**3GPP TSG-RAN WG4 Meeting #104-bis-e R4-2217029**

**Electronic Meeting, October 10-19, 2022**

**Source:** Samsung

**Title:** Work plan for Enhanced NR support for high speed train scenario in FR2

**Agenda item:** 6.12.1

**Document for:** Approval

1. Introduction

In RAN#95e meeting, the Rel-18 RAN4-led work item on enhanced NR support for high speed train scenario in FR2 has been approved as [1], which has been further updated in [2]. This Rel-18 can be regarded as the continuous enhancement over the Rel-17 feature of NR support of FR2 HST, in which Rel-17 WI RAN4 has focused on train roof-mounted high-power devices for NR SA single carrier scenario in FR2, by studying the FR2 HST deployment scenario and specifying the channel modelling, RF, RRM and demodulation requirements for FR2 HST.

Specifically, the Rel-18 enhanced NR support for high speed train scenario in FR2 contains the following objectives for core part:

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| * Only train roof-mounted high power devices with target applicable carrier frequency up to 30GHz and up to 350km/h velocity are considered in this WI
* Specify the RF requirements for intra-band carrier aggregation (CA) scenario, and investigate and specify the RRM requirements for intra-band carrier aggregation (CA) scenario [RAN4]
* Specify the requirement for simultaneous multi-panel operation for train roof-mounted FR2 high power devices [RAN4]:
	+ Maximum 2 active panels supporting the multi-panel simultaneous reception.
	+ NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception
* Study on reference tunnel deployment scenario for FR2 HST and specify the channel model and corresponding core requirements if any [RAN4]
* Specify UL timing adjustment solution, including explicit NW signalling assistance, for FR2 HST scenario with large UL/DL propagation delay difference from different RRHs/TRPs to UE [RAN4, RAN2].
* Note: RAN1/RAN2 work can be triggered by RAN4 LS.
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Furthermore, for the performance part, the following objectives are included:

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| * Specify the necessary RRM test cases based on the outcome on corresponding core part.
* Investigate and if needed specify the demodulation performance requirements for intra-band carrier aggregation (CA) HST scenario.
* Specify the necessary demodulation performance requirements for simultaneous multi-panel reception.
	+ NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception
* Specify the other necessary RRM and demodulation performance requirements depending on the outcome of core part.
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To drive the discussion on FR2 HST enhancement WI, RAN4 work plans for core and performance parts are provided in this contribution.

# 2. Work Plan for Core Part

Following approved WID [1], the objectives for core part can be categorized into the following topics:

* + 1. RF core requirements for intra-band CA and simultaneous multi-panel operation;
		2. RRM core requirements for intra-band CA, simultaneous multi-panel operation and UL timing adjustment;
		3. Study on reference tunnel deployment scenario and specify core requirement if any.

Based on the assigned TU given in WID [1], the work plan for RAN4 core part is proposed as below:

**Work Plan for Core Part:**

RAN4#104-bis-e: Oct. 10th – 19th, 2022

* Agree overall work plan for core and performance part;
* UE RF requirement:
	+ Initial discussion on UE RF core requirement impact due to intra-band CA for FR2 PC6 and endorse the CR for intra-band CA RF enhancement;
	+ Initial discussion on UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
* RRM (core) requirement:
	+ Initial discussion on UE RRM core requirement impact due to intra-band CA for FR2 PC6;
	+ Initial discussion on UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST;
	+ Initial discussion on potential enhancement(s) on UL timing adjustment solution.
* Initial study on reference tunnel deployment scenario.

RAN4#105: Nov. 14th – 18th, 2022

* UE RF requirement:
	+ further check UE RF core requirement impact due to intra-band CA for FR2 PC6;
	+ Try to identify UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
* RRM (core) requirement:
	+ Try to identify UE RRM core requirement impact due to intra-band CA for FR2 PC6;
	+ Tyr to identify UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST;
	+ Further discussion on potential enhancement(s) on UL timing adjustment solution.
* Study on reference tunnel deployment scenario:
	+ Identify the required deployment scenarios with key parameters.

RAN4#106: Feb. 27th – Mar. 03rd, 2023

* UE RF requirement:
	+ further check UE RF core requirement impact due to intra-band CA for FR2 PC6;
	+ Further discussion on UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
* RRM (core) requirement:
	+ Conclude UE RRM core requirement impact due to intra-band CA for FR2 PC6;
	+ Further discussion on UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST;
	+ Further discussion on potential enhancement(s) on UL timing adjustment solution, and corresponding RAN4 requirement impact.
* Study on reference tunnel deployment scenario:
	+ Conclude the required deployment scenarios with key parameters;
	+ Evaluation based on the identified deployment scenario.

RAN4#106-bis-e: Apr. 17th – 26th, 2023

* UE RF requirement:
	+ conclude discussion on UE RF core requirement impact due to intra-band CA for FR2 PC6 and update the endorsed CR if necessary;
	+ Identified UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
* RRM (core) requirement:
	+ CR draft to be endorsed on UE RRM core requirement impact due to intra-band CA for FR2 PC6;
	+ Identified UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ Conclude on potential enhancement(s) on UL timing adjustment solution, and identify corresponding RAN4 requirement impact.
* Study on reference tunnel deployment scenario:
	+ Continue evaluation based on the identified deployment scenario;
	+ Discussion on reference tunnel deployment channel.

RAN4#107: May 22nd – 26th, 2023

* UE RF requirement:
	+ CR draft to be agreed on UE RF core requirement impact due to intra-band CA for FR2 PC6;
	+ CR draft to be endorsed on UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
* RRM (core) requirement:
	+ CR draft to be agreed on UE RRM core requirement impact due to intra-band CA for FR2 PC6;
	+ CR draft to be endorsed on UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
	+ CR draft to be endorsed on UL timing adjustment solution’s RRM requirement impact.
* Study on reference tunnel deployment scenario:
	+ Conclude on reference tunnel deployment channel.

RAN4#108: Aug. 23th – 27th, 2023

* UE RF requirement:
	+ CR draft to be agreed on UE RF core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
* RRM (core) requirement:
	+ CR draft to be agreed on UE RRM core requirement for simultaneous multi-panel operation, specifically for FR2 HST.
	+ CR draft to be agreed on UL timing adjustment solution’s RRM requirement impact.
* Study on reference tunnel deployment scenario:
	+ CR and/or TP agreed on reference tunnel deployment channel.

# 3. Work Plan for Performance Part

Considering the FR2 HST enhancement work item contains a comprehensive scope for scenario enhancement, the corresponding RRM performance requirement and demodulation requirement are included in RAN4 performance part [1]. It should be noted that the demodulation requirement (either for UE or for BS) should be based upon the outcome of channel modeling for tunnel scenario discussion.

Based on the assigned TU, the work plan for RAN4 performance part is proposed as below:

**Work Plan for Performance Part:**

RAN4#106-bis-e: Apr. 17th – 26th, 2023

* RRM (performance) requirement:
	+ Discussion on UE RRM performance requirement impact due to intra-band CA for FR2 PC6;
	+ Discussion on RRM performance requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ Discussion on RRM performance requirement for UL timing adjustment solution.
* Demodulation:
	+ Discussion on test case and applicability rule for intra-band CA for FR2 PC6.
	+ Discussion on test case for simultaneous multi-panel reception for FR2 PC6.
	+ Discussion on test case in reference tunnel deployment channel, if identified.

RAN4#107: May 22nd – 26th, 2023

* RRM (performance part):
	+ Further discussion on UE RRM performance requirement impact due to intra-band CA for FR2 PC6;
	+ Further discussion on RRM performance requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ Further discussion on RRM performance requirement for UL timing adjustment solution.
* Demodulation:
	+ Further discussion on test case and applicability rule for intra-band CA for FR2 PC6.
	+ Further discussion on test case for simultaneous multi-panel reception for FR2 PC6.
	+ Further discussion on test case in reference tunnel deployment channel, if identified.

RAN4#108: Aug. 23th – 27th, 2023

* RRM (performance part):
	+ CR drafting on UE RRM performance requirement impact due to intra-band CA for FR2 PC6;
	+ CR drafting on RRM performance requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ CR drafting on RRM performance requirement for UL timing adjustment solution.
* Demodulation:
	+ CR drafting on test case and applicability rule for intra-band CA for FR2 PC6.
	+ CR drafting on test case for simultaneous multi-panel reception for FR2 PC6.
	+ CR drafting on test case in reference tunnel deployment channel, if identified.

RAN4#108-bis: Oct. 09th – 18th, 2023

* RRM (performance part):
	+ CR to be endorsed on UE RRM performance requirement impact due to intra-band CA for FR2 PC6;
	+ Continue CR drafting on RRM performance requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ Continue CR drafting on RRM performance requirement for UL timing adjustment solution.
* Demodulation:
	+ CR to be endorsed on test case and applicability rule for intra-band CA for FR2 PC6.
	+ CR to be endorsed on test case for simultaneous multi-panel reception for FR2 PC6.
	+ CR to be endorsed on test case in reference tunnel deployment channel, if identified.

RAN4#109: Nov. 13th – 17th, 2023

* RRM (performance part):
	+ CR to be agreed on UE RRM performance requirement impact due to intra-band CA for FR2 PC6;
	+ CR drafting to be endorsed/approved on RRM performance requirement for simultaneous multi-panel operation, specifically for FR2 HST, based upon conclusions from FR2 multi-RX reception WI.
	+ CR drafting to be endorsed/approved on RRM performance requirement for UL timing adjustment solution.
* Demodulation:
	+ CRs to be agreed for demodulation performance requirements.

RAN4#110: Feb. TBD, 2024

* RRM (performance part):
	+ Complete CRs for RRM test cases for the impacted RRM requirements.
	+ Complete remaining issues (if any) for RRM test cases for the impacted RRM requirements.
* Demodulation:
	+ Complete CRs for demodulation performance requirements.

# 4. Conclusion

This contribution provides the overall RAN4 work plan for core and performance parts for FR2 HST enhancement work item, with detailed plans in the above sections.

# 5. Reference

[1] RP-220985, “New WID on enhanced NR support for high speed train scenario in frequency range 2 (FR2)”, Samsung.

[2] RP-222272, “Revised WID on enhanced NR support for high speed train scenario in frequency range 2 (FR2)”, Samsung.