**3GPP TSG-RAN4 Meeting #94-e *draftR4-2002407***

**Online, , 24th Feb 2020 - 6th Mar 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **CR0158** | **rev** |  | **Current version:** |  |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | CR for 38.104: HST PUSCH demodulation Annex including both FRC and channel model |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** | 2020-03-03 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | This draftCR introduces the annexes for PUSCH requirements under high speed train conditions assuming a UE velocity of up to 350km/h. |
|  |  |
| ***Summary of change:*** | Add HST scenario 1-NR350 and scenario 3-NR350 as Annex G.3.Add new FRCs for performance requirements in high speed train scenarios within Annex A.3 (MCS2) and A.4 (MCS16), for DM-RS Pos2 configuration. |
|  |  |
| ***Consequences if not approved:*** | PUSCH performance under high speed train conditions assuming a UE velocity of up to 350km/h is not ensured. |
|  |  |
| ***Clauses affected:*** | A.3 (modify), A.4 (modify), G.3 (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.141-1, TS 38.141-2 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | Agenda item: 8.17.2.2.1 |
|  |  |
| ***This CR's revision history:*** | R4-2001691 |

**<<Start of first change>>**

# A.3 Fixed Reference Channels for performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.3-2, table A.3-2A, table A.3-4, and table A.3-6 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.3-2A for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer.

- FRC parameters are specified in table A.3-4 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

- FRC parameters are specified in table A.3-6 for FR1 PUSCH with transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer.

The parameters for the reference measurement channels are specified in table A.3-7 to table A.3-12 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.3-7 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.3-8 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers.

- FRC parameters are specified in table A.3-9 for FR2 PUSCH with transform precoding enabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.3-10 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.3-11 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

- FRC parameters are specified in table A.3-12 for FR2 PUSCH with transform precoding enabled, *Additional DM-RS position = pos1* and 1 transmission layer.

Table A.3-1: Void

Table A.3-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3-8 | G-FR1-A3-9 | G-FR1-A3-10 | G-FR1-A3-11 | G-FR1-A3-12 | G-FR1-A3-13 | G-FR1-A3-14 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 1352 | 2856 | 5768 | 1320 | 2792 | 5768 | 14856 |
| Transport block CRC (bits) | 16 | 16 | 24 | 16 | 16 | 24 | 24 |
| Code block CRC size (bits) | - | - | 24 | - | - | 24 | 24 |
| Number of code blocks - C | 1 | 1 | 2 | 1 | 1 | 2 | 4 |
| Code block size including CRC (bits) (Note 2) | 1368 | 2872 | 2920 | 1336 | 2808 | 2920 | 3744 |
| Total number of bits per slot | 7200 | 14976 | 30528 | 6912 | 14688 | 30528 | 78624 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| 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*, *l0*= 2 and *l* =11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [5].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. |

Table A.3-2A: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (QPSK, R=193/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A3-33 | G-FR1-A3-34 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 52 | 106 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 |
| Modulation | QPSK | QPSK |
| Code rate (Note 2) | 193/1024 | 193/1024 |
| Payload size (bits) | 2600 | 5256 |
| Transport block CRC (bits) | 16 | 24 |
| Code block CRC size (bits) | - | 24 |
| Number of code blocks - C | 1 | 2 |
| Code block size including CRC (bits) (Note 2) | 2616 | 2664 |
| Total number of bits per slot | 13728 | 27984 |
| Total resource elements per slot | 6846 | 13992 |
| 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 = pos2*, and *l0*= [2 or 3] for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [5].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. |

Table A.3-3: Void

**<<End of first change>>**

**<<Start of second change>>**

# A.4 Fixed Reference Channels for performance requirements (16QAM, R=658/1024)

The parameters for the reference measurement channels are specified in table A.4-2, table A.4.2A, and table A.4-4 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.4-2 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

* FRC parameters are specified in table A.4-2A for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos 2 and 1 transmission layer.
* FRC parameters are specified in table A.4-4 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

The parameters for the reference measurement channels are specified in table A.4-5 to table A.4-8 for FR2 PUSCH performance requirements:

- FRC parameters are specified in table A.4-5 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 1 transmission layer.

- FRC parameters are specified in table A.4-6 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos0* and 2 transmission layers.

- FRC parameters are specified in table A.4-7 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

- FRC parameters are specified in table A.4-8 for FR2 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 2 transmission layers.

Table A.4-1: Void

Table A.4-2: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A4-8 | G-FR1-A4-9 | G-FR1-A4-10 | G-FR1-A4-11 | G-FR1-A4-12 | G-FR1-A4-13 | G-FR1-A4-14 |
| Subcarrier spacing [kHz] | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 52 | 106 | 24 | 51 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 | 658/1024 |
| Payload size (bits) | 9224 | 19464 | 38936 | 8968 | 18960 | 38936 | 100392 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 3 | 5 | 2 | 3 | 5 | 12 |
| Code block size including CRC (bits) (Note 2) | 4648 | 6520 | 7816 | 4520 | 6352 | 7816 | 8392 |
| Total number of bits per slot | 14400 | 29952 | 61056 | 13824 | 29376 | 61056 | 157248 |
| Total symbols per slot | 3600 | 7488 | 15264 | 3456 | 7344 | 15264 | 39312 |
| 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*, *l0*= 2 and *l*=11 for PUSCH mapping type A, *l0*= 0 and *l* =10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [5].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. |

Table A.4-2A: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer (16QAM, R=658/1024)

|  |  |  |
| --- | --- | --- |
| Reference channel | G-FR1-A4-29 | G-FR1-A4-30 |
| Subcarrier spacing [kHz] | 15 | 30 |
| Allocated resource blocks | 52 | 106 |
| Data bearing CP-OFDM Symbols per slot (Note 1) | 11 | 11 |
| Modulation | 16QAM | 16QAM |
| Code rate (Note 2) | 658/1024 | 658/1024 |
| Payload size (bits) | 17424 | 35856 |
| Transport block CRC (bits) | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 |
| Number of code blocks - C | 3 | 5 |
| Code block size including CRC (bits) (Note 2) | 5840 | 7200 |
| Total number of bits per slot | 27456 | 55968 |
| Total resource elements per slot | 6846 | 13992 |
| 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 = pos2*, and *l0*= [2 or 3] for PUSCH mapping type A, as per table 6.4.1.1.3-3 of TS 38.211 [5].NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [15]. |

Table A.4-3: Void

**<<End of second change>>**

**<<Start of third change>>**

#### G.2.3.2.3 MIMO Correlation Matrices using cross polarized antennas

The values for parameters *α*, *β* and *γ* for low spatial correlation are given in Table G.2.3.2.3-1.

Table G.2.3.2.3-1: Values for parameters α, β and γ

|  |
| --- |
| Low spatial correlation |
| α | β | γ |
| 0 | 0 | 0 |
| Note 1: Value of *α* applies when more than one pair of cross-polarized antenna elements at gNB side.Note 2: Value of *β* applies when more than one pair of cross-polarized antenna elements at UE side. |

The correlation matrices for low spatial correlation are defined in Table G.2.3.2.3-2 as below.

Table G.2.3.2.3-2: MIMO correlation matrices for low spatial correlation

|  |  |
| --- | --- |
| 1x8 case |  |
| 2x8 case |  |

In Table G.2.3.2.3-2,  is a  identity matrix.

# G.3 High speed train condition

High speed train conditions are as follows:

- Scenario 1-NR350: Open space

- Scenario 3-NR350: Tunnel

The high speed train conditions for the test of the baseband performance are two non-fading propagation channels. For BS with Rx diversity, the Doppler shift time variation is the same for each antenna at each time instant.

Doppler shift for both scenarios is given by:

  (G.3.1)

where  is the Doppler shift and  is the maximum Doppler frequency. The cosine of angle is given by:

 ,  (G.3.2)

 ,  (G.3.3)

 ,  (G.3.4)

where  is the initial distance of the train from BS, and  is BS-Railway track distance, both in meters;  is the velocity of the train in m/s,  is time in seconds.

The required input parameters are listed in table G.3-1. The resulting time varying Doppler shift is shown in Figure G.3-1, G.3-2, G.3-3 and G.3-4. The Doppler shift was derived such that it corresponds to a velocity of around 350km/h for band n1 for the 15kHz SCS and for band n77 for the 30kHz SCS. However, the same Doppler shift requirement shall be applied regardless of the frequency of operation of the basestation and thus for lower frequencies, the supported speed is higher.

Table G.3-1: Parameters for high speed train conditions for UE velocity 350 km/h

|  |  |
| --- | --- |
| Parameter | Value |
| Scenario 1-NR350 | Scenario 3-NR350 |
|  | 700 m | 300 m |
|  | 150 m | 2 m |
|  | 350 km/h | 350 km/h |
|  | 1340 Hz for 15kHz SCS2334 Hz for 30kHz SCS | 1340 Hz for 15kHz SCS2334 Hz for 30kHz SCS |



Figure G.3-1: Doppler shift trajectory for scenario 1-NR350 (15 kHz SCS)



Figure G.3-2: Doppler shift trajectory for scenario 3-NR350 (15 kHz SCS)



Figure G.3-3: Doppler shift trajectory for scenario 1-NR350 (30 kHz SCS)



Figure G.3-4: Doppler shift trajectory for scenario 3-NR350 (30 kHz SCS)

**<<End of third change>>**