**3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-22xxxxx**

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

**Agenda item:** **6.18.3**

**Source: China Telecom**

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

**Document for:** **Approval**

# Introduction

This document provides the way forward on PUSCH demodulation performance of Rel-17 NR coverage enhancement.

# PUSCH repetition type A with 32 repetitions

## Whether to define BS demodulation requirements for PUSCH repetition type A with 32 repetitions

* + Option 1: Yes
	+ Option 2: No

## Parameters for BS requirements for PUSCH repetition type A with 32 repetitions (if introduced)

* + Option 1:
		- Counting based on physical slots and available slots (i.e., UL slots) for FDD and TDD respectively
		- QPSK 1/3 (MCS 4), 4PRB PUSCH allocation
		- Inter-slot frequency hopping enabled
		- DFT-S-OFDM and CP-OFDM
		- FR1 and FR2
	+ Other options are not precluded

## Test metric for BS PUSCH demodulation test cases (if introduced)

* + Option 1: Test SNR at which the PUSCH achieves 70% of throughput
	+ Other options are not precluded

# PUSCH TB over Multi Slots (TBoMS)

## Whether to define BS demodulation requirements for PUSCH TBoMS

* + Define BS demodulation requirements for PUSCH TBoMS and further discuss the test parameters

## Physical/available slots for BS requirements for PUSCH TBoMS

* + For FDD:
		- Option 1: 4 physical/available slots
		- Option 2: 8 available slots
		- Option 3: 2 available slots
	+ For TDD:
		- Option 1: 4 available slots
		- Option 2: 2 available slots

## Repetition number for BS requirements for PUSCH TBoMS

* + Option 1: 4
	+ Option 2: Not to consider repetition for TBoMS
	+ Option 3: FFS after available slot number is agreed

## PRB number for BS requirements for PUSCH TBoMS

* + Option 1: Narrow PUSCH allocation
		- Option 1A: Single PRB PUSCH allocation
		- Option 1B: Non-single PRB allocation, i.e., 5 or 10 PRBs
	+ Option 2: Full applicable test bandwidth
	+ Option 3: FFS pending whether frequency hopping should be enabled

## Inter-slot frequency hopping for BS requirements for PUSCH TBoMS

* + Option 1: Enabled
	+ Option 2: Disabled
	+ Option 3: FFS

## TDD UL-DL pattern for BS requirements for PUSCH TBoMS

* + For 30kHz SCS:
		- 7D1S2U, S=6D:4G:4U as starting point
		- As baseline, reuse the existing applicability for test requirement for different TDD UL-DL patterns.
		- The above sub-bullets can be further updated if technical issues are found
	+ For 15kHz SCS:
		- FFS whether 15kHz SCS will be included

## Transform precoding for BS requirements for PUSCH TboMS

* + Option 1: Cover both DFT-S-OFDM and CP-OFDM
	+ Option 2: CP-OFDM only
	+ Option 3: Prioritize CP-OFDM

## Whether to consider UCI multiplexing on PUSCH for TBoMS transmission

* + Option 1: Test PUSCH demodulation with UCI multiplexing for TBoMS transmission
	+ Option 2: Not to test PUSCH demodulation with UCI multiplexing for TBoMS transmission
	+ Option 3: FFS

## Other parameters for BS requirements for PUSCH TboMS

* + Cover both FR1 and FR2
	+ For MCS
		- Option 1: QPSK 1/3 MCS 4
		- Option 2: MCS 2
	+ For RV sequence for HARQ transmission
		- Option 1: [0 2 3 1]
		- Option 2: [0 3 0 3] in case two repetitions will be considered
		- Other options are not precluded pending on the repetition number
	+ For PUSCH mapping type:
		- Option 1: Cover PUSCH mapping type A and type B
		- Other options are not precluded
	+ For other parameters, use the parameters in the following table as starting point

|  |  |
| --- | --- |
| Parameter | Value |
| HARQ | Maximum number of HARQ transmissions | 4 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | 0 |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment |  |  |
| Start symbol | 0  |
| Allocation length | 14  |
| Code block group based PUSCH transmission | Disabled |

## Test metric for BS demodulation requirements for PUSCH TBoMS

* + Option 1: Test SNR at which the PUSCH achieves 70% of throughput
	+ Other options are not precluded

# PUSCH demodulation with Joint Channel Estimation (JCE)

## Whether to define BS PUSCH demodulation requirements with JCE

* + Define BS PUSCH demodulation requirements with JCE, while the detailed parameters should be set following RAN1 and RAN4 RF agreements

## Slot number for JCE in BS PUSCH demod requirements

* + For TDD
		- Option 1: 2 consecutive slots
		- Other options are not precluded
	+ For FDD
		- Option 1: 2 consecutive slots
		- Option 2: more than 2 consecutive slots
		- Option 3: 4 consecutive slots
		- Option 4: 8 consecutive slots
		- Other options are not precluded
	+ Note: Slot number refers to the actual TDW number

## Configured TDW (cTDW) length for BS PUSCH demod with JCE

* + For TDD
		- Option 1: 4 slots
		- Other options are not precluded
	+ For FDD
		- Option 1: 4 slots
		- Other options are not precluded

## PUSCH repetition type for BS PUSCH demod requirements with JCE

* + Agree to use Back-to-back PUSCH transmissions
	+ Repetition Type will be further discussed

## PRB number for BS PUSCH demod requirements with JCE

* + Option 1: 4 PRB
	+ Option 2: Full applicable test bandwidth

## Inter-slot frequency hopping for BS PUSCH demod requirements with JCE

* + Option 1: Enabled
	+ Option 2: Disabled

## TDD UL-DL pattern for BS PUSCH demod requirements with JCE

* + For 30kHz SCS:
		- Option 1: 7D1S2U, S=6D:4G:4U
		- Option 2: Depend on the slot number for JCE
	+ For 15kHz SCS:
		- Option 1: Reuse the pattern in the spec, i.e., 3D1S1U, S=10D:2G:2U
		- Option 2: Consider other TDD patterns

## Transform precoding for BS PUSCH demod requirements with JCE

* + Option 1: Cover both DFT-S-OFDM and CP-OFDM
	+ Option 2: CP-OFDM only
	+ Option 3: Prioritize CP-OFDM
	+ Option 4: FFS whether DFT-S-OFDM should be included

## Other parameters for BS PUSCH demod requirements with JCE

* + Option 1:
		- QPSK 1/3 (MCS 4)
		- FR1 and FR2
	+ Option 2:

|  |  |
| --- | --- |
| Parameter | Value |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0,2,3,1 |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | 0 |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0  |
| Allocation length | 14  |
| **Rel-17 PUSCH aggregation factor** (RAN1 name TBD) | **n8**  |
| **AvailableSlotCounting** (RAN1 name TBD) | **enabled** |
| Code block group based PUSCH transmission | Disabled |

* + Option 3: Use configuration of existing Rel-16 PUSCH requirements with repetition Type A as the starting point
	+ Option 4: MCS2

## Test metric for BS PUSCH demod requirements with JCE

* + Option 1: Test SNR at which the PUSCH achieves 70% of throughput
	+ Other options are not precluded

# References