**3GPP TSG-RAN WG4 Meeting #102-e R4-2207198**

**Electronic Meeting, 21st Feb – 3rd Mar, 2022**

**Title:** WF on NTN SAN demodulation requirements

**Source:** Huawei, HiSilicon

**Agenda item:** 10.13.6.1

**Document for:** Approval

# Introduction

This WF capture all agreements and open issues for the following topics in [102-e][325] NR\_NTN\_Demod.

* Topic #2: Satellite Access Node demodulation requirements
  + Issue 2-1: General assumptions
  + Issue 2-2: PUSCH requirements
  + Issue 2-3: PUCCH requirements
  + Issue 2-4: PRACH requirements

The agreed WFs on NTN SAN demodulation requirements in previous meetings are listed as following.

* R4-2203043, RAN4#101bis-e

# Topic #2: Satellite Access Node demodulation requirements

## Issue 2-1: General assumptions

**Issue 2-1-1: Doppler shift model**

*Agreements*

* Consider 200Hz as the maximum Doppler shift for UL in service link

*Candidate options*

* Option 1: Do not consider the residual Doppler error for UL in feeder link
* Option 2: Consider the residual Doppler error for UL in feeder link. 0.5ppm is the worst case.

**Issue 2-1-2: Delay spread model**

*Candidate options*

* Option 1: Single delay spread
  + Option 1a: 100ns
  + Option 1b: 250ns
* Option 2: Different delay spread
  + Option 2a: 10ns/50ns/150ns
  + Option 2b: 10ns/50ns/250ns.

## Issue 2-2: PUSCH requirements

**Issue 2-2-1: Scope of PUSCH requirements**

*Agreements*

* Not to consider the requirements for mapping Type B with non-slot transmission

*Candidate options*

* Option 1: Do not consider 2 step RACH case
* Option 2: Consider the 2 step RACH case

**Issue 2-2-2: Channel model for PUSCH**

*Agreements*

* Select NTN-TDL-A and NTN-TDL-C as the channel model for PUSCH requirements

**Issue 2-2-3: SCS/CBW set for PUSCH requirements**

*Candidate options*

* Option 1: 15kHz SCS: 5MHz/10MHz/20MHz, 30kHz SCS: 10MHz/20MHz
* Option 2: a few of PRBs for all SCS

**Issue 2-2-4: Modulation order for PUSCH requirements**

*Agreements*

* Select MCS4 for PUSCH requirements

**Issue 2-2-5: Antenna configuration for PUSCH requirements**

*Agreements*

* UE 1Tx
* SAN 2Rx

*Candidate options*

* FFS: SAN 1Rx, SAN 4Rx and SAN 8Rx

**Issue 2-2-6: Test parameters for NTN PUSCH**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

|  |  |  |
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| **Parameter** | | **Value** |
| Channel model | | NTN-TDL-A and NTN-TDL-C |
| MCS | | MCS4 |
| Transform precoding | | Disabled and Enabled |
| 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, group hopping and sequence hopping are disabled |
| Time domain | PUSCH mapping type | A, B |
| resource | Start symbol | 0 |
| assignment | Allocation length | 14 |
| Frequency domain resource | RB assignment | FFS |
| assignment | Frequency hopping | Disabled |
| TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 |
| Code block group based PUSCH transmission | | Disabled |

**Issue 2-2-7: Test parameters for NTN UL timing adjustment**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| Channel bandwidth | | FFS |
| MCS | | MCS4 |
| Channel model | | NTN-TDL-A |
| 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 |
|  | DM-RS position (*l0*) | 2 |
|  | Additional DM-RS position | pos2 |
|  | Number of DM-RS CDM group(s) without data | 2 |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | DM-RS port | {0} |
| Time domain resource assignment | DM-RS sequence generation | NID0=0, nSCID =0 for moving UE  NID0=1, nSCID =1 for stationary UE |
|  | PUSCH mapping type | Both A and B |
|  | Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | FFS |
|  | Starting PRB index | FFS |
|  | Frequency hopping | Disabled |
| SRS resource allocation | Slots in which sounding RS is transmitted (Note 1) | slot #1 in radio frames |
|  | SRS resource allocation | FFS |
| NOTE 1. The transmission of SRS is optional. And the transmission comb and SRS periodic are configured as KTC = 2, and TSRS = 10 respectively. | | |

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| **Parameter** | **Scenario X** |
| Channel model | Stationary UE: AWGN  Moving UE: NTN-TDLA<Doppler>-<DS> |
| UE speed | 120 km/h |
| CP length | Normal |
| A | 15 kHz: 10 s  30 kHz: 5 s |
|  | 15 kHz: 0.04 s-1  30 kHz: 0.08 s-1 |

**Issue 2-2-8: Test parameters for NTN PUSCH repetition type A**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| Channel model | | NTN-TDL-A |
| MCS | | 5 in Table 3 |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 3, 0, 3 [Note 2] |
| 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 |
| PUSCH aggregation factor | n2 |
| Frequency domain resource assignment | RB assignment | FFS |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 2: The effective RV sequence is {0, 2, 3, 1} with slot aggregation. | | |

**Issue 2-2-9: Test parameters for NTN msgA PUSCH for 2-step RA type**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| **Parameter** | | **Value** |
| Transform precoding | | Disabled |
| Channel bandwidth | | FFS |
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| Channel model | | NTN-TDL-A |
| MCS | | FFS |
| DM-RS | DM-RS configuration type | 1 |
|  | DM-RS duration | single-symbol DM-RS |
|  | DM-RS position (*l0*) | 2 |
|  | Additional DM-RS position | pos2 or 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 | Both A and B |
| Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | 2 PRBs |
| Starting PRB index | 0 |
| Frequency hopping | Disabled |
| Time offset (TO) Cycling (µs) | start:end | 15k SCS: FFS |
|  |  | 30k SCS: FFS |
| Test Metric | BLER | 0.01 |
| NOTE 1: A single requirement is defined that is applicable regardless of whether pos1 or pos2 is configured for the additional DM-RS position  NOTE 2: The power ratio between preamble and msgA (msgA-DeltaPreamble) is set to be sufficient to achieve 100% preamble detection. The SNR for the requirement is defined on the msgA PUSCH | | |

## Issue 2-3: PUCCH requirements

**Issue 2-3-1: Scope of PUCCH requirements**

*Agreements*

* In addition to PUCCH format 0/1/2/3/4, RAN4 to define NTN multi-slot PUCCH demodulation requirements
* Prioritize UCI with HARQ on PUCCH demodulation requirement

**Issue 2-3-2: Channel model for PUCCH requirements**

*Agreements*

* RAN4 to only consider NTN-TDLA channel model for PUCCH requirements definition

**Issue 2-3-3: SCS/CBW set for PUCCH requirements**

*Agreements*

* To follow the same SCS/CBW set as PUSCH as the start point

*Candidate options*

* Option 1: No need to reduce test
* Option 2: Need to reduce test cases (specify if any)

**Issue 2-3-4: Antenna configuration for PUCCH**

*Agreements*

* UE 1Tx
* SAN 2Rx

*Candidate options*

* FFS: SAN 1Rx, SAN 4Rx and SAN 8Rx

**Issue 2-3-5: Test parameters for NTN PUCCH format 0/1/2/3/4**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| **Parameter** | **Test** |
| PUCCH format | 0 |
| Number of UCI information bits | 1 |
| Number of PRBs | 1 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | N/A for 1 symbol Enabled for 2 symbols |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 13 for 1 symbol  12 for 2 symbols |
| Channel model | NTN-TDLA |
| Number of OFDM symbols | FFS |
| Test metric | ACK missed detection probability <1% |

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| **Parameter** | **Test** |
| PUCCH format | 1 |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Cyclic Prefix | Normal |
| Channel model | NTN-TDLA |
| Test metric | NACK to ACK probability<0.1%, ACK missed detection probability <1% |

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| **Parameter** | **Value** |
| PUCCH format | 2 |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | N/A |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Number of PRBs | 4 |
| Number of symbols | 1 |
| The number of UCI information bits | 4 |
| First symbol | 13 |
| DM-RS sequence generation | *NID*0=0 |
| Cyclic Prefix | Normal |
| Channel model | NTN-TDLA |
| Test metric | NACK to ACK probability<0.1%, ACK missed detection probability <1% |

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| **~~Parameter~~** | **~~Value~~** |
| ~~e~~ | ~~2~~ |
| ~~Modulation order~~ | ~~QSPK~~ |
| ~~First PRB prior to frequency hopping~~ | ~~0~~ |
| ~~Intra-slot frequency hopping~~ | ~~enabled~~ |
| ~~Frist PRB after frequency hopping~~ | ~~The largest PRB index – (Number of PRBs – 1)~~ |
| ~~Number of PRBs~~ | ~~9~~ |
| ~~Number of symbols~~ | ~~2~~ |
| ~~The number of UCI information bits~~ | ~~22~~ |
| ~~First symbol~~ | ~~12~~ |
| ~~DM-RS sequence generation~~ | *~~N~~~~ID~~*~~0~~~~=0~~ |
| ~~Cyclic Prefix~~ | ~~Normal~~ |
| ~~Channel model~~ | ~~NTN-TDLA~~ |
| ~~Test metric~~ | ~~UCI block error probability<1%~~ |

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| **Parameter** | **Value** |
| PUCCH format | 3 |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of PRBs | FFS |
| Number of symbols | FFS |
| The number of UCI information bits | FFS |
| First symbol | 0 |
| Cyclic Prefix | Normal |
| Additional DM-RS configuration | FFS |
| Channel model | NTN-TDLA |
| Test metric | FFS |

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| **Parameter** | **Value** |
| PUCCH format | 4 |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Number of PRBs | 1 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of symbols | 14 |
| The number of UCI information bits | FFS |
| First symbol | 0 |
| Length of the orthogonal cover code | n2 |
| Index of the orthogonal cover code | n0 |
| Cyclic Prefix | Normal |
| Additional DM-RS configuration | FFS |
| Channel model | NTN-TDLA |
| Test metric | FFS |

**Issue 2-3-6: Test parameters for NTN PUCCH multi-slot PUCCH format 1**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| **Parameter** | **Test** |
| PUCCH format | 1 (multi-slot) |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index  – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of slots for PUCCH repetition | 2 |
| Cyclic Prefix | Normal |
| Channel model | NTN-TDLA |
| Test metric | NACK to ACK probability<0.1%, ACK missed detection probability <1% |

## Issue 2-4: PRACH requirements

**Issue 2-4-1: Channel model for PRACH**

*Agreements*

* Define NTN SAN PRACH demodulation requirement for AWGN and NLOS multi-path channel.

**Issue 2-4-2: Test parameters for NTN PRACH demodulation requirement**

*For information, not agreement*

* Interested companies are encouraged to provide initial simulation results in next meeting.

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| --- | --- |
| Parameter | Value |
| Preamble format | FFS |
| Antenna | FFS |
| SCS | FFS |
| Propagation | AWGN, NTN-TDLA |
| Frequency offset | FFS |
| Time error tolerance | FFS |

# Reference

1. R4-2207169, Email discussion summary for [102-e][325] NR\_NTN\_Demod, RAN4#102-e, Qualcomm Incorporated
2. R4-2203043, WF on NTN SAN demodulation requirements, RAN4#101bis-e, Huawei, HiSilicon