**3GPP TSG-RAN WG4 Meeting #108bis R4-2316916**

**Xiamen, China, 9th Oct-13th Oct, 2023**

**Title:** WF on FR2 HST demodulation requirements

**Agenda Item:** 8.12.5

**Source: Samsung**

**Document for:** Approval

# Topic #1: Deployment and Channel Modelling

## Sub-topic 1-1: Deployment and Channel Model for Demodulation requirement with simultaneous Rx reception in open space scenario

**Issue 1-1-1: RRH and (initial train) positioning of channel model for PDSCH requirements with multi-Rx Reception**

**Agreement**:

* The location of RRH k is given as x\_k=k\*D\_s+j\*D\_min, where: k∈[-∞,∞], j=sqrt(-1) and D\_minis the distance between the RRHs and railway track, while D\_s is the distance of two RRHs, both in meters
* The train location is denoted as: y=a+j\*0, a∈[-D\_(s\_offset),∞] and a means distance in meters, which means the train is right on the track. a=a\_0+vt where v (m/s) is the moving speed of the train and a\_0=-D\_(s\_offset).
* Update the initial UE position (t=0) in the figure describing beam serving coverage for multi-Rx reception in Bi-directional scenario from RAN4#107 WF [R4-2309825] as follows:



* Update the FR2 HST-DPS Channel Profile in B.3.4 in 38.101-4
  + a=a\_0+vt where v (m/s) is the moving speed of the train
    - a\_0 = - D\_(s\_offset) for B.3.4.1 Unidirectional Deployment Channel Profile
    - a\_0 =0 for B.3.4.2 Bidirectional Deployment Channel Profile

**Issue 1-1-2: Whether need to include relative power for channel model for PDSCH requirements with Multi-Rx Reception**

**Agreement**

* Do not consider relative power profile modelling based on FR2 HST UE location for HST FR2 scenario to specify PDSCH requirement with multi-Rx simultaneous reception

## Sub-topic 1-2 Deployment and Channel Model in tunnel scenario

**Issue 1-2-1: Channel Model in Tunnel Scenario for UE demodulation and BS demodulation**

**Agreement**

* No need to introduce a new channel model for HST FR2 Tunnel deployment scenario for both UE and BS demodulation requirements in Rel-18

# Topic #2: UE demodulation for CA requirement

## Sub-topic 2-1: Intra-band CA requirement

**Issue 2-1-1: FRC for CA requirement**

**Tentative agreement**

* Confirm the FRC tables shown in Appendix for FR2 HST-DPS CA PDSCH demodulation requirements.
  + Uni-directional HST-DPS with CA scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Reference channel |  | UNI-1 TDD | UNI-2 TDD | UNI-3 TDD |  |
| Channel bandwidth | MHz | 50 | 100 | 400 |  |
| Subcarrier spacing | kHz | 120 | 120 | 120 |  |
| Allocated resource blocks | PRBs | 32 | 66 | 264 |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} |  | 9 | 9 | 9 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} |  | 13 | 13 | 13 |  |
| For slot i = 1 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For slot i = 2 |  | 13 | 13 | 13 |  |
| For slot i = 3 |  | 9 | 9 | 9 |  |
| Allocated slots per 2 frames |  | 126 | 126 | 126 |  |
| MCS table |  | 64QAM | 64QAM | 64QAM |  |
| MCS index |  | 17 | 17 | 17 |  |
| Modulation |  | 64QAM | 64QAM | 64QAM |  |
| Target Coding Rate |  | 0.43 | 0.43 | 0.43 |  |
| Number of MIMO layers |  | 2 | 2 | 2 |  |
| Number of DMRS REs |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} |  | 18 | 18 | 18 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} |  | 18 | 18 | 18 |  |
| For Slot i = 1 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slot i = 2 |  | 18 | 18 | 18 |  |
| For Slot i = 3 |  | 18 | 18 | 18 |  |
| Overhead for TBS determination |  | 6 | 6 | 6 |  |
| Information Bit Payload per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | Bits | 13832 | 28680 | 114776 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | Bits | 21504 | 45096 | 180376 |  |
| For Slot i = 1 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slot i = 2 |  | 21504 | 45096 | 180376 |  |
| For Slot i = 3 |  | 13832 | 28680 | 114776 |  |
| Transport block CRC per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | Bits | 24 | 24 | 24 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | Bits | 24 | 24 | 24 |  |
| For Slot i = 1 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slot i = 2 |  | 24 | 24 | 24 |  |
| For Slot i = 3 |  | 24 | 24 | 24 |  |
| Number of Code Blocks per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | CBs | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | CBs | 2 | 4 | 14 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | CBs | 3 | 6 | 22 |  |
| For Slot i = 1 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slot i = 2 |  | 3 | 6 | 22 |  |
| For Slot i = 3 |  | 2 | 4 | 14 |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A | N/A |  |
| For Slots i = 5 and 85 (Note 3) | Bits | 41856 | 90360 | 406368 |  |
| For Slots i = 6 and 86 (Note 3) | Bits | 41856 | 90360 | 406368 |  |
| For Slot i, if mod(i, 5) = 3 for i from {7,…, 84, 87, …, 159} | Bits | 33408 | 68904 | 275616 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {7,…,84,87,…,159} | Bits | 51072 | 105336 | 421344 |  |
| For Slot i = 1 | Bits | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slot i = 2 |  | 51072 | 105336 | 421344 |  |
| For Slot i = 3 |  | 33408 | 68904 | 275616 |  |
| Max. Throughput averaged over 2 frames | Mbps | 123.2 | 257.839 | 1031.409 |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: Binary Channel Bits are calculated under assumption of 52 PRBs TRS allocation when the number of allocated resource blocks are more than 52.  Note 4: SS/PBCH block is transmitted in slot #1 with periodicity 20ms | | | | | |

* + Bi-directional HST-DPS with CA scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Unit | Value | | | |
| Reference channel |  | BI-1 TDD | BI-2 TDD | BI-2 TDD |  |
| Channel bandwidth | MHz | 50 | 100 | 400 |  |
| Subcarrier spacing | kHz | 120 | 120 | 120 |  |
| Allocated resource blocks | PRBs | 32 | 66 | 264 |  |
| Number of consecutive PDSCH symbols |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} |  | 9 | 9 | 9 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} |  | 13 | 13 | 13 |  |
| For Slot i=1,2,3 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Allocated slots per 2 frames |  | 124 | 124 | 124 |  |
| MCS table |  | 64QAM | 64QAM | 64QAM |  |
| MCS index |  | 17 | 17 | 17 |  |
| Modulation |  | 64QAM | 64QAM | 64QAM |  |
| Target Coding Rate |  | 0.43 | 0.43 | 0.43 |  |
| Number of MIMO layers |  | 2 | 2 | 2 |  |
| Number of DMRS REs |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} |  | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} |  | 18 | 18 | 18 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} |  | 18 | 18 | 18 |  |
| For Slot i = 1,2,3 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Overhead for TBS determination |  | 6 | 6 | 6 |  |
| Information Bit Payload per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | Bits | 13832 | 28680 | 114776 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | Bits | 21504 | 45096 | 180376 |  |
| For Slot i = 1,2,3 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Transport block CRC per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | Bits | 24 | 24 | 24 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | Bits | 24 | 24 | 24 |  |
| For Slot i = 1,2,3 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Number of Code Blocks per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | CBs | N/A | N/A | N/A |  |
| For Slot i, if mod(i, 5) = 3 for i from {4,…, 159} | CBs | 2 | 4 | 14 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {5,…,159} | CBs | 3 | 6 | 22 |  |
| For Slot i = 1,2,3 |  | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Binary Channel Bits Per Slot |  |  |  |  |  |
| For Slots 0 and Slot i, if mod(i, 5) = 4 for i from {0,…,159} | Bits | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| For Slots i = 5 and 85 (Note 3) | Bits | 33408 | 76632 | 392640 |  |
| For Slots i = 6 and 86 (Note 3) | Bits | 33408 | 76632 | 392640 |  |
| For Slot i, if mod(i, 5) = 3 for i from {7,…, 94,87, …, 159} | Bits | 33408 | 68904 | 275616 |  |
| For Slot i, if mod(i, 5) = {0,1,2} for i from {7,…,84,87,…,159} | Bits | 51072 | 105336 | 421344 |  |
| For Slot i = 1,2,3 | Bits | N/A (Note 4) | N/A (Note 4) | N/A (Note 4) |  |
| Max. Throughput averaged over 2 frames | Mbps | 121.433 | 254.15 | 1016.651 |  |
| Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms  Note 2: Slot i is slot index per 2 frames  Note 3: Binary Channel Bits are calculated under assumption of 52 PRBs TRS allocation when the number of allocated resource blocks are more than 52.  Note 4: SS/PBCH block is transmitted in slot #1, slot #2 and slot #3 with periodicity 20ms | | | | | |

**Issue 2-1-2: Release independent for CA requirement**

**Agreement**

* Do not define FR2 HST CA requirement to be release independent from Rel-17 according to the UE capability with PC6 UE. FR2 HST CA requirement is applicable from Rel-18

**Issue 2-1-3: CA requirements derivation**

**Tentative agreement**

* Companies are encouraged to provide both ideal and impairment results for PDSCH CA requirements derivation.

# Topic #3: PDSCH requirement with multi-Rx reception

## Sub-topic 3-1: General for PDSCH requirement with multi-Rx reception

**Issue 3-1-1: UE processing assumption for the FFT window**

**Issue 3-1-2: Necessity to introduce RTD into channel model for CPE FFT processing test**

**Issue 3-2-1: Number of MCS for PDSCH requirement for multi-Rx reception**

**Issue 3-2-2: Number of SNR for PDSCH requirement for multi-Rx reception**

**Way forward:**

* Introduce RTD in the FR2 HST PDSCH requirement between the different RX panels
* Define two different fixed MCS values per each Panels for PDSCH requirement with multi-Rx reception with fixed FRC
* Encourage companies to evaluate the performance difference under assumption on FFT (single FFT across Rx chains, and separate FFT per RF chain) with the following test setup and test metric
  + - RTD:
      * Option 1: (2CP) 1.2 us
      * Option 2: (1.5CP) 0.9us
      * Option 3: (2.5CP) 1.45us
    - MCS:
      * Option 1: Set MCS 19 for Rx panel 1 and Set MCS13 for Rx panel 2 for FR2 HST simultaneous multi-Rx scenario.
    - Test metric for SNR derivation
      * 70% Tput for each PDSCH

**Issue 3-2-3: Power scaling for two served RRH**

**Tentative agreement:**

* Do not consider the power scaling factor 1/sqrt(2) to transmitted PDSCH signal from each TRxP

## Sub-topic 3-2: Test setup for PDSCH requirement with multi-Rx reception

**Issue 3-2-4: PDSCH allocation timeline in the UE Demod Test**

**Way forward**

* The overview period after receiving MAC CE activate TCI switching for each panel from the through statistic is specified as
  + THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS pro
  + THARQ = 4 is the number of slots between PDSCH and corresponding HARQ-ACK;
  + TMAC proc = 24 is the number of slots to process MAC-CE;
  + TTRS proc = 16 is the number of slots for TRS processing;
  + FFS on
    - TfirstSSB
    - TfirstTRSafterSSB

**Issue 3-2-5: Applicability rule for PDSCH requirement with simultaneous multi-Rx reception**

**Tentative agreement:**

* Introduce the following test applicability rule for PDSCH requirement with multi-Rx reception
  + UE Power Class 6 (PC6);
  + simultaneousReceptionFR2HST-r18;
  + maxNumberActiveTCI-PerBWP > 1
  + multiDCI-MultiTRP-r16;
  + overlapPDSCHsFullyFreqTime-r16;

# Topic #4: Demoduation requirements for tunnel scenario

## Sub-topic 4-1: Test Scope of demodulation requirements of tunnel scenario

**Issue 4-1-1: Whether to define UE demodulation requirements for tunnel deployment scenario in FR2 HST**

**Agreement:**

* No new UE demodulation requirement introduced for Tunnel scenario in Rel-18 FR2 HST WI

**Issue 4-1-2: Whether to define BS demodulation requirements for tunnel deployment scenario in FR2 HST**

**Agreement**:

* No new BS demodulation requirement introduced for Tunnel scenario in Rel-18 FR2 HST WI

# Topic #5: Work split for Rel-18 FR2 HST demodulation

|  |  |
| --- | --- |
| Work split | Company |
| Big CR for FR2 HST demodulation | Samsung |
| Simulation result summary for FR2 HST demodulation | Samsung |
| PDSCH requirement with CA | Nokia |
| PDSCH requirement with multi-Rx reception | Huawei, QC |
| Channel Model for Multi-Rx | Samsung |
| Applicability rule of PDSCH requirement with multi-Rx | QC |
| FRC for PDSCH requirement with CA and multi-Rx | Ericsson |