**3GPP TSG-RAN WG4 Meeting # 110**  **R4-23xxxxx**

Athens, Greece, 26th Feb-1st March, 2024

**Agenda item:** 8.8.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [110][316] NR\_HST\_FR2\_enh\_Demod

**Document for:** Information

# Introduction

This contribution summarises the open issues and submitted draft CR on demodulation requirements for FR2 HST under 8.8.3. Five topics are captured:

* Topic #3: PDSCH requirements with multi-Rx Chain DL reception
* Topic #4: Feature lists
* Topic #5: draft CR

The performance part of Rel-18 FR2 HST WI will be expected in Feb meeting of Y2024. Moderator suggest to prioritize the discussions on the remaining test setup of PDSCH requirement with multi-Rx reception as following topics

* Topic #1: PDSCH requirements with multi-Rx Chain DL reception
	+ Sub-topic 1-1: Test setup for PDSCH requirement with multi-Rx reception
		- Issue 1-1-1: MCS pair for PDSCH requirement for multi-Rx chain reception
		- Issue 1-1-2: PDSCH allocation timeline in the UE Demod Test
			* Issue 1-1-2-1: FFS on considering Tfirst SSB after TRS and TSBB proc in the PDSCH allocation timeline for FR2 HST with multiple Rx panels
			* Issue 1-1-2-2: TCI state switching scheduling for left-facing panel (backward-looking Rx panel or left panel)
			* Issue 1-1-2-3: TCI state switching scheduling for right-facing panel (forward-looking Rx panel or right panel)
			* Issue 1-1-2-4: common value of THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
			* Issue 1-1-2-5: common value of THARQ + TMAC Proc + TfirstTRS + TTRS proc
* Topic #2: Feature lists
	+ Sub-topic 2-1: UE feature lists for FR2 HST demodulation requirement
		- Issue 2-1-1: UE feature lists for FR2 PDSCH requirements with CA
		- Issue 2-1-2: UE feature lists for FR2 PDSCH requirements with multi-Rx chain reception

# Topic #1: PDSCH requirement with multi-Rx reception

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2401570 | Samsung | Proposal 1: Define (MCS 19, MCS 13) for PDSCH requirement with multi-Rx reception.Proposal 2: The overview period after receiving MAC CE activate TCI switching for each panel from the through statistic can be reused * THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS pro
* For Left Panel
	+ PDSCH and PDCCH associated with TCI sate is transmitted by k RRH from slot #

$$\left\{\begin{matrix}0&,k=-1\\k\*n+16457+1+T\_{HARQ}+T\_{MAC proc}+T\_{firstSSB}+T\_{SSB proc}+T\_{firstTRSafterSSB}+T\_{TRS proc}&,k=0,1,2…\end{matrix}\right.$$* + To slot#

$(k+1)\*n+16457+T\_{HARQ}+T\_{MAC proc}$ ， k=-1, 0,1,2…* + $T\_{firstSSB}$ = 155
	+ $T\_{firstTRSafterSSB}$ = 69
	+ $T\_{HARQ}$ = 4, $T\_{MAC proc}$ =24, $T\_{SSB proc}$ and $T\_{TRS proc}$ =16
* For Right Panel
	+ PDSCH and PDCCH associated with TCI sate is transmitted by k RRH from slot #

$$\left\{\begin{matrix}0&,k=1\\(k-1)\*n+1+T\_{HARQ}+T\_{MAC proc}+T\_{firstSSB}+T\_{SSB proc}+T\_{firstTRSafterSSB}+T\_{TRS proc}&,k=2,3…\end{matrix}\right.$$* + To slot#

$k\*n+T\_{HARQ}+T\_{MAC proc}$ ， k=1,2…* + $T\_{firstSSB}$ = 132
	+ $T\_{firstTRSafterSSB}$ = 69
	+ $T\_{HARQ}$ = 4, $T\_{MAC proc}$ =24, $T\_{SSB proc}$ and $T\_{TRS proc}$ =16
 |
| R4-2401571 | Samsung | Draft CR on channel model  |
| R4-2401572 | Samsung | Draft Big CR for FR2 HST  |
| R4-2401573 | Samsung | Simulation results summary |
| R4-2401699 | Huawei,HiSilicon | Proposal 1: MCS pair {19, 11} should be selected based on RTD=1.5xCP.Proposal 2: The existing formula in Rel-17 for the TCI switching time can be reused, i.e. THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS proc.Proposal 3: Schedule TCI state switching command using MCS4 in the slots where SSB transmitted, i.e. slot#57600n-160 for the panel 1 and slot#57600n+16320 for the panel 2 respectively that is the closest SSB transmission slots before the exacting switching points.Proposal 4: For both panels, TMAC Proc can be 24 slots that is corresponding to 3ms, TfirstSSB can be 132 slots that is calculated by min(SSB@slot#160n-THARQ-TMAC Proc), TSSB proc can be 16 slots that is corresponding to 2ms, TfirstTRSafterSSB can be 69 slots that is calculated by min(TRS@slot#(80n+5)-TSSB), TTRS proc can be 16 slots that is corresponding to 2ms.Proposal 5: Remove the third bullet of the components for demodulation in feature list 34-1. |
| R4-2401700 | Huawei,HiSilicon | Draft CR on PDSCH requirement with multi-Rx reception for FR2 HST (TS38.101-4, Rel-18) |
| R4-2401756 | Ericsson | draft CR to 38.101-4: FRC of PDSCH demodulation requirements for FR2 HST |
| R4-2401757 | Ericsson | Proposal 1: Set MCS 11 for TRP#2. Proposal 2: For the forward-looking Rx panel, scheduling TCI state switching command can be slot# 57600 x n, n=0, 1, 2, …* PDSCH throughput statistics starts: THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
	+ THARQ = 4 (slots), TMAC Proc = 24 (slots), TSSB proc = 16 (slots), and TTRS proc = 16 (slots)
	+ TfirstSSB =132 (= SSB period (160) - THARQ - TMAC Proc)
	+ TfirstTRSafterSSB = 69 (= TRS period (80) - TRS offset from SSB (5) - TTRS proc)

Proposal 3: For the backward-looking Rx panel, scheduling TCI state switching command can be slot# 57600 x n + 16320, n = 0, 1, 2, …* PDSCH throughput statistics starts: THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
	+ THARQ = 4 (slots), TMAC Proc = 24 (slots), TSSB proc = 16 (slots), and TTRS proc = 16 (slots)
	+ TfirstSSB =132 (= SSB period (160) - THARQ - TMAC Proc)
	+ TfirstTRSafterSSB = 69 (= TRS period (80) - TRS offset from SSB (5) - TTRS proc)
 |
| R4-2402716 | Nokia, Nokia Shanghai Bell | Observation 1: The WID of Rel-18 Enhanced HST FR2 stated that for CA, only intra-band CA is considered.Proposal 1: RAN4 to include “intra-band” to the Feature group: “Enhanced demodulation requirements for intra-band CA HST FR2”Proposal 2: RAN4 to include “intra-band” to the Components: “1. Support of the enhanced demodulation requirements specified for intra-band CA for HST FR2 UE” |
| R4-2402717 | Nokia, Nokia Shanghai Bell | Observation 1: With RTD = 1.5 CP (with the corresponding power difference of 6.5 dB), it can be observed that both pairs of MCSs, namely, (19,11) and (19,13), are able to reach 70% Throughput.Proposal 1: RAN4 to select the highest MCS pair (19,13) to be used in defining the PDSCH requirements for HST FR2 with multi-Rx.Observation 2: Even with RTD = 2.5 CP (with a corresponding power difference of 10.8 dB), MCS pair (19,11) can still achieve 70% Throughput criteria.Observation 3: Based on the offline discussions, option 4 can be used as the baseline for discussions among companies.Proposal 2: RAN4 to continue the process of aligning the understanding on the parameters for PDSCH allocation timeline for Rel-18 HST FR2 with multi-RX, and to finalize them in RAN4#110.Proposal 3: To remove the square bracket [] from component number 3), which is the component about demodulation part, and to use the following formulation: “Support of enhanced demodulation processing to support FR2-1 PC6 UEs with simultaneous DL signals reception associated with two different QCL TypeD RSs” |
| R4-2402718 | Nokia, Nokia Shanghai Bell | Simulation Results for PDSCH requirement with multi-Rx |
| R4-2402749 | Qualcomm Incorporated | Proposal 1: RAN4 to use MCS pair [19, 13] for the definition of the FR2 HST with multiRX requirementsObservation 1: Channel profile will switch at slot #57600\*n for right-facing panels, and on slot #[57600\*n + 16457] for left-facing panels;Observation 2: FR2 UE had to wait for SSB in FR2 HST bidirectional deployment with single active panel to handle a FO doppler jump out of TRS range. This is not the case in FR2 HST with multiple active panels;Proposal 2: RAN4 not to consider Tfirst SSB after TRS and TSBB proc in the PDSCH allocation timeline for FR2 HST with multiple RX panels;Observation 3: Existing HST DPS tests schedule MAC command for TCI state switch in the SSB slot.Observation 4: If TCI state switch is scheduled in the last available SSB slot (#16320) before channel profile switches to the new RRH profile, the UE will switch to the new TCI before the channel.Proposal 3: In FR2 HST Demod requirements with multiple RX chains, RAN4 to choose, for TCI state switching command, the last slot transmitted by the RRH according to the RRH coverage and scheduling assumptions channel, following the approach used in FR1 HST DPS.Proposal 4: TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = 0 (i≠0) for right-facing panels, n = 57600.Proposal 5: TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = nL (i≠0) for left-facing panels, n = 57600 and nL= 16457. |
| R4-2402750 | Qualcomm Incorporated | DraftCR for FR2 HST Enhancements – Applicability Rules |
| R4-2402754 | Qualcomm Incorporated | Simulation Results for PDSCH requirement with multi-Rx reception |

## Open issues summary

Last RAN4 meeting agreements in the WF R4-2321063

List of open issues

* Sub-topic 1-1: Test setup for PDSCH requirement with multi-Rx reception
	+ Issue 1-1-1: MCS pair for PDSCH requirement for multi-Rx chain reception
	+ Issue 1-1-2: PDSCH allocation timeline in the UE Demod Test
		- Issue 1-1-2-1: FFS on considering Tfirst SSB after TRS and TSBB proc in the PDSCH allocation timeline for FR2 HST with multiple Rx panels
		- Issue 1-1-2-2: TCI state switching scheduling for left-facing panel (backward-looking Rx panel or left panel)
		- Issue 1-1-2-3: TCI state switching scheduling for right-facing panel (forward-looking Rx panel or right panel)
		- Issue 1-1-2-4: common value of THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
		- Issue 1-1-2-5: common value of THARQ + TMAC Proc + TfirstTRS + TTRS proc

### Sub-topic 1-1: Test setup for PDSCH requirement with multi-Rx reception

**Issue 1-1-1: MCS pair for PDSCH requirement for multi-Rx chain reception**

* Observations
	+ Observation 1 (Nokia):
		- With RTD = 1.5 CP (with the corresponding power difference of 6.5 dB), it can be observed that both pairs of MCSs, namely, (19,11) and (19,13), are able to reach 70% Throughput.
		- Even with RTD = 2.5 CP (with a corresponding power difference of 10.8 dB), MCS pair (19,11) can still achieve 70% Throughput criteria.
* Proposals
	+ Option 1 (Samsung, QC, Nokia): {MCS 19, MCS 13}
	+ Option 2 (Huawei, Ericsson): {MCS 19, MCS 11}
* Recommended WF
	+ Based on the average impairment results, the SNR gap between MCS 19 and MCS11 is closer to 6.5dB (power difference between two TRPs is about 6.5dB related with 1.5xCP). Meanwhile, MCS 13 has large gap among companies compared with MCS11, to move forward, can we take {MCS 19, MCS 11} for PDSCH requirement with multi-Rx reception?
	+ More discussion needed.
	+ Encourage companies to provide the impairment results for requirement derivation

Ideal simulation results summary

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| RTD | MCS | QC | Samsung | Ericsson | Nokia | Huawei | Average | SPAN | Average SNR gap (MCS 19-MCS13/11) |
| (1.5CP) | 19 | 12.4 | 11.6 | 11.1 | 12.6 | 12.2 | 11.98 | 1.5 | n/a |
| 13 | 7.4 | 6.4 | 6.2 | 10.0 | 9.2 | 7.84 | 3.8 | 4.14 |
| 11 | 5.6 | 4.6 | 4.4 | 7.0 | 7.0 | 5.72 | 2.6 | 6.26 |

Impairment simulation results summary

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| RTD  | MCS | QC | Samsung | Ericsson | Nokia | Huawei | Average | gap | Average SNR gap (MCS 19-MCS13/11) |
| (1.5CP) | 19 | 14.9 | 13.6 | 13.1 | 15.1 |  | 14.175 | 2 | n/a |
| 13 | 9.9 | 8.4 | 8.2 | 12.5 |  | 9.75 | 4.3 | 4.425 |
| 11 | 8.1 | 6.6 | 6.6 | 9.5 |  | 7.7 | 2.9 | 6.475 |

**Issue 1-1-2: PDSCH allocation timeline in the UE Demod Test**

* WF in the RAN4#109 meeting

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| --- | --- |
| **Issue 3-2-5: PDSCH allocation timeline in the UE Demod Test****WF*** + Option 1
		- The overview period after receiving MAC CE activate TCI switching for each panel from the through statistic can be reused
			* THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS pro
			* Scheduling TCI switching command can be slot#57600n for the right panel and slot#57600n+12800for the left panel,
			* THARQ = 4 (slots), TMAC Proc = 24 (slots), TSSB proc=16slots, and TTRS pro =16 (slots)
			* TfirstSSB =132 (slots),
			* TfirstTRSafterSSB =69 (slots)

* + Option 2
		- * Schedule TCI state switching command using MCS4 in the slots where SSB transmitted, i.e. slot#57600n for the panel 1 and slot#57600n+16480 for the panel 2 respectively.
			* For both panels, TfirstSSB can be 132 slots that is calculated by min (SSB@slot#160n-THARQ-TMAC Proc), TfirstTRSafterSSB can be 69 slots that is calculated by min(TRS@slot#(80n+5)-TSSB).
	+ Option 3: It is needed to first align the understanding on the parameters for PDSCH allocation timeline in Rel-18 HST FR2 with multi-RX before deciding to change the parameters currently used in Rel-17 HST
	+ Option 4
		- * RAN4 to consider the PDSCH/PDCCH scheduling timeline proposed above for agreement for FR2 HST multi-RX;

|  |
| --- |
| * PDCCH and PDSCH associated with TCI # (TBD, **left**-facing RRH panels) is transmitted from slot #
	+ 0, k = 0;
	+ (k - 1)\*n1 + 1 + THARQ + TMAC proc + Tfirst TRS Left + TTRS proc, k = 1,2,3,…;

to slot# * + k \* n1 + 1 + THARQ + TMAC proc, k = 0,1,2,3…;

PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.* PDCCH and PDSCH associated with TCI # (TBD, **right**-facing RRH panels) is transmitted from slot #
	+ 0, k = -1;
	+ k \* n1 + n2 + 1 + THARQ + TMAC proc + Tfirst TRS Right + TTRS proc, k = 0, 2,3,…;

to slot# * + (k + 1) \* n1 + n2 + 1 + THARQ + TMAC proc, k = -1, 0,1,2,3…;

 PDCCH and PDSCH are DTXed in other slots in which throughput statistics are not considered.The values in the proposed allocation above are:* 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;

For Left-facing panels:* n­1 = 57600 is the number of slots between two TCI switches according to the agreed geometry for scenario B-1;
* Tfirst TRS Left = 51 is the number of slots to first TRS transmission occasion for Left-facing RRH panels after MAC-CE command is decoded by the UE;

For Right-facing panels:* n2 = 16457 is the number of slots transmitted in 2\*Ds\_offset according to the agreed geometry for scenario B-1;

- Tfirst TRS Right = 74 is the number of slots to first TRS transmission occasion for Right-facing RRH panels after MAC-CE command is decoded by the UE; |

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* Observations
	+ Observation 1 (Nokia):
		- Based on the offline discussions, option 4 can be used as the baseline for discussions among companies.
	+ Observation 1 (QC):
		- Channel profile will switch at slot #57600\*n for right-facing panels, and on slot #[57600\*n + 16457] for left-facing panels;
		- FR2 UE had to wait for SSB in FR2 HST bidirectional deployment with single active panel to handle a FO doppler jump out of TRS range. This is not the case in FR2 HST with multiple active panels;
		- Existing HST DPS tests schedule MAC command for TCI state switch in the SSB slot.
		- If TCI state switch is scheduled in the last available SSB slot (#16320) before channel profile switches to the new RRH profile, the UE will switch to the new TCI before the channel.
* Proposals
	+ Option 1 (QC)
		- RAN4 not to consider Tfirst SSB after TRS and TSBB proc in the PDSCH allocation timeline for FR2 HST with multiple RX panels;
		- In FR2 HST Demod requirements with multiple RX chains, RAN4 to choose, for TCI state switching command, the last slot transmitted by the RRH according to the RRH coverage and scheduling assumptions channel, following the approach used in FR1 HST DPS.
		- TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = 0 (i≠0) for right-facing panels, n = 57600
		- TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = nL (i≠0) for left-facing panels, n = 57600 and nL= 16457.
	+ Option 2 (Huawei)
		- The existing formula in Rel-17 for the TCI switching time can be reused, i.e. THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS proc.
		- Schedule TCI state switching command using MCS4 in the slots where SSB transmitted, i.e. slot#57600n-160 for the panel 1 and slot#57600n+16320 for the panel 2 respectively that is the closest SSB transmission slots before the exacting switching points.
		- For both panels, TMAC Proc can be 24 slots that is corresponding to 3ms, TfirstSSB can be 132 slots that is calculated by min(SSB@slot#160n-THARQ-TMAC Proc), TSSB proc can be 16 slots that is corresponding to 2ms, TfirstTRSafterSSB can be 69 slots that is calculated by min(TRS@slot#(80n+5)-TSSB), TTRS proc can be 16 slots that is corresponding to 2ms.
	+ Option 3(Ericsson):
		- For the forward-looking Rx panel, scheduling TCI state switching command can be slot# 57600 x n, n=0, 1, 2, …
			* PDSCH throughput statistics starts: THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
				+ THARQ = 4 (slots), TMAC Proc = 24 (slots), TSSB proc = 16 (slots), and TTRS proc = 16 (slots)
				+ TfirstSSB =132 (= SSB period (160) - THARQ - TMAC Proc)
				+ TfirstTRSafterSSB = 69 (= TRS period (80) - TRS offset from SSB (5) - TTRS proc)



* + - For the backward-looking Rx panel, scheduling TCI state switching command can be slot# 57600 x n + 16320, n = 0, 1, 2, …
			* PDSCH throughput statistics starts: THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc
				+ THARQ = 4 (slots), TMAC Proc = 24 (slots), TSSB proc = 16 (slots), and TTRS proc = 16 (slots)
				+ TfirstSSB =132 (= SSB period (160) - THARQ - TMAC Proc)
				+ TfirstTRSafterSSB = 69 (= TRS period (80) - TRS offset from SSB (5) - TTRS proc)
			* Option 3a: scheduling the TCI state switching command in the SSB slot before slot 2x Ds\_offset



* + - * Option 3b: scheduling the TCI state switching command is at the slot 2x Ds\_offset



* + Option 4 (Nokia):
		- RAN4 to continue the process of aligning the understanding on the parameters for PDSCH allocation timeline for Rel-18 HST FR2 with multi-RX, and to finalize them in RAN4#110.
	+ Option 5 (Samsung)
		- The overview period after receiving MAC CE activate TCI switching for each panel from the through statistic can be reused
			* THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS pro
			* For Left Panel
				+ PDSCH and PDCCH associated with TCI sate is transmitted by k RRH from slot #

$$\begin{matrix}0&,k=-1\\k\*n+16457+1+T\_{HARQ}+T\_{MAC proc}+T\_{firstSSB}+T\_{SSB proc}+T\_{firstTRSafterSSB}+T\_{TRS proc}&,k=0,1,2…\end{matrix}$$

* + - * + To slot#

$(k+1)\*n+16457+T\_{HARQ}+T\_{MAC proc}$ ， k=-1, 0,1,2…

* + - * + $T\_{firstSSB}$ = 155
				+ $T\_{firstTRSafterSSB}$ = 69
				+ $T\_{HARQ}$ = 4, $T\_{MAC proc}$ =24, $T\_{SSB proc}$ and $T\_{TRS proc}$ =16
			* For Right Panel
				+ PDSCH and PDCCH associated with TCI sate is transmitted by k RRH from slot #

$$\left\{\begin{matrix}0&,k=1\\(k-1)\*n+1+T\_{HARQ}+T\_{MAC proc}+T\_{firstSSB}+T\_{SSB proc}+T\_{firstTRSafterSSB}+T\_{TRS proc}&,k=2,3…\end{matrix}\right.$$

* + - * + To slot#

$k\*n+T\_{HARQ}+T\_{MAC proc}$ ， k=1,2…

* + $T\_{firstSSB}$ = 132
	+ $T\_{firstTRSafterSSB}$ = 69
	+ $T\_{HARQ}$ = 4, $T\_{MAC proc}$ =24, $T\_{SSB proc}$ and $T\_{TRS proc}$ =16
* Recommended WF
	+ The following issues need to be clarified

**Issue 1-1-2-1: FFS on considering Tfirst SSB after TRS and TSBB proc in the PDSCH allocation timeline for FR2 HST with multiple Rx panels**

* Proposals
	+ Option 1 (QC): No
		- FR2 UE had to wait for SSB in FR2 HST bidirectional deployment with single active panel to handle a FO doppler jump out of TRS range. This is not the case in FR2 HST with multiple active panels
		- THARQ + TMAC proc + Tfirst TRS + TTRS proc
	+ Option 2 (Ericsson, Huawei, Samsung): yes
		- The existing formula in Rel-17 for the TCI switching time can be reused, i.e. THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS proc.
* Recommended WF
	+ More discussion needed

**Issue 1-1-2-2: TCI state switching scheduling for left-facing panel (backward-looking Rx panel or left panel)**

* Proposals
	+ Option 1 (QC, Samsung)
		- Configure TCI state switching command scheduled by MAC CE in the last available slot according to the channel delay profile and RRH coverage, following the approach used in FR1 HST DPS
		- TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = Nl (i≠0) for left-facing panels, n = 57600 and Nl= 16457.
	+ Option 2 (Ericsson, Huawei)
		- Configure TCI state switching command scheduled by MAC CE in the last available slot before channel profiles
		- Schedule TCI state switching command using MCS4 in the slots where SSB transmitted, i.e. slot#57600n+16320, that is the closet SSB transmission slots before exacting switching points
* Recommended WF
	+ More discussion needed

**Issue 1-1-2-3: TCI state switching scheduling for right-facing panel (forward-looking Rx panel or right panel)**

* Proposals
	+ Option 1 (QC, Samsung, Ericsson)
		- Configure TCI state switching command scheduled by MAC CE in the last available slot according to the channel delay profile and RRH coverage, following the approach used in FR1 HST DPS
		- TCI state switching command scheduled by MAC CE with MCS 4 is transmitted in slot #i that satisfy mod(i, n) = 0 (i≠0) for right-facing panels, n = 57600
	+ Option 2 (Huawei)
		- Schedule TCI state switching command using MCS4 in the slots where SSB transmitted, i.e. slot#57600n-160, that is the closet SSB transmission slots before exacting switching points
* Recommended WF
	+ More discussion needed

**Issue 1-1-2-4: common value of THARQ + TMAC Proc + TfirstSSB + TSSB proc + TfirstTRSafterSSB + TTRS proc**

* Proposals for left-facing panel (backward-looking Rx panel or left panel)
	+ Option 1 (Ericsson, Huawei)
		- THARQ = 4
		- TMAC Proc =24
		- TSSB proc =16
		- TTRS proc =16
		- TfirstSSB = 132 (= SSB period (160) – THARQ – TMAC Proc)
		- TfirstTRSafterSSB = 69 (= TRS period (80) – TRS offset from SSB (5) – TTRS proc)
	+ Option 2 (Samsung)
		- THARQ = 4
		- TMAC Proc =24
		- TSSB proc =16
		- TTRS proc =16
		- TfirstSSB = 155 (= SSB period (160) – THARQ – TMAC Proc – $16457$ )
		- TfirstTRSafterSSB = 69 (= TRS period (80) – TRS offset from SSB (5) – TTRS proc)
* Proposals for right-facing panel (forward-looking Rx panel or right panel)
	+ Option 1 (Samsung, Huawei, Ericsson)
		- THARQ = 4
		- TMAC Proc =24
		- TSSB proc =16
		- TTRS proc =16
		- TfirstSSB = 132 (= SSB period (160) – THARQ – TMAC Proc)
		- TfirstTRSafterSSB = 69 (= TRS period (80) – TRS offset from SSB (5) – TTRS proc)
* Recommended WF
	+ More discussion needed

**Issue 1-1-2-5: common value of THARQ + TMAC Proc + TfirstTRS + TTRS proc**

* Proposals for left-facing panel (backward-looking Rx panel or left panel)
	+ Option 1 (QC)
		- THARQ = 4
		- TMAC Proc =24
		- TTRS proc =16
		- TfirstTRS = 51
* Proposals for right-facing panel (forward-looking Rx panel or right panel)
	+ Option 1 (QC)
		- THARQ = 4
		- TMAC Proc =24
		- TTRS proc =16
		- TfirstTRS = 74
* Recommended WF
	+ More discussion needed

# Topic #2: Feature lists

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2401570 | Samsung |

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the Gnb to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 34. NR\_HST\_FR2\_enh | 34-2 | Enhanced demodulation requirements for CA HST FR2 | 1. Support of the enhanced demodulation requirements specified for CA for HST FR2 UE | 22-1 | Yes | NA | UE does not support enhanced demodulation requirements for CA | Per BC | No | FR2 only | N/A | Component 1 candidate value: true/false | Optional without capability signalling |

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the Gnb to know if the feature is supported** | **Applicable to the capability signalling exchange between Ues (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 34-1 | Support of NR FR2 HST with simultaneous DL reception with [two different QCL TypeD RSs] | [1] Support of enhanced RF requirement to nterpr FR2-1 PC6 Ues with simultaneous DL reception with two different QCL TypeD RSs]2) Support of enhanced RRM requirement to nterpr FR2-1 PC6 Ues with simultaneous DL reception with [two different QCL TypeD RSs] [3] Support of enhanced demodulation processing to nterpr FR2-1 PC6 Ues with simultaneous DL reception with two different QCL TypeD RSs] | 22-1, [16-2c] | Yes  | N/A | UE does not nterpr FR2 high speed train scenario with simultaneous DL reception with [two different QCL TypeD RSs] | Per UE | N/A | FR2 only | N/A | FFS how to give the condition of bi-directional deployment | Optional with capability signaling |

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| R4-2401699 | Huawei,HiSilicon | Proposal 5: Remove the third bullet of the components for demodulation in feature list 34-1. |
| R4-2402716 | Nokia, Nokia Shanghai Bell | Observation 1: The WID of Rel-18 Enhanced HST FR2 stated that for CA, only intra-band CA is considered.Proposal 1: RAN4 to include “intra-band” to the Feature group: “Enhanced demodulation requirements for intra-band CA HST FR2”Proposal 2: RAN4 to include “intra-band” to the Components: “1. Support of the enhanced demodulation requirements specified for intra-band CA for HST FR2 UE” |
| R4-2402717 | Nokia, Nokia Shanghai Bell | Proposal 3: To remove the square bracket [] from component number 3), which is the component about demodulation part, and to use the following formulation: “Support of enhanced demodulation processing to support FR2-1 PC6 Ues with simultaneous DL signals reception associated with two different QCL TypeD RSs” |

## Open issues summary

Last RAN4 meeting agreements in the WF R4-2321063

List of open issues

* Sub-topic 2-1 UE feature lists for FR2 HST demodulation requirement
	+ Issue 2-1-1: UE feature lists for FR2 PDSCH requirements with CA
	+ Issue 2-1-2: UE feature lists for FR2 PDSCH requirements with multi-Rx chain reception

### Sub-topic 2-1: UE feature lists for FR2 HST demodulation requirement

**Issue 2-1-1: UE feature lists for FR2 PDSCH requirements with CA**

* Observation
	+ Observation 1 (Nokia):
		- The WID of Rel-18 Enhanced HST FR2 stated that for CA, only intra-band CA is considered.
* Proposals
	+ Option 1 (Nokia, Samsung)
		- RAN4 to include “intra-band” to the Feature group: “Enhanced demodulation requirements for intra-band CA HST FR2”
		- RAN4 to include “intra-band” to the Components: “1. Support of the enhanced demodulation requirements specified for intra-band CA for HST FR2 UE”

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the Gnb to know if the feature is supported** | **Applicable to the capability signalling exchange between Ues (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 34. NR\_HST\_FR2\_enh | 34-2 | Enhanced demodulation requirements for CA HST FR2 | 1. Support of the enhanced demodulation requirements specified for CA for HST FR2 UE | 22-1 | Yes | NA | UE does not support enhanced demodulation requirements for CA | Per BC | No | FR2 only | N/A | Component 1 candidate value: true/false | Optional without capability signalling |

* Recommended WF
	+ More discussion needed

**Issue 2-1-2: UE feature lists for FR2 PDSCH requirements with multi-Rx chain reception**

* Proposals
	+ Option 1 (Nokia, Samsung)
		- To remove the square bracket [] from component number 3), which is the component about demodulation part, and to use the following formulation: “Support of enhanced demodulation processing to support FR2-1 PC6 Ues with simultaneous DL signals reception associated with two different QCL TypeD RSs”

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the Gnb to know if the feature is supported** | **Applicable to the capability signalling exchange between Ues (V2X WI only)”.** | **Consequence if the feature is not nterpre by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability nterpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 34-1 | Support of NR FR2 HST with simultaneous DL reception with [two different QCL TypeD RSs] | [1] Support of enhanced RF requirement to support FR2-1 PC6 Ues with simultaneous DL reception with two different QCL TypeD RSs]2) Support of enhanced RRM requirement to support FR2-1 PC6 Ues with simultaneous DL reception with [two different QCL TypeD RSs] [3] Support of enhanced demodulation processing to support FR2-1 PC6 Ues with simultaneous DL reception with two different QCL TypeD RSs] | 22-1, [16-2c] | Yes  | N/A | UE does not support FR2 high speed train scenario with simultaneous DL reception with [two different QCL TypeD RSs] | Per UE | N/A | FR2 only | N/A | FFS how to give the condition of bi-directional deployment | Optional with capability signaling |

* + Option 2 (Huawei):
		- Remove the third bullet of the components for demodulation in feature list 34-1.
* Recommended WF
	+ More discussion needed

# Topic #3: draft CR

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** | **Moderator Notes** |
| R4-2401700 | Huawei, HiSilicon | Draft CR on PDSCH requirement with multi-Rx reception (TS38.101-4, Rel-18) | PDSCH requirement with multi-Rx reception |
| R4-2401756 | Ericsson | Draft CR on FRC for PDSCH requirement with CA | Add FRC for PDSCH requirement with multi-Rx |
| N/A | Nokia | Draft CR On HST FR2 PDSCH with CA for 38.101-4 |  |
| R4-2402750 | Qualcomm | Draft CR on applicability of UE Demod requirements for FR2 HST with multi-RX | Update the clause number for FR2 HST |
| R4-2401571 | Samsung | Draft CR for channel model on Rel-18 FR2 HST demodulation requirement | Resubmitted draft CR endorsed in the RAN#109 meeting |
| R4-2401572 | Samsung | Draft big CR on FR2 HST |  |