicability |  |
| Conformance requirements for PUSCH with interlace allocation | [Huawei] |
| Performance requirements for CG-UCI multiplexed on PUSCH with interlace allocation (if agreed) |  |
| FRC for PUSCH with interlace allocation | [Huawei] |
| Performance requirements for PUCCH format 0 with interlace allocation | [Ericsson] |
| Performance requirements for PUCCH format 1 with interlace allocation | [Ericsson] |
| Performance requirements for PUCCH format 2 with interlace allocation | [Ericsson][Samsung] |
| Performance requirements for PUCCH format 3 with interlace allocation | [Ericsson][Samsung] |
| Performance requirements and Annex for PRACH with LRA=1151 and LRA=571 | [Nokia] |
| 38.141-2 | Manufacturer declarations and test applicability |  |
| Performance requirements for PUSCH with interlace allocation | [Huawei] |
| Performance requirements for CG-UCI multiplexed on PUSCH with interlace allocation (if agreed) |  |
| FRC for interlaced PUSCH with interlace allocation | [Huawei] |
| Performance requirements for PUCCH format 0 with interlace allocation | [Ericsson] |
| Performance requirements for PUCCH format 1 with interlace allocation | [Ericsson] |
| Performance requirements for PUCCH format 2 with interlace allocation | [Ericsson][Samsung] |
| Performance requirements for PUCCH format 3 with interlace allocation | [Ericsson][Samsung] |
| Performance requirements and Annex for PRACH with LRA=1151 and LRA=571 | [Nokia] |
| Simulation results | Simulation results summary sheet creation and maintaining |  |

# Topic #6: Simulation results for information.

## PUSCH

* Huawei

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bandwidth (MHz) | 20  | 40  | 60  | 80  |
| SCS (kHz) | 15  | 30  | 15 | 30 | 15 | 30 |
| SNR@70% of maxTP(dB) | DMRS Type A | 10.4 | 10.4 | 10.6 | 10.6 | 10.6 | 10.5 |
| DMRS Type B | 10.4 | 10.4 | 10.6 | 10.6 | 10.6 | 10.5 |

* Nokia

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bandwidth (MHz) | 20  | 40  | 60  | 80  |
| SCS (kHz) | 15  | 30  | 15 | 30 | 15 | 30 |
| SNR@70% of maxTP(dB) | DMRS Type A | 11.18 | 9.67 | 11.51 | 9.96 | 10.02 | 10 |
| DMRS Type B | 11.18 | 9.69 | 11.52 | 9.99 | 10.05 | 10.03 |

* Ericsson

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bandwidth (MHz) | 20  | 40  | 60  | 80  |
| SCS (kHz) | 15  | 30  | 15 | 30 | 15 | 30 |
| SNR@70% of maxTP(dB) | DMRS Type A | 9.5 | 9.4 |  |  |  | 9.8 |
| DMRS Type B | 9.5 | 9.4 |  |  |  | 9.8 |

## PUCCH

* PF0

|  |  |  |  |
| --- | --- | --- | --- |
| Test metric (SNR Db @ 1% of BLER or 1% of ACK miss or 0.1%of NACK) | Huawei | Nokia | Ericsson |
| ACK miss | ACK miss | ACK miss |
| TDLA30-10 | 15kHz | -4.6 |  |  |
| 30kHz | -3.9 |  |  |
| TDLC300-100 | 15kHz | -6.2 | -5.8 | -7.44 dB |
| 30kHz | -6.1 | -5.8 | -7.24 dB |

* PF1

|  |  |  |  |
| --- | --- | --- | --- |
| Test metric (SNR Db @ 1% of BLER or 1% of ACK miss or 0.1%of NACK) | Huawei | Nokia | Ericsson |
| ACK miss | NACK2ACK | ACK miss | NACK2ACK | ACK miss | NACK2ACK |
| TDLA30-10 | 15kHz |  -16.0 | -15.3 |  |  |  |  |
| 30kHz | -15.1 | -14.6 |  |  |  |  |
| TDLC300-100 | 15kHz | -17.2 | -16.7 | -17.6 | -16.5 | -18 | -17.5 |
| 30kHz | --17.1 | -16.3 | -17.6 | -16.5 | -18 | -17.5 |

* PF2

|  |  |  |
| --- | --- | --- |
| Test metric (SNR Db @ 1% of BLER or 1% of ACK miss or 0.1%of NACK) | Huawei | Nokia  |
| 4 bits (ACK miss) | 22bits(UCI BLER) | 4 bits (ACK miss) | 22bits(UCI BLER) |
| TDLA30-10 | 15kHz | -0.1 | 1.3 |  |  |
| 30kHz | 0.70 | 1.9 |  |  |
| TDLC300-100 | 15kHz | -1.5 | -0.4 | -5.5 | -0.1 |
| 30kHz | -1.3 | 0.2 | -5.6 | 0 |

* PF3

|  |  |  |
| --- | --- | --- |
| Test metric (SNR Db @ 1% of BLER or 1% of ACK miss or 0.1%of NACK) | Huawei | Nokia |
| 4 bits | 16bits | 4 bits | 16bits |
| 4 symbols (ACK miss) | 4symbols(UCI BLER) | 14 symbols(UCI BLER) | 4 symbols (ACK miss) | 4symbols(UCI BLER) | 14 symbols(UCI BLER) |
| TDLA30-10 | 15kHz | -3.2 | -2.8 | -7.5 |  |  |  |
| 30kHz | -2.6 | -2.2 | -7.2 |  |  |
| TDLC300-100 | 15kHz | -5.1 | -3.9 | -9.0 |  | -7.8 |  |
| 30kHz | -5 | -3.6 | -8.7 |  | -7.7 |  |

## PRACH

|  |  |  |  |
| --- | --- | --- | --- |
| Test metric: SNR@ 1% of PRACH miss detection probability. | AWGN | TDLC-300-100 | TDLA-30-10 |
| *LRA*=1151 | *LRA*=571 | *LRA*=1151 | *LRA*=571 | *LRA*=1151 | *LRA*=571 |
| A2 | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Ericsson | Huawei | Nokia | Huawei | Nokia |
| -23.36 | -23.4 | -20.34 | -20.6 | -17.4 | -17.0 | -13.9 | -14.1 | -14.7 | -18.3 | -17.5 | -14.7 | -13.7 |
| B4 | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Ericsson | Huawei | Nokia | Huawei | Nokia |
| -27.02 |  | -24.0 |  | -20.6 |  | -17.5 |  | -18.8 | -21.1 |  | -18.4 |  |
| C2 | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Huawei | Nokia | Ericsson | Huawei | Nokia | Huawei | Nokia |
| -23.7 | -23.3 | -20.6 | -20.6 | -17.3 | -17.1 | -14.0 | -14.0 | -14.8 | -18.1 | -17.4 | -14.9 | -13.6 |

Note: For time error tolerance of TDLA:

Nokia: 0.67us for LRA=571, 0.41us for LRA=1171

Huawei: 0.81us for LRA=571, 0.55us for LRA=1171