**3GPP TSG-RAN WG4 Meeting #101-bis-e R4-2203031**

**Electronic Meeting, 17th Jan 2022 - 25th Jan 2022**

**Agenda item:** 6.18.3

**Source:** Nokia, Nokia Shanghai Bell

**Title:** WF on PUCCH demodulation performance of Rel-17 NR coverage enhancement

**Document for:** Approval

# Background

* This is the first time that the Rel-17 NR coverage enhancement WI is treated in RAN4 demodulation performance. Hence there are no prior WFs.
* Corresponding Email summary in RAN4#101-bis-e
  + R4-2203117 Email discussion summary for [101-bis-e][319] NR\_cov\_enh\_Demod\_NWM.

# WF on topic#2: PUCCH Enhancements of Rel-17 NR Coverage Enhancement

## General

Issue 2-1-1: Test metric for BS PUCCH demodulation test cases

* Option 1: (Nokia, Intel, Samsung, QC)
  + Test UCI block error probability for PUCCH format 2/3/4
  + Test NACK to ACK detection probability for PUCCH format 1
* Option 2: Reusing the existing test metric for different PUCCH formats can be reused as a baseline (CTC)
* Option 3: FFS (E///, HW)

Recommended WF:

– Further discuss in the next meeting.

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | Agree to further discuss in the next meeting |
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## Dynamic indication of PUCCH repetition

Issue 2-2-1: Whether to define BS demodulation requirements for dynamic indication of PUCCH repetition

Agreement:

Agree not to define BS demodulation requirements for dynamic indication of PUCCH repetition.

Recommended WF:

Tentative agreements seem agreeable.

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| **Company** | **Comments** |
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## PUCCH demodulation with Joint Channel Estimation (JCE)

Issue 2-3-1: Whether to define BS PUCCH demodulation requirements with JCE

* Option 1: Yes (China Telecom, Nokia, Intel, QC)
* Option 2: No (HW)
* Option 3: FFS after the finalization of core requirements in RAN1 and RAN4 (E///, Samsung)

Recommended WF:

Further check whether we can agree to define BS demodulation requirements for PUCCH with JCE.  
Option 1 is currently supported by the majority.

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| **Company** | **Comments** |
| Huawei | Still prefer Option 2 as we stated in 1st round. |
| China Telecom | We support to define BS demodulation requirements for PUCCH with JCE. Test parameters can be further discussed pending agreements in RAN4 RF and RAN1.  The need of PUCCH enhancement has been verified in RAN1, we should focus on whether to define requirement based on whether there is BS demodulation impact. |
| Nokia, Nokia Shanghai Bell | RAN1 has identified for PUCCH to be included in improvements and said improvements required changes in the receiver implementation, as such only option1 and option 3 make sense to us.  We think that core requirements are advanced enough for it to be clear that demod requirements are needed. The last remaining details will not change the fact that DMRS bundling impacts demodulation performance.  As such, we think option1 can be tentative agreement in this meeting. |
| Intel | Support Option 1. Same comment as Nokia. |
| Samsung | In general, we agree that JCE has impact on baseband processing, as mentioned, TDW is still under discussion in RAN1, we suggest to further discuss until the remaining details are finalized. |
| Ericsson | We share the same view as Samsung. |

Issue 2-3-2: PUCCH format for BS PUCCH demodulation requirements with JCE (if introduced)

* Option 1: Format 3 (China Telecom)
* Option 2: Format 1, 2, 3, 4 (Nokia)
* Option 3 : Format 1 (Intel, E///, QC)
* Option 4: Format 1 and Format 2 or 3 or 4 (Intel)
* Option 5: Format 1 and 3 (Nokia)

Recommended WF:

Further discuss in the next meeting.

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| **Company** | **Comments** |
| Huawei | We prefer to further discuss in the next meeting considering that currently we don’t make conclusion whether to define BS PUCCH demodulation requirements with JCE. |
| China Telecom | We can accept including Format 1 and further discuss other formats.  We are fine to further discuss in next meeting. |
| Nokia | Agree with the recommended WF. |
| Intel | Support the recommended WF. |
| Samsung | We should focus on the test scope firstly, for details formats for requirement, we prefer to further discuss in the next meeting, to select which format is more benefit with JCE  Meanwhile, we don’t think it is necessary to cover all the formats for requirement to verify JCE functionality |
| Ericsson | Support further discussion in the next meeting. |

Issue 2-3-3: Slot number for JCE in BS PUCCH demod requirements (if introduced)

* For TDD
* Option 1: 2 consecutive slots (China Telecom, Intel, Samsung)
* Option 2: 4 slots within the configured TDW (Nokia)
* Option 3: Depending on the issue 1-4-2 (E///)
* For FDD
* Option 1: 2 consecutive slots (Intel, Samsung)
* Option 2: more than 2 consecutive slots (China Telecom)
* Option 3: 4 (Nokia, CTC)
* Option 4: 8 (CTC)
* Option 4: Depending on the issue 1-4-2 (E///)
* Note: Slot number refers to the actual TDW length

Recommended WF:

Further discuss in the next meeting

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | Ok to come back in the next meeting. |
| WFModerator (Nokia) | The WF discussion of coverage enhancement for PUSCH has added the note: “Slot number refers to the actual TDW number” to clarify what the slot number in this issue has been referring to since the initial moderator summary.  We duplicated this note here to avoid similar misunderstandings in PUCCH WF discussions. Please comment, if this is not acceptable. |
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Issue 2-3-4: Other parameters for BS PUCCH demodulation requirements with JCE (if introduced)

* Option 1: (China Telecom)
* 11 or 22 bits for PUCCH format 3
* 1 PRB allocation and 14 OFDM symbols
* Inter-slot frequency hopping with DMRS bundling
* FR1 and FR2
* Option 2 (Nokia)
  + Use legacy configuration as starting point but disable intra-slot frequency hopping to allow for DM-RS bundling.

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* Option 3: Consider test configuration of existing multi-slot PUCCH requirements as the starting point (Intel)

Recommended WF:

– Further discuss in the next meeting

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| **Company** | **Comments** |
| Nokia, Nokia Shanghai Bell | We have deleted our proposed table and replaced with our main intention to use legacy configuration as starting point but disable intra-slot frequency hopping to allow for DM-RS bundling. |
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