**3GPP T****SG-RAN WG4 Meeting #109 R4-2318209**

**Chicago, USA, November 13 – November 17, 2023**

**Agenda item:** 8.6.4.1

**Source:** Moderator (Nokia, Nokia Shanghai Bell)

**Title:** Topic summary for [109][317] NR\_RF\_FR2\_req\_Ph3\_Demod

**Document for:** Information

# Introduction

This contribution summarises the open issues for NR\_RF\_FR2\_req\_Ph3\_Demod under AI 8.6.4 at RAN4#109.

This topic was introduced in RAN4 demodulation at RAN4#108 with a completion by RAN#103 in March 2024.

Two topics are captured:

* Topic #1: PUSCH Requirements
* Topic #2: Work Split

Some companies have proposed FRCs and whilst these are very welcome the information from will be discussed during RAN4#109 to support the draftCRs on FRC development.

A work plan for the demodulation aspect of this topic was agreed at RAN4#108 as follows:

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| --- |
| ~~RAN4#108:~~ |
|  | ~~Discussion and agreement on work plan.~~~~Discussion on performance requirements scope.~~~~Initial discussion on simulation assumptions~~ |
| RAN4#108-bis  |
|   | ~~Discussions on performance requirements scope.~~ ~~Discussions on simulation assumptions.~~ ~~Discussions on work split.~~~~Initial round of simulation results collection and alignment.~~  |
| RAN4#109  |
|   | Finalise discussions on performance requirements scope.Finalise discussions on simulation assumptions.Second round of simulation results collection and alignment.Initial draft CRs. |
| RAN4#110  |
|   | Final round of simulation results collection and alignment.CRs submitted. |

# Topic #1: PUSCH Requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2319707 | Keysight Technologies UK Ltd | **Proposal 1** Follow previous RAN4 agreement SNR limit = 20 dB on BS OTA demod for FR2. Propose not to re-open this study for UL256QAM demod testing. |
| R4-2320215 | Huawei, HiSilicon | **Proposal 1:** Define 50MHz, 100MHz and 200MHz requirements for 120kHz SCS for FR2 UL 256QAM.**Proposal 2:** Do not consider 60kHz SCS requirements for FR2 UL 256QAM. |
| R4-2320216 | Huawei, HiSilicon | Simulation results for FR2-1 UL 256QAM |
| R4-2319842 | Samsung | **Proposal 1:** Only define PUSCH requirement with FR2 256QAM for 120KHz SCS**Proposal 2:** Define PUSCH requirement with 50MHz CBW. The requirement with 100MHz and 200MHz can be defined, if there is a large performance difference among difference CBW with testable SNR |
| R4-2319318 | Ericsson | Observation 1 No much effort is needed to consider 60kHz SCS requirement.Observation 2 200MHz CBW need 6dB higher link budget margin for OTA test setup than 50MHz CBW.**Proposal 1** Introduce 60kHz SCS 50MHz CBW requirements for FR2-1 PUSCH 256QAM.**Proposal 2** Consider 120kHz SCS 100MHz CBW additional to 50MHz CBW requirements if necessary. |
| R4-2319319 | Ericsson | Simulation results for FR2-1 UL 256QAM |
| R4-2318877 | Xiaomi | **Proposal 1:** To reduce the testing workload, 100MHz channel bandwidth can be removed at least.**Proposal 2:** FRC parameters for 256QAM PUSCH performance requirements in table 2.2-1 and table 2.2-2 can be considered as the starting point.Table 2.2-1: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer (256QAM, R=682.5/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A9-1 | G-FR2-A9-2 | G-FR2-A9-3 |
| Subcarrier spacing [kHz] | 60 | 120 | 120 |
| Allocated resource blocks | 66 | 32 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 9 | 9 | 9 |
| Modulation | 256QAM | 256QAM | 256QAM |
| Code rate (Note 2) | 682.5/1024 | 682.5/1024 | 682.5/1024 |
| Payload size (bits) | 37896 | 18432 | 75792 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 3 | 9 |
| Code block size including CRC (bits) (Note 2) | 7608 | 6176 | 8448 |
| Total number of bits per slot without PT-RS | 57024 | 27648 | 114048 |
| Total number of bits per slot with PT-RS (Note 3) | 54648 | 26496 | 109296 |
| Total symbols per slot without PT-RS | 7128 | 3456 | 14256 |
| Total symbols per slot with PT-RS (Note 3) | 6831 | 3312 | 13662 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos0* with *l0*= 0 as per Table 6.4.1.1.3-3 of TS 38.211 [9].NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. |

Table 2.2-2: FRC parameters for FR2 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (256QAM, R=682.5/1024)

|  |  |  |  |
| --- | --- | --- | --- |
| Reference channel | G-FR2-A9-4 | G-FR2-A9-5 | G-FR2-A9-6 |
| Subcarrier spacing [kHz] | 60 | 120 | 120 |
| Allocated resource blocks | 66 | 32 | 132 |
| CP-OFDM Symbols per slot (Note 1) | 8 | 8 | 8 |
| Modulation | 256QAM | 256QAM | 256QAM |
| Code rate (Note 2) | 682.5/1024 | 682.5/1024 | 682.5/1024 |
| Payload size (bits) | 33816 | 16392 | 67584 |
| Transport block CRC (bits) | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 2 | 9 |
| Code block size including CRC (bits) (Note 2) | 6792 | 8232 | 7536 |
| Total number of bits per slot without PT-RS | 50688 | 24576 | 101376 |
| Total number of bits per slot with PT-RS (Note 3) | 48576 | 23552 | 97152 |
| Total symbols per slot without PT-RS | 6336 | 3072 | 12672 |
| Total symbols per slot with PT-RS (Note 3) | 6072 | 2944 | 12144 |
| NOTE 1: *DM-RS configuration type* = 1 with *DM-RS duration = single-symbol DM-RS* and the number of DM-RS CDM groups without data is 2, *Additional DM-RS position = pos1* with *l0*= 0 and *l* =8 as per Table 6.4.1.1.3-3 of TS 38.211 [9].NOTE 2: Code block size including CRC (bits) equals to *K'* in sub-clause 5.2.2 of TS 38.212 [15].NOTE 3: PT-RS configuration *KPT-RS =2, LPT-RS =1*. |

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| R4-2319529 | ZTE Corporation | **Proposal 1:** Not to consider 60kHz SCS for FR2-1 UL 256QAM demodulation requirements.**Proposal 2:** To consider 50MHz BW and 200MHz BW for FR2-1 UL 256QAM demodulation requirements. |
| R4-2319530 | ZTE Corporation | Simulation results for FR2-1 UL 256QAM |
| R4-2318052 | Nokia, Nokia Shanghai Bell | **Proposal 1:** RAN4 shall use 50 MHz for defining requirements with 60 kHz for 256QAM BS DemodulationObservation 1: There is little difference between different CBWs with 120 kHz**Proposal 2:** RAN4 shall only define one CBW for SCS 120 kHz SCS for 256QAM BS Demodulation.**Proposal 3:** RAN4 shall use 50 MHz for defining requirements with 120 kHz SCS for 256QAM BS Demodulation. |
| R4-2318053 | Nokia, Nokia Shanghai Bell | Simulation results for FR2-1 UL 256QAM |
| R4-2320217 | Huawei ,HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson, Samsung, NTT Docomo, Xiaomi, ZTE | *Reserved for simulation summary* |

## Open issues summary

### Sub-topic 1-1: Carrier BW and SCS

**Issue 1-1: 60 kHz SCS and corresponding carrier BW**

* Proposals:
* Option 1: 60 kHz SCS, 50 MHz (Nokia, Xiaomi, Ericsson)
* Option 2: Do not define 60kHz requirements (ZTE, Huawei, Samsung)
* Recommended WF
* For discussion at meeting

**Issue 1-2: 120 kHz SCS and corresponding carrier BW**

* Proposals:
* Option 1: 50MHz (Nokia, Ericsson, Samsung)
* Option 2: 100MHz (Ericsson)
* Option 3: 50, 200 MHz (ZTE, Xiaomi)
* Option 4: 50, 100, 200 MHz (Huawei)
* Recommended WF
* Define requirements for 50 MHz, for discussion on other CBW at meeting.

### Sub-topic 1-2 SNR Limit

**Issue 1-3: SNR Limit**

* Proposals:
* Follow previous RAN4 agreement SNR limit = 20 dB on BS OTA demod for FR2. Propose not to re-open this study for UL256QAM demod testing (Keysight)
* Recommended WF
* Follow previous RAN4 agreement SNR limit = 20 dB on BS OTA demod for FR2..

# Topic #2: Draft CRs

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| --- |
| CR split |
| TDoc Number | Specification | Content part | Company |
| R4-2318233 | 38.104 | PUSCH requirement | Nokia |
| R4-2319320 | 38.141-2 | PUSCH requirement | Ericsson |
| R4-2319526 | 38.104 | FRC tables | ZTE |
| R4-2319527 | 38.141-2 | FRC tables | ZTE |
| R4-2320214 | 38.104 | Applicability rule, manufactory declaration, measurement uncertainty and test tolerance, delay profiles for FR2 | Huawei |
| N/A | 38.141-2 | Applicability rule, manufactory declaration, measurement uncertainty and test tolerance, delay profiles for FR2 | Samsung |

# Topic #3: Big CR Work Split

## Open issues summary

Sub-topic 3-1: Big CR Work Split

**Issue 3-1: Work Plan**

* Proposals
	+ Option 1: Table to volunteer for Big CR split and simulation summary will be provided during the meeting.
* Recommended WF
	+ Big CR work split for demodulation to be agreed at RAN4#109.