**3GPP TSG-RAN WG4 Meeting # 104-e R4-2214126**

**Electronic Meeting, 15– 26 August 2022**

**Agenda item:** 9.7.5

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

**Title:** Email Discussion Summary for [104-e][206] NR\_HST\_FR2\_RRM\_1

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

It is appreciated that the delegates for this topic put their contact information in the table below.

**Contact information**

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Moderator (Nokia, Nokia Shanghai Bell) | Dimitri Gold | dimitri.gold@nokia-bell-labs.com  |
| CATT | Yanze Fu | fuyanze@catt.cn |
|  |  |  |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

## Background and scope

This document will be used to guide and summarize the email discussion for the topic of Rel-17 NR HST FR2 enhancements RRM core requirements maintenance, with the email thread identifier “[104‑e][206] NR\_HST\_FR2\_RRM\_1”.

In this email thread, the following agenda items are discussed:

* 9.7.2 RRM core requirement maintenance
	+ 9.7.2.1 RRC Idle/Inactive and connected state mobility requirements
	+ 9.7.2.2 Timing and signaling characteristics requirements
	+ 9.7.2.3 Measurement procedure requirements

The following WFs were approved previously:

* R4-2103679, WF on Rel-17 NR HST FR2 enhancements, RRM requirements, Nokia, Nokia Shanghai Bell, RAN4#98-e.
* R4-2105794, WF on FR2 HST RRM requirements, Nokia, Nokia Shanghai Bell, RAN4#98-bis-e.
* R4-2115334, WF on FR2 HST RRM requirements (part 1), Nokia, Nokia Shanghai Bell, RAN4#100-e.
* R4-2115335, WF on FR2 HST RRM requirements (part 2), Samsung, RAN4#100-e.
* R4-2120292, WF on FR2 HST RRM requirements (part 1), Nokia, Nokia Shanghai Bell, RAN4#101-e.
* R4-2120416, WF on FR2 HST RRM requirements (part 2), Samsung, RAN4#101-e.
* R4-2202594, WF on FR2 HST RRM (part 1), Nokia, Nokia Shanghai Bell, RAN4#101-bis-e.
* R4-2202767, WF on FR2 HST RRM (part 2), Samsung, RAN4#101-bis-e.
* R4-2206848, WF on FR2 HST RRM (part 1), Nokia, Nokia Shanghai Bell, RAN4#102-e.
* R4-2210608, WF on HST FR2 RRM Core Requirement Maintenance, Nokia, Nokia Shanghai Bell, RAN4#103-e.

As a moderator for FR2 HST enhancements RRM discussion, we would like to suggest the following candidate target of 1st and 2nd round email discussion:

* 1st round:
	+ In Topic#1, some of the issues still require further discussion. It is necessary to align understanding of the companies of all possible UL timing adjustment mechanisms, if/when relaxation in UL transmit timing accuracy requirements is allowed.
	The agreements shall be reflected in the CR.
	+ In Topic#2, no new Issues were introduced. The companies need to align on the issues that were discussed for the several meetings already.
	The agreements shall be reflected in the CRs.
* 2nd round:
	+ Achieve agreements on all remaining open issues and finalize the corresponding maintenance CRs.

## Email discussion guidelines

The moderator would like to ask companies to adhere to the following guidelines, when taking part in [104-e][206] NR\_HST\_FR2\_RRM\_1.

Please also check the “RAN4#104-e meeting arrangements and guidelines”, available on the reflector, for fundamental guidelines and deadlines.

The preferred method of commenting is to add/update your company’s view directly in this email summary document (use change marks whenever appropriate) and upload it to [104-e][206] NR\_HST\_FR2\_RRM\_1 draft folder corresponding to the stage of the meeting, e.g., pre-meeting, first round, second round.

* Draft folder:
[[104-e][206] NR\_HST\_FR2\_RRM\_1](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Inbox/Drafts/%5B104-e%5D%5B206%5D%20NR_HST_FR2_RRM_1?login=1)
<https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Inbox/Drafts/%5B104-e%5D%5B206%5D%20NR_HST_FR2_RRM_1>
* It is expected that delegates will download the latest version (including other companies’ versions) of the summary document, insert comments and upload it again.
* To ensure the comments are captured timely and correctly, delegates are encouraged to:
	+ Rename the file by adding your company name and changing the file version.
	Example:
	“Summary\_104-e\_206\_HST\_FR2\_RRM\_1\_r1\_**v05\_CATT\_Nokia**.docx” -> “Summary\_104-e\_206\_HST\_FR2\_RRM\_1\_r1\_**v06\_Nokia\_QC**.docx”
	+ There is no need to send e-mails in the reflector when comments in the summary are added.
	+ Please, check for updated base document versions, right before uploading your updates.
* Please, do not hesitate to mark your company as supporting a certain option directly in this document.
Please refrain from rewriting existing options and proposed WFs; ask the moderator (in your company’s comment) to modify/add.
* It is encouraged to give a short reasoning for each view expressed (1-2 sentences are recommended).
Please avoid statements like “Option X”, without further explication or reasoning.

# Topic #1: UL timing

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2211595](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211595.zip) | Qualcomm, Inc. | **FR2 HST RRM core****Observation 1-1**: The transmission restriction or any other requirement imposed before RACH can’t eliminate the interference across UEs on UL since the UL transmission after RACH has a misaligned frame boundary with the UL transmission from UEs in the old TCI state. Moreover, DL signals from different RRHs also arrived with misaligned frame boundaries due to propagation delay difference. **Observation 1-2**: Since UL gradual timing adjustment is still applicable to UE, before RACH procedure and 200ms after TCI state switch, UE still follow the previous TCI state timing up to Tq autonomous adjustment, which is much smaller than CP and frame boundary misalignment has negligible impact to the UEs on the previous TCI state, at least much smaller than UE Tx after RACH. **Observation 2**: We can eliminate cross UE interference on UL only when all UEs are transmitting on the same timing regardless of TCI state, otherwise UL transmission from UEs with different TCI states from different RRHs have misaligned frame boundaries. **Proposal 1**: Network applies different offsets to DL frame boundaries of different RRHs to pre-compensate the propagation delay difference across different RRHs to eliminate UL and DL interference across UEs when UEs in the same region are on different TCI states from different RRHs. Network doesn’t schedule UL transmission if network can’t handle different UL reception timing on different RRHs. After all the UEs are on the TCI states from the same RRH in the same region, network schedules RACH session to all UEs to acquire new UL and (uncompensated) DL timing. **Proposal 2**: If proposal 1 is too complicated for network implementation, given that transmission restriction can not eliminate UL interference across different TCI states, no additional requirement should be defined.[Moderator]: Observation and proposal below are treated in Topic#2.**Observation 3**: Interference on SSBs in FR2 HST is rare since (1) trains crossing each other is rare and duration is very short due to high speed (2) no interference across SSBs due to the agreed constraints on consecutive SSBs. With negligible interference, enhanced (faster) L1-RSRP measurement is sufficient for FR2 HST. **Proposal 3**: Follow FR1 HST, do not introduce L1-SINR measurement delay requirement enhancement. |
| [R4-2211674](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211674.zip) | CATT | **Discussion on remaining issues of timing and signal characteristics requirements for HST FR2****Proposal 1**: When highSpeedLargeOneStepUL-TimingFR2-r17 is disabled, after the TCI state switch, option 4 is acceptable. |
| [R4-2212473](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2212473.zip) | Samsung | **Remaining issues on RRM core requirement for FR2 HST****Observation 1**: There are different ways in practice to perform RA-based UL timing adjustment, by considering PDCCH-order (for RA triggering) is sent from the source RRH or target RRH. **Observation 2**: The issue of UE transmission in the new TCI state after TCI state switching but before the new TA is acquired cause more negative influence for the case in which PDCCH-order is sent from new TCI after TCI switching. **Proposal 1**: No need to transmit or scheduling restriction for UL after the TCI state switch, when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled.[Moderator]: Two proposal below are treated in Topic#2.**Proposal 2**: For SMTC limit in HST FR2 enhancement requirements, to adopt the below Option 1, i.e., Option 1: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply. **Proposal 3**: For L1-SINR measurements core requirement, do not define enhancement for L1-SINR.  |
| [R4-2213342](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213342.zip) | Ericsson | **RRM remaining issues for HST FR2****Proposal 1**: Support Option2, no impact on UE behavior after TCI state switch.[Moderator]: Proposal below is treated in Topic#2.**Proposal 2**: Do not define enhancement for L1-SINR unless practical use cases can prove the necessity. |
| [R4-2213387](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213387.zip) | Nokia, Nokia Shanghai Bell | **On HST FR2 UL Transmit Timing Requirements****Observation 1**: The UE is able to track fine DL timing after the TCI state switch in HST FR2 scenarios even after the large jump in propagation delay and when target TCI state was not in the active TCI state list. **Observation 2**: Currently, for some UE categories in HST FR2 deployments, it is allowed to transmit in UL with a larger timing error after the TCI state switch (±7Ts instead of ±3.5Ts= Te). It is defined and unclear on the network side when and how the UE shall adjust its timing back within ±Te. **Observation 3**: In the case of HO, after the HO interruption time (TS 38.133, Clause 6.1.1.4.2), the UE can transmit in UL with the timing error limit within ±Te. **Proposal 1**: RAN4 to specify explicitly when the UE shall adjust its UL timing to within ±Te after the TCI state switch, i.e., when it can follow again the reequipments from 7.1.2.1. **Proposal 2**: If target TCI state is not in the active TCI state list, limit the time needed for the UE to follow again clause 7.1.2.1 requirements and to adjust its UL timing within ±Te. It should happen not later than Trs + 2ms after the TCI state switch.**Observation 4:** Using either network-based (e.g., RACH-based) or large one-shot UL timing adjustment mechanisms, the UE should be able to achieve transmit timing error within ±Te after the TCI state switch. However, no UL timing error requirements are defined explicitly for TCI state switch in TS 38.133.**Proposal 4:** RAN4 to introduce UE initial transmission timing error requirement after the TCI state switch.**Proposal 5:** UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies when it is the first transmission after the TCI state switch. |
| [R4-2213399](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213399.zip) | Nokia, Nokia Shanghai Bell | **CR to 38.133 on UL Transmit Timing in HST FR2 Scenario** |
| [R4-2213866](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213866.zip) | ZTE Corporation | **Discussion on remaining issues of Timing for HST FR2****Proposal 1**: In order to align the understanding from different companies, further clarification on the agreement bout the accuracy of UL transmit timing is necessary. Our understanding is as below: * If largeOneStepUL-timingFR2-r17 is disabled, accuracy relaxation is not allowed. Otherwise, accuracy relaxation is allowed possibly and needs further decision by the UE.
* If largeOneStepUL-timingFR2-r17 is enabled, since the one-shot TA adjustment is triggered by TCI state switching plus the contrast between DL timing difference and the threshold, so immediately after each TCI state switching, UE needs to check whether accuracy relaxation is allowed. The following cases are possible:
	+ Case 1: If UE can only track one TCI state
		- If the DL timing difference is above the threshold, the accuracy relaxation is allowed.
		- Otherwise, the accuracy relaxation is not allowed.
	+ Case 2: If UE can track multiple TCI states and the target TCI state is not in the list
		- If the DL timing difference is above the threshold, the accuracy relaxation is allowed.
		- Otherwise, the accuracy relaxation is not allowed.
	+ Case 3: If UE can track multiple TCI states and the target TCI state is in the list
		- The accuracy relaxation is not allowed no matter whether the DL timing difference is above the threshold or not.

**Proposal 2**: We agree with the relaxation of UL transmit timing accuracy from legacy ±Te to ±7Ts in FR2. So the brackets can be removed. For RACH based solution, **Proposal 3**: Compared with Option 1 and Option 3, Option 4 is more feasible. However Option 4 is somehow radical since no matter inter-RRH TCI state or intra-RRH TCI state switch occurs, the transmit restriction is always applied. **Proposal 4**: Aim to optimize the scheduling/transmit restriction, the threshold of DL timing difference is useful. For the exact value of threshold, re-use the value determined for one-shot TA adjustment is fine. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: Large one-step UL timing adjustment

*Sub-topic description:*

One shot large UL timing adjustment for FR2 Power Class 6 UE requirements are formulated in TS 38.133, Clause 7.1.2.3, and some of the values are still in square brackets:

|  |
| --- |
| **7.1.2.3 One shot large UL timing adjustment for FR2 Power Class 6 UE**When *highSpeedMeasFlagFR2-r17* is configured and *highSpeedLargeOneStepUL-TimingFR2-r17* is enabled for UE supporting FR2 power class 6 and [*largeOneStepUL-timingFR2-r17*] capability, the following requirements apply to the UE:- If the absolute value , the requirement in clause 7.1.2.1 apply to the first UL transmission after a TCI state switch.- Otherwise, the UE transmit timing immediately after TCI state switch shall be and clause 7.1.2.1 requirements don’t apply.- The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±Te as specified in clause 7.1.2 if the new target TCI state is within active TCI state list, otherwise ±[7Ts], and the reference point is .Above,- (in units) is the DL timing defined as the time when UE receives downlink frame with new target TCI state.- (in units) is the DL timing defined as the time when UE receives downlink frame with old source TCI state. |

#### Issue 1-1-1: Time period of relaxed UL transmit timing accuracy

* Background:

Following the requirements from Clause 7.1.2.3

* When highSpeedMeasFlagFR2-r17 is configured and highSpeedLargeOneStepUL-TimingFR2-r17 is enabled for UE supporting FR2 power class 6 and [largeOneStepUL-timingFR2-r17] capability
* And the absolute value
* And the new target TCI state is not in the active TCI state list

The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±[7Ts].

* Proposals and/or Observations
	+ Observation 1 (Nokia): The UE is able to track fine DL timing after the TCI state switch in HST FR2 scenarios even after the large jump in propagation delay and when target TCI state was not in the active TCI state list.
	+ Observation 2 (Nokia): Currently, for some UE categories in HST FR2 deployments, it is allowed to transmit in UL with a larger timing error after the TCI state switch (±7Ts instead of ±3.5Ts= Te). It is defined and unclear on the network side when and how the UE shall adjust its timing back within ±Te.
	+ Observation 3 (Nokia): In the case of HO, after the HO interruption time (TS 38.133, Clause 6.1.1.4.2), the UE can transmit in UL with the timing error limit within ±Te.
	+ **Proposal 1** (Nokia): RAN4 to specify explicitly when the UE shall adjust its UL timing to within ±Te after the TCI state switch, i.e., when it can follow again the reequipments from 7.1.2.1.
	+ **Proposal 2** (Nokia): If target TCI state is not in the active TCI state list, limit the time needed for the UE to follow again clause 7.1.2.1 requirements and to adjust its UL timing within ±Te. It should happen not later than Trs + 2ms after the TCI state switch.
* Candidate options
	+ Option 1 [Nokia]: Adopt Proposals 1 and 2.
	+ Option 2: Keep current spec as it is: *The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±Te as specified in clause 7.1.2 if the new target TCI state is within active TCI state list, otherwise ±[7Ts].*
* Recommended WF
	+ Companies are encouraged to share their understanding whether UL transmit timing accuracy shall return to within ±Te=4.5Ts from ±7Ts after the TCI state switch and when.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Regarding Proposal 1 in Option1, we can not find reason to specify the UL timing after a TCI state switch since it’s identical to legacy TCI state switch. Between Proposal 2 in Option 1 and Option 2, We prefer Proposal 2 in Option 1 which can close the loop. Besides of that, Trs in Proposal 2 shall be replaced by Tssb if going with Proposal 2. Trs represents SMTC priority in current specification. And, *7Ts* shall be replaced by 7\*64 Tc.  |
| QC | As the analysis shown in the previous meeting contribution, gNB can capture almost all the power with 7Ts UL timing error margin, and therefore leave the further convergence of UL timing to UE implementation doesn’t break the system. Also, as we explained in the previous contribution, DL timing estimation error is not the source contributing to additional timing errors, calibration error is the major source. Therefore, guarantee convergence according to additional DL RS is not feasible from UE perspective. In addition, the first UL timing error has the reference timing of , while 7.1.2.1 requirement has , therefore mixing 7.1.2.1 and 7.1.2.3 lead to infeasible and incorrect requirement. To sum up, proposal 1 and 2 in option 1 is infeasible from UE implementation perspective, and it is also incorrect specification. Therefore, we should keep spec as it is and select option 2. |
| Nokia | Firstly, we would like to clarify the understanding of current requirements in Clause 7.1.2.3 with other companies:*Are reduced UL transmit timing requirements (i.e., ±7Ts) are applicable all the time after the TCI state switch or only shortly after the switch?*Currently, the requirement states that: “Otherwise, the UE transmit timing **immediately after TCI** state switch … and **clause 7.1.2.1 requirements don’t apply**”. What “immediately” means?In our view, the UE shall be able to adjust it’s UL transmit timing within ±Te if not immediately after the TCI state switch then, some time after that. It is not clear, *why UE cannot achieve Te accuracy and convergence after TCI state switch if this can be achieved after HO?*Thus, we propose to limit the time when reduced UL transmit timing accuracy is allowed after the TCI state switch. NW needs this information to be aware of the scale of UL transmit timing error and to optimally schedule UL transmissions after the TCI switch.We support Option 1, and Proposal 2 is the concrete formulation that is also reflected in our CR R4-2213399.**To QC:**As we argued at the previous meeting, the most part of the energy can be captured only if the error in UL timing is positive, i.e., 7Ts, and the signal is received at gNB later, with a delay. However, if the error is negative, i.e., -7Ts, then the signal is transmitted from the UE too early and arrives too early at the gNB. In this latter case, the energy is concentrated further way from the reception window. |
| QC | The “immediately after TCI state switch” refers to the first UL after TCI state, as the parallel description on small DL timing difference case. In HO, the timing difference is much smaller than the scenario under discussion, as it typically happens in the middle of two cells.For Nokia’s comment on 7Ts or -7Ts, given that the correct timing is on the center of CP/2 and CP/2 ~ 9Ts, -7Ts timing error can be accommodated similarly as 7Ts. If we follow Nokia’s argument, we need to restrict the timing error to positive, instead of reduce it to +/-Te, because even -Te the signal arrives too early. |
| Nokia2 | We would like to thank QC for the answers to our questions!However, we still have some additional questions and comments:1. If ““immediately after TCI state switch” refers to the first UL after TCI state”, then do you still expect that gradual timing adjustment requirements (7.1.2.1) will become applicable at some point after the TCI state switch, i.e., not for the first UL?
2. It is not clear to us why for HO timing difference is much smaller?HO can also be associated with a jump in propagation of the same scale as the TCI state switch.For example, in the scenario below, RRH1 and RRH2 can belong to the same or different cell. In the first case (same) it will be a TCI state switch, whereas in the second one (different), it will be a HO. In both cases a jump in propagation delay will be similar in magnitude.
3. It is described in the requirements that UL transmit timing is relative the first tap of DL signal received at the UE. Hence, UL transition takes place ahead of the DL reference, and the timing is defined by the value of timing advance (TA).Therefore, TA value defines the begging of UL transmission (i.e., of the whole UL symbol), and not when the middle of CP is transmitted. Correspondingly, up to our understanding, an error in UL transmit timing should be relative to the beginning of the symbol and not to the CP/2.
 |
| ZTE | We understand and agree with the motivation of Option 1. For the Proposal 2 in Option 1, another condition that DL timing difference larger than threshold can be added. So the Proposal 2 can be revised as:* **Proposal 2** (Nokia): If target TCI state is not in the active TCI state list and the DL timing difference is larger than [CP/4], limit the time needed for the UE to follow again clause 7.1.2.1 requirements and to adjust its UL timing within ±Te. It should happen not later than Trs + 2ms after the TCI state switch.
 |
| QC | To address Nokia’s question1. We can compromise to have Tq requirement in 7.1.2.1 applicable to UL slots except the first after TCI state switch, but as we pointed out in the previous comment, Te part of 7.1.2.1 is not applicable due to inapplicability of reference timing from 7.1.2.1 to 7.1.2.3.
2. If you are talking about HO in FR2 HST uni-directional model, the correct comparison is RACH case, and whether the timing requires relaxation, it’s a new issue so we can have further discussion by checking RACH procedure.
3. The gNB or RRHs should have tolerance for negative timing offset since even in legacy requirement, -3.5Ts offset is possible. And the same remedy applies to -7Ts, similar to extend 3.5Ts to 7Ts. The point is the total delay spread is not exceeding CP/2 and gNB can select the best window to accommodate timing errors.
 |
| OPPO | Prefer option 2 to keep the current agreements. |

#### Issue 1-1-2: Value of relaxed UL transmit timing accuracy

* Background

Following the requirements from Clause 7.1.2.3

* When highSpeedMeasFlagFR2-r17 is configured and highSpeedLargeOneStepUL-TimingFR2-r17 is enabled for UE supporting FR2 power class 6 and [largeOneStepUL-timingFR2-r17] capability
* And the absolute value
* And the new target TCI state is not in the active TCI state list

The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±[7Ts].

* Proposals and/or Observations
	+ **Proposal 1** (ZTE): We agree with the relaxation of UL transmit timing accuracy from legacy ±Te to ±7Ts in FR2. So the brackets can be removed.
* Recommended WF
	+ Companies are encouraged to indicate whether they support Proposal 1 or not.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We interpret that Proposal 1 is identical to Option 2 in Issue 1-1-1. We can use the agreement on Issue 1-1-1.  |
| QC | We support proposal 1. |
| Nokia | We think that that the previous Issue 1-1-1 shall be clarified before the square brackets can be removed. |
| ZTE | Proposal 1 just tries to affirm the exact value of relaxed UL timing error since in last meeting we are not sure about the value of ±7Ts, so the brackets were kept. Not referring to the question discussed in Issue 1-1-1.  |
| OPPO | Support proposal 1. |

### Sub-topic 1-2: Other remaining UL transmit timing issues

*Sub-topic description:*

This sub-topic is devoted to the discussion of other remaining UL transmit timing issues. The focus is:

1. On general requirement on UL transmit timing accuracy after the TCI state switch.
2. On the requirement when *highSpeedLargeOneStepUL-TimingFR2-r17* is disabled.

#### Issue 1-2-1: Initial UL transmit timing after TCI state switch

* Background

The requirements when large one-step timing adjustment mechanism is enabled are described in Clause 7.1.2.3.

The requirements on the UE initial transmission timing error are described in Clause 7.1.2.

Gradual UL transmit timing adjustment requirements are present in Clause 7.1.2.1.

* Proposals and/or Observations
	+ Observation 1 (Nokia): Using either network-based (e.g., RACH-based) or large one-shot UL timing adjustment mechanisms, the UE should be able to achieve transmit timing error within ±Te after the TCI state switch. However, no UL timing error requirements are defined explicitly for TCI state switch in TS 38.133.
	+ **Proposal 1** (Nokia): RAN4 to introduce UE initial transmission timing error requirement after the TCI state switch.
	+ **Proposal 2** (Nokia): UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies when it is the first transmission after the TCI state switch.
	+ **Proposal 3** (ZTE): In order to align the understanding from different companies, further clarification on the agreement bout the accuracy of UL transmit timing is necessary. Our understanding is as below:
		- If largeOneStepUL-timingFR2-r17 is disabled, accuracy relaxation is not allowed. Otherwise, accuracy relaxation is allowed possibly and needs further decision by the UE.
		- If largeOneStepUL-timingFR2-r17 is enabled, since the one-shot TA adjustment is triggered by TCI state switching plus the contrast between DL timing difference and the threshold, so immediately after each TCI state switching, UE needs to check whether accuracy relaxation is allowed. The following cases are possible:
			* Case 1: If UE can only track one TCI state
				+ If the DL timing difference is above the threshold, the accuracy relaxation is allowed.
				+ Otherwise, the accuracy relaxation is not allowed.
			* Case 2: If UE can track multiple TCI states and the target TCI state is not in the list
				+ If the DL timing difference is above the threshold, the accuracy relaxation is allowed.
				+ Otherwise, the accuracy relaxation is not allowed.
			* Case 3: If UE can track multiple TCI states and the target TCI state is in the list
				+ The accuracy relaxation is not allowed no matter whether the DL timing difference is above the threshold or not.
* Candidate options:
	+ Option 1 [Nokia]: UE initial transmission timing error after the TCI state switch shall be less than or equal to ±Te. Enhance the requirement in 7.1.2.
	+ Option 2 [ZTE]: If largeOneStepUL-timingFR2-r17 is enabled, target TCI state is not in the active TCI state list, and the DL timing difference is above the threshold the accuracy relaxation is allowed.
* Recommended WF
	+ Companies are invited to share their view on the general understanding of UL TX timing accuracy after the TCI state switch.
	+ Companies are encouraged to discuss whether a general requirement (Option 1) can be introduced, and/or an exception (Option 2) shall be kept.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Regarding option 1, we can wait for outcome of Issue 1-1-1.Regarding Option 2, case 1 and case 2 both can be treated as **‘**target TCI state is not in the list**’,** Case 3 is **‘**target TCI state is in the list ’which is identical to agreed TCI state switch. We think the case ‘target TCI state is not in the list’ is what issue 1-1-1 and 1-1-2 shall deal with? If the above understanding is wrong, please correct us. |
| QC | Option 1 covers the scenarios outside FR2 HST, and this out of scope option should be excluded.Option 2 is agreeable and already captured in the spec:*The UE UL transmission timing error after the TCI state switching procedure shall be less than or equal to ±Te as specified in clause 7.1.2 if the new target TCI state is within active TCI state list, otherwise ±[7Ts].*Note that target TCI state can’t be in active TCI state if UE can only track one TCI state. |
| Nokia | Based on the analysis presented in our discussion paper [[R4-2213387](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213387.zip%22%20%5Ct%20%22_parent)] and also by ZTE, almost for all types of UL transmit timing adjustment, after the TCI state switch (with or without highSpeedLargeOneStepUL-TimingFR2-r17) the accuracy shall stay within ±Te.The only exception (steps 12, 15) shall be clarified and is discussed in the Issue 1-1-1.In any case, we see it beneficial to define the accuracy of the first UE transmission timing accuracy after the TCI state switch.If the companies has concerns that such a requirements is too generic, we can apply it to Power Class 6 UEs one.Such a requirement can be added in 7.1.2 as following:The UE initial transmission timing error shall be less than or equal to ±Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or it is the PRACH transmission, or it is the msgA transmission, or it is the first transmission sent on the PSCell for activating the deactivated SCG without RACH, or it is the first transmission sent by Power Class 6 UE after a TCI state switch.Then,1. The requirements in 7.1.2.3 can be simplified because only the case with the exception from 7.1.2 need to be described,
2. Requirements in 7.1.2 will also cover the case when UL timing requirement when large one-step mechanism is disabled (i.e., RACH-based procedure) discussed in the following Issue 1-2-2.

We support Option 1 but Option 2 can be still discussed further based on the outcomes of Issue 1-1-1. |
| ZTE | Yes, as moderator said, Option 1 is the general requirement same as legacy. Option 2 is the exception case introduced for PC6 one-shot TA solution. So we suggest we only need to add the exception case and give clear condition, not need to repeat general requirement again, since 7.1.2.1 has specified.  |

#### Issue 1-2-2: UL timing requirement when large one-step mechanism is disabled

* Background

Chairman notes from RAN4#102-e [RP-220925]:

|  |
| --- |
| Agreement:* The conditions when one shot large UL timing adjustment requirements apply are FFS
* Requirements for the case when [*largeOneStepUL-timingFR2-r17*] is not enabled need to be defined and are FFS. It is not precluded to reuse legacy requirements.
 |

At RAN4#103-e, the discussion continued, and the following agreement and WF were achieved [R4-2210608]:

|  |
| --- |
| **Issue 1-3-1: Requirements for the case when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled****Agreement**:No need to introduce new UL timing requirements for the case when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled.**Issue 1-3-2: Scheduling/Transmit restriction after TCI state switch****Way Forward**:Further discussion is needed whether and how to define transmit or scheduling restriction for UL after the TCI state switch when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled.* Option 2: No impact on UE behavior
* Option 3: Define scheduling restriction on DL and UL after inter-RRH TCI state switch and before PRACH transmission when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled
* Option 4: after the TCI state switch, the UE shall not transmit except for RACH preamble in the new target TCI before one of the following conditions is fulfilled:

- the new timing advance is acquired and applied in the target TCI state according to the requirements in clause 7.3;- the UL transmission is scheduled by the gNB. In this case, the requirements in clause 7.1.2.1 apply.* Other options are not precluded
 |

* Proposals and/or Observations
	+ Observation 1-1 (QC): The transmission restriction or any other requirement imposed before RACH can’t eliminate the interference across UEs on UL since the UL transmission after RACH has a misaligned frame boundary with the UL transmission from UEs in the old TCI state. Moreover, DL signals from different RRHs also arrived with misaligned frame boundaries due to propagation delay difference.
	+ Observation 1-2 (QC): Since UL gradual timing adjustment is still applicable to UE, before RACH procedure and 200ms after TCI state switch, UE still follow the previous TCI state timing up to Tq autonomous adjustment, which is much smaller than CP and frame boundary misalignment has negligible impact to the UEs on the previous TCI state, at least much smaller than UE Tx after RACH.
	+ Observation 2 (QC): We can eliminate cross UE interference on UL only when all UEs are transmitting on the same timing regardless of TCI state, otherwise UL transmission from UEs with different TCI states from different RRHs have misaligned frame boundaries.
	+ **Proposal 1** (QC): Network applies different offsets to DL frame boundaries of different RRHs to pre-compensate the propagation delay difference across different RRHs to eliminate UL and DL interference across UEs when UEs in the same region are on different TCI states from different RRHs. Network doesn’t schedule UL transmission if network can’t handle different UL reception timing on different RRHs. After all the UEs are on the TCI states from the same RRH in the same region, network schedules RACH session to all UEs to acquire new UL and (uncompensated) DL timing.
	+ **Proposal 2** (QC): If proposal 1 is too complicated for network implementation, given that transmission restriction can not eliminate UL interference across different TCI states, no additional requirement should be defined.
	+ **Proposal 3** (CATT): When highSpeedLargeOneStepUL-TimingFR2-r17 is disabled, after the TCI state switch, option 4 is acceptable.
	+ Observation 3 (Samsung): There are different ways in practice to perform RA-based UL timing adjustment, by considering PDCCH-order (for RA triggering) is sent from the source RRH or target RRH.
	+ Observation 4 (Samsung): The issue of UE transmission in the new TCI state after TCI state switching but before the new TA is acquired cause more negative influence for the case in which PDCCH-order is sent from new TCI after TCI switching.
	+ **Proposal 4** (Samsung): No need to transmit or scheduling restriction for UL after the TCI state switch, when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled.
	+ **Proposal 5** (Ericsson): Support Option2, no impact on UE behavior after TCI state switch.
	+ **Proposal 6** (ZTE): Compared with Option 1 and Option 3, Option 4 is more feasible. However Option 4 is somehow radical since no matter inter-RRH TCI state or intra-RRH TCI state switch occurs, the transmit restriction is always applied.
* Candidate options:
	+ Option 2 [Ericsson, QC, Samsung]: No impact on UE behavior (no additional requirements)
	+ Option 3: Define scheduling restriction on DL and UL after inter-RRH TCI state switch and before PRACH transmission when highSpeedLargeOneStepUL-TimingFR2-r17 is disabled
	+ Option 4 [CATT, ZTE]: After the TCI state switch, the UE shall not transmit except for RACH preamble in the new target TCI before one of the following conditions is fulfilled:
		- the new timing advance is acquired and applied in the target TCI state according to the requirements in clause 7.3;
		- the UL transmission is scheduled by the gNB.
		In this case, the requirements in clause 7.1.2.1 apply.
	+ Option 5 [QC]: Network applies different offsets to DL frame boundaries of different RRHs to pre-compensate the propagation delay difference to eliminate UL and DL interference.
* Recommended WF
	+ Companies are invited to discuss the candidate options in the 1st round.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We support Option 2 because the impacted time period is limited and the probability of impacting to other UL transmission is rare in HTS FR2 scenario.  |
| QC | We proposed option 5 as a complete resolution to the issue raised by Nokia. We oppose option 4 because Tq requirement still applies to UE, and therefore before RACH, the UE in the new TCI state has timing aligned with UE in the old TCI state, no frame boundary misalignment exists. Therefore, option 4 can’t improve the system performance. In addition, ZTE also recognize the throughput impact in intra-RRH TCI state switch cases, and proposal 1 in issue1-2-3 is the remedy of this issue. However, as we commented in issue 1-2-3, proposal 1 is not feasible and therefore, option 4 can’t resolve interference but can introduce performance degradation. |
| Nokia | We still support Option 4 for the following reasons:1. Option 4 avoids UL transmissions (i.e., PUCCH, PUSCH or SRS) with wrong UL timing after the TCI state switch.It is safe approach that does not seem to contradict any possible RACH-based implementation.Moreover, transmission with wrong UL timing contradicts the design principles of UL timing adjustment in NR in general.
2. It clearly defines what requirements apply when *highSpeedLargeOneStepUL-TimingFR2-r17* is disabled, i.e., that PRACH procedure is used.
3. It provides the way to avoid PRACH procedure in the case when the TCI state switch without propagation delay jump (intra-RRH), i.e. when the UL transmission can be scheduled directly.

However, to allow more flexibility in the choice of the procedure when *highSpeedLargeOneStepUL-TimingFR2-r17* is disabled, we have a **compromise proposal in the previous Issue 1-2-1**. If a requirement on the first UL transmission timing accuracy after the TCI state switch is defined, no changes in Clause 7.1.2.3 will be needed anymore.Additionally, we have a few comments on the observations and proposal by other companies:**To QC:**We acknowledge that in the case when multiple UEs are considered to be connected to the neighboring non-collocated HST FR2 RRHs, additional interference at UL/DL symbol borders can be present. However, in Rel-17 we have a general approach to consider only CPE per train:Number of CPE devices per train/carriage:* RAN4 requirement can be defined based on the baseline of 1 CPE device per train.

Thus, it will be hard to agree on possible scenarios with multiple CPE at this meeting. Moreover, the solution in Proposal 5 is rather complication from NW implementation point of view. For example, it requires monitoring of all connected UEs and their movement directions in the cell, and the definition of the value of offset is not trivial. We are open to discuss this issues further, but in Rel-18 WI.However, even with one UE in the HST FR2 scenario it is still possible that UL Rx and DL Tx clash at the gNB (see an example below), if UE transmits with wrong timing.Transmission restriction will avoid such a situation.**To Samsung:**We have already posed a number of questions for the UL timing adjustment procedure proposed in your paper. For example, we doubt that both source and target RRHs are capable to receive PRACH simultaneously because PRACH transition occasions are related to SSB that are multiplex in time for different RRHs. Then, it may be uncertainty in UE behavior when TAC and TCI state switch commands are received next to each other.Nevertheless, we do not insist on the standardization of a particular UL timing adjustment procedure. The most important is to define that UL transmit timing accuracy is within Te when UE transmits for the first time after the TCI state switch. This can be achieved either with Option 4 or with the Proposal from the previous Issue 1-2-1. |
| QC | To Nokia: if only one UE is considered, the interruption to DL can be resolved by scheduling restriction on DL, anyway the DL Rx timing changed a lot and UE can’t track it. Without DL and with one UE in the system, there is no interruption. |
| ZTE | We prefer Option 4, and if the impact of wrong UL timing is very limited(since in fact NW can know about it and drop the CG PUSCH, periodic PUCCH/SRS transmitted in wrong UL timing), Option 2 is also fine to us. |
| OPPO | Support option 2. |

#### Issue 1-2-3: Threshold on DL timing difference for RACH-based procedure

* Background

This Issue was discussed at RAN4#103-e, Issue 1-3-3 in the email discussion summary [R4-2210490]. The following option was proposed:

Option 1: Apply DL propagation delay time difference threshold both when highSpeedLargeOneStepUL-TimingFR2-r17 is enabled and disabled.

The motivation behind the proposal was to optimize UL transmit timing adjustment at intra-RRH TCI state switch when *highSpeedLargeOneStepUL-TimingFR2-r17* is disabled, and RACH preamble transmission is not needed.

* Proposals and/or Observations
	+ **Proposal 1** (ZTE): Aim to optimize the scheduling/transmit restriction, the threshold of DL timing difference is useful. For the exact value of threshold, re-use the value determined for one-shot TA adjustment is fine.
* Recommended WF
	+ Companies are invited to discuss Proposal 1 further.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Ok with Proposal 1, it may be helpful to flexibility UE’s operation to some extent.  |
| QC | UE can’t detect large DL timing difference as proposal one, since UE doesn’t have correct DL timing estimation in RACH-based scheme. Therefore, proposal 1 is not feasible.  |
| Nokia | We agree with Proposal 1.Why it is not possible for the UE to evaluate DL timing difference after the TCI state switch similarly to how it is done when highSpeedLargeOneStepUL-TimingFR2 is enabled?With such a threshold defined, the UE will be aware weather PRACH procedure will be triggered or not. |
| ZTE | Proposal 1 is related with Issue 1-2-2. If Option 4 was identified in Issue 1-2-2, the Proposal 1 here is necessary so as to avoid the unnecessary throughput loss. |

CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |
| --- |
| [**R4-2213399**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213399.zip)**, CR to 38.133 on UL Transmit Timing in HST FR2 Scenario, Nokia, Nokia Shanghai Bell** |
| *QC* | *All changes are pending open issue discussion, suggest to return to this CR.* |
| *Company B* |  |
|  |  |

## Summary for 1st round

Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
| **Sub-topic** | **Status summary**  |
| **Sub-topic #1-1:** TBA | Issue 1-1-1: TBA*Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBAIssue 1-1-2: TBA*Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA |
| **Sub-topic #1-2: TBA** | **Issue 1-2-1: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA**Issue 1-2-2: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA |

CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: Remaining issues in RRM CORE maintenance

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2211597](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211597.zip) | Qualcomm, Inc. | **CR: FR2 HST Scheduling restriction on SSB** |
| [R4-2211675](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211675.zip) | CATT | **Discussion on maintenance for measurement procedure requirements for HST FR2****Proposal 1**: In Table 9.2.5.1-11 & Table 9.2.5.2-7, use Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps as 24 for power class 6 when DRX cycle > 80ms. The same principle is applied in intra-frequency measurement with measurement gaps. **Proposal 2**: support option 1: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply. The same principle is applied in intra-frequency measurement with measurement gaps. **Proposal 3**: When HST FR2 flags are configured for other power classes other than PC6, the legacy requirements should be used. **Proposal 4**: For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied |
| [R4-2211676](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211676.zip) | CATT | **CR on RRM core requirements for measurement procedure requirements for HST FR2** |
| [R4-2213865](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213865.zip) | ZTE Corporation | **Discussion on remaining issues of RRC idle, inactive and connected state mobility requirements for HST FR2****Proposal 1**: We prefer to respect the previous agreement. So Option 1 is recommended.**Proposal 2**: We prefer Option 1, i.e. for L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied. |
| [R4-2213889](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213889.zip) | Nokia, Nokia Shanghai Bell | **Discussions on remaining issues in RRM enhancements for Rel-17 FR2 HST**Observation 1: L1-SINR measurement requirements are applicable to FR2 HST.**Proposal 1**: For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied.Observation 2: Legacy requirements for PSS/SSS detection and measurement delays apply to FR2 HST when SMTC periodicity > 40 ms. Observation 3: When the legacy requirements for PSS/SSS detection and measurement delays apply to FR2 HST UE travelling at the maximum speed 350 km/h, complete mobility failures occur as shown by the simulation results. **Proposal 2**: For UE supporting power class 6 with highSpeedMeasFlagFR2-r17 configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-11; [otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-2.]Note: Operation with TPSS/SSS\_sync\_intra in Table 9.2.5.1-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios considered in this release.**Proposal 3**: For UE supporting power class 6 with highSpeedMeasFlagFR2-r17 configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; [otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.]Note: Operation with T SSB\_measurement\_period\_intra in Table 9.2.5.2-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios considered in this release.  |
| [R4-2213891](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213891.zip) | Nokia, Nokia Shanghai Bell | **CR to TS 38.133: Clarification of intrafrequency cell identification for FR2 HST**  |
| [R4-2213892](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213892.zip) | Nokia, Nokia Shanghai Bell | **CR to TS 38.133: SSB-based L1-SINR measurements for FR2 NR HST** |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Issue 2-1: L1-SINR reporting with CSI-RS based CMR and no dedicated IMR configured

* Background

The Issue left open at the previous Ran4#103-e meeting [R4-2210608] with the following options:

* Option 1: For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied.
* Option 2: Do not define enhancement for L1-SINR
* Other options are not precluded
* Proposals and/or Observations
	+ Observation 1 (QC): Interference on SSBs in FR2 HST is rare since (1) trains crossing each other is rare and duration is very short due to high speed (2) no interference across SSBs due to the agreed constraints on consecutive SSBs. With negligible interference, enhanced (faster) L1-RSRP measurement is sufficient for FR2 HST.
	+ Proposal 1 (QC): Follow FR1 HST, do not introduce L1-SINR measurement delay requirement enhancement.
	+ Proposal 2 (Samsung): For L1-SINR measurements core requirement, do not define enhancement for L1-SINR.
	+ Proposal 3 (Ericsson): Do not define enhancement for L1-SINR unless practical use cases can prove the necessity.
	+ Proposal 4 (CATT): For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied
	+ Proposal 5 (ZTE): We prefer Option 1, i.e. for L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied.
	+ Observation 1 (Nokia): L1-SINR measurement requirements are applicable to FR2 HST.
	+ Proposal 6 (Nokia): For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied.
* Candidate options:
	+ Option 1 [CATT, ZTE, Nokia]: For L1-SINR measurements with SSB-based CMR and dedicated IMR configured for FR2 HST, the same enhancements as SSB-based L1-RSRP measurements should be applied.
	+ Option 2 [QC, Samsung, Ericsson]: Do not define enhancement for L1-SINR
* Recommended WF
	+ Discuss the candidate options in the first round.
	+ Companies are encouraged to indicate a capability to compromise since it is the last meeting for Rel-17.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 2. We don’t observe the use case of L1-SINR. |
| QC | We don’t see use case for L1-SINR in FR2 HST given the SSB scheduling restriction and fixed deployment and trajectory. |
| CATT | We want to ask the clarification for the title “Issue 2-1: L1-SINR reporting with CSI-RS based CMR and no dedicated IMR configured” and proposals. Is it with CSI-RS or SSB? We support option 1.For option 2, does it mean all L1-SINR? |
| ZTE | Prefer Option 1. |
| Nokia | In response to CATT’s question, this issue is about L1-SINR reporting with with SSB based CMR and dedicated IMR configured. We have provided a text proposal in a draft CR (R4-2213892).Support Option 1. |
| OPPO | Support option 2. |

### Issue 2-2: SMTC in HST FR2 enhanced requirements

* Background

This issue was actively discussed at the RAN4#103-e, and the following WF was achieved [R4-2210608]

**GtW Agreement:**

Option 1 agreed as starting point and further work on the drafting CR revision including table heading and note 3.

**Way forward:**

Further discussion is needed on how to define HST FR2 requirements if SMTC periodicity is > 40 ms.

* Option 1: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply.
* Option 2: Delete NOTE 3, keep table titles without changes and set M2 = 1.5
* Other options are not precluded

In the discussions, NOTE 3 was defined in the following way: When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply

For reference, the subtract from the latest version of TS 38.133 is presented below:

 For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-11; [otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-2.]

Table 9.2.5.1-2: Time period for PSS/SSS detection, (Frequency range FR2)

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(Mpss/sss\_sync\_w/o\_gaps x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 320ms | max(600ms, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified |

Table 9.2.5.1-11: Time period for PSS/SSS detection when [*highSpeedMeasFlagFR2-r17*] is configured, (Frequency range FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: For UE supporting power class 6, M1= 6 if [*highSpeedMeasFlagFR2-r17* = set1] or M1= 18 if [*highSpeedMeasFlagFR2-r17* = set2]NOTE 3: Mpss/sss\_sync\_w/o\_gaps =24. |

* Proposals and/or Observations
	+ Proposal 1 (Samsung): For SMTC limit in HST FR2 enhancement requirements, to adopt the below Option 1, i.e.,
		- Option 1: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply.
	+ Proposal 2 (CATT): support option 1: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply. The same principle is applied in intra-frequency measurement with measurement gaps.
	+ Proposal 3 (ZTE): We prefer to respect the previous agreement. So Option 1 is recommended.
	+ Observation 1 (Nokia): Legacy requirements for PSS/SSS detection and measurement delays apply to FR2 HST when SMTC periodicity > 40 ms.
	+ Observation 2 (Nokia): When the legacy requirements for PSS/SSS detection and measurement delays apply to FR2 HST UE travelling at the maximum speed 350 km/h, complete mobility failures occur as shown by the simulation results.
	+ Proposal 4 (Nokia): For UE supporting power class 6 with highSpeedMeasFlagFR2-r17 configured, if SMTC <= 40ms, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-11; [otherwise, TPSS/SSS\_sync\_intra is given in Table 9.2.5.1-2.]
		- Note: Operation with TPSS/SSS\_sync\_intra in Table 9.2.5.1-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios considered in this release.
	+ Proposal 5 (Nokia): For UE supporting power class 6 with highSpeedMeasFlagFR2-r17 configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; [otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.]
		- Note: Operation with T SSB\_measurement\_period\_intra in Table 9.2.5.2-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios considered in this release.
* Candidate options:
	+ Option 1 [Samsung, CATT, ZTE]: Apply the FR2 HST enhanced requirement only when SMTC <=40ms cases. When SMTC period > 40ms, requirements in Table 9.2.5.2-2 apply.
	+ Option 2 [Nokia]: Add a clarification Note in Clause 9.2.5.1:
	Operation with TPSS/SSS\_sync\_intra in Table 9.2.5.1-2 (TSSB\_measurement\_period\_intra in Table 9.2.5.2-2) may not be guaranteed for the maximum speed under high-speed deployment scenarios considered in this release.
* Recommended WF
	+ Based on the online and offline discussions at RAN4#103-e it is Moderator’s understanding that even though the companies would like to have more flexibility in the configuration, there is not intent to use legacy requirements in the HST FR2 scenario.
	Can Option 2 be agreeable?

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We support Option1. |
| QC | We support option 2, but the notes are more appropriate for WF than spec since spec won’t mention “this release”. Suggest to capture the note in WF as a compromised option. |
| CATT | We support option 1. For concern from option 2, we understand. But we don’t think it is necessary to add the note in spec. In similar situation before, if the legacy requirements cannot guaranteed, there is no such note. We accepted to add it in WF.  |
| ZTE | Prefer Option 1. |
| Nokia | The performance with legacy requirements under FR2 HST suffers serious performance degradation as shown in our simulation results. After examination on a case-by-case basis, we conclude that the note is useful and added for clarification. We are fine to revise the wording as follows:* Note: Operation with TPSS/SSS\_sync\_intra in Table 9.2.5.1-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios ~~considered in this release~~.
 |

### Issue 2-3: Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps for power class 6 UEs

* Background

The requirements on intrafrequency measurement without measurement gaps are defined in Caluse 9.2.5 of TS 38.133:

 Mpss/sss\_sync\_w/o\_gaps : For a UE supporting FR2 power class 1 or 5, Mpss/sss\_sync\_w/o\_gaps =40. For a UE supporting power class 2, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2 power class 3, Mpss/sss\_sync\_w/o\_gaps =24. For a UE supporting FR2 power class 4, Mpss/sss\_sync\_w/o\_gaps =24

 Mmeas\_period\_w/o\_gaps : For a UE supporting power class 1 or 5, Mmeas\_period\_w/o\_gaps =40. For a UE supporting FR2 power class 2, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 3, Mmeas\_period\_w/o\_gaps =24. For a UE supporting power class 4, Mmeas\_period\_w/o\_gaps =24.

However, power class 6 UEs are not present in the requirements above.

Note, that Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps are not used for the enhanced requirements when DRX cycle <= 80 ms.

* Proposals and/or Observations
	+ Proposal 1 (CATT): In Table 9.2.5.1-11 & Table 9.2.5.2-7, use Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps as 24 for power class 6 when DRX cycle > 80ms. The same principle is applied in intra-frequency measurement with measurement gaps.
* Recommended WF
	+ Companies are welcomed to discuss whether Proposal 1 is agreeable.
	+ If Proposal is agreeable, then shall “NOTE 3: Mpss/sss\_sync\_w/o\_gaps =24” be needed in HST FR2 enhanced tables?

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson  | We can support Proposal 1, it is helpful to better interpretation.  |
| QC | Proposal 1 is captured in spec already, can CATT clarify that is there any further agreement is needed? The proposed change in CR is in the table already:Table 9.2.5.1-11: Time period for PSS/SSS detection when [*highSpeedMeasFlagFR2-r17*] is configured, (Frequency range FR2) when SMTC period <= 40ms

|  |  |
| --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra |
| No DRX | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil(M1Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | ceil(1.5x Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps Note 3 x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identifiedNOTE 2: For UE supporting power class 6, M1= 6 if [*highSpeedMeasFlagFR2-r17* = set1] or M1= 18 if [*highSpeedMeasFlagFR2-r17* = set2]NOTE 3: Mpss/sss\_sync\_w/o\_gaps =24. |

 |
| CATT | It hasn’t been fully captured in current spec. *If removing square bracket can be agreed in the open issue, the current definition is:*For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.Take an example, if UE is PC6, without highSpeedMeasFlagFR2-r17 configured, follow the yellow part, it should be meet the requirements in Table 9.2.5.2-2. But in legacy tables in Table 9.2.5.2-2, it uses the definition Mmeas\_period\_w/o\_gaps. . *There is no definition for PC6. It cannot be covered in the FR2 HST table 9.2.5.2-7.* |
| Nokia | Pending the outcome of Issue 2-2. |

### Issue 2-4: Requirement for intra-frequency measurement with measurement gaps.

* Background

The Issue is the extension of the agreements in the two pervious Issues, applied to the measurements without gaps.

* Proposals and/or Observations
	+ Proposal 1 (CATT): The same principle is applied in intra-frequency measurement with measurement gaps.
* Recommended WF
	+ Companies are encouraged to indicated whether the same principle like in the previous two Issue shall be applied both to intra-frequency measurements with and without measurement gaps.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | OK with Proposal 1. |
| QC | Support proposal 1, but suggest to revise CR following 9.2.5 tables.  |
| CATT | Support P1. Can go to R4-2211676 directly.  |
| ZTE | Fine with Proposal 1. |
| Nokia | Pending the outcome of Issue 2-2. |
| OPPO | Support option 1. |

### Issue 2-5: Applicability of enhanced requirements for other PCs

* Background

At RAN4#102-e it was agreed [R4-2206848]:

Issue 1-2-3: Indication of HST FR2 RRM feature support and Applicability of enhanced RRM requirements (PC 6)

|  |
| --- |
| **Agreement:*** No enhanced requirement should be applied to other than PC6 UEs even when HST FR2 flags are configured.
* PC6 shall be used to identify the feature support of HST FR2 operation.
 |

* Proposals and/or Observations
	+ **Proposal 1** (CATT): When HST FR2 flags are configured for other power classes other than PC6, the legacy requirements should be used.
* Recommended WF
	+ Companies are encouraged to share their views whether a new agreement in addition to the previous one from RAN4#102-e is needed.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We agree on proposal 1, that is the reason the HST requirements are defined provided PC6 and flag both are valid. |
| QC | Support proposal 1. |
| CATT | Support proposal 1.  |
| ZTE | Fine with Proposal 1. |
| Nokia | A question clarification concerning Proposal 1: What is the impact to the specification? |
| OPPO | Support option 1. |

### Issue 2-6: Other

* Recommended WF
	+ Companies can bring up any new issues below.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | In Clause 3.6.13 Applicability of requirements for FR2 it is stated thatUnless stated otherwise, the requirements for FR2 are applicable to both FR2-1 and FR2-2.Following the WID, HST FR2 scenarios were analyzed for carriers below 30 GHz.Thus, we **Propose** to agree that HST FR2 requirements are applicable for FR2-1 only and add a corresponding exception in Clause 3.6.13. |
| CATT | We agree to follow the WID. But for HST FR2, we have already has the applicability in clause 3.6.14. For power class 6, it is only for n257/n258/n261 in 38101 which below 30GHz.  |
| ZZZ |  |

CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |
| --- |
| [**R4-2211597**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211597.zip)**, CR: FR2 HST Scheduling restriction on SSB, Qualcomm, Inc.** |
| *CATT* | *There is no clause 9.5.8.**Clause 9.8 is not included.*  |
| *Nokia* | *It is not necessary to capture the agreement in the specification. As a compromise, we suggest capturing this in the TR.*  |
|  |  |

|  |
| --- |
| [**R4-2211676**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2211676.zip)**, CR on RRM core requirements for measurement procedure requirements for HST FR2 CATT** |
| *QC* | *Change in 9.2.5 is covered in the FR2 HST tables and may not be necessary. We suggest to align changes in 9.2.6 to 9.2.6 in current spec.* |
| *CATT* | *We think change in 9.2.5 is necessary.**If removing square bracket can be agreed in the open issue, the current definition is:*For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-7; otherwise, T SSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.Take an example, if UE is PC6, without highSpeedMeasFlagFR2-r17 configured, follow the yellow part, it should be meet the requirements in Table 9.2.5.2-2. But in legacy tables in Table 9.2.5.2-2, it uses the definition Mmeas\_period\_w/o\_gaps. . *There is no definition for PC6. It cannot be covered in the FR2 HST table 9.2.5.2-7.* |
| QC | Thanks CATT for clarification, the changes are good for us.  |
| Nokia | Pending the outcome of Issue 2-2. |

|  |
| --- |
| [**R4-2213891**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213891.zip)**, CR to TS 38.133: Clarification of intrafrequency cell identification for FR2 HST Nokia, Nokia Shanghai Bell** |
| Ericsson | Rely on Issue 2-2 |
| *QC* | Pending issue 2-2 |
| CATT | Rely on Issue 2-2. part of change are overlapped with R4-2211676 |

|  |
| --- |
| [**R4-2213892**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104-e/Docs/R4-2213892.zip)**, CR to TS 38.133: SSB-based L1-SINR measurements for FR2 NR HST Nokia, Nokia Shanghai Bell** |
| *QC* | Pending issue 2-1 |
| *CATT* | *In latest version 38133.h60, the change of Table 9.8.4.2-3 has already been included. Are we looking into different versions?* |
| Nokia | Thanks for pointing this out, CATT. This could be an editorial mistake.According to the Chairman notes of the last meeting, the draft CR (corresponding to the changes) was postponed. **R4-2211089 CR to TS 38.133: SSB-based L1-SINR measurements for FR2 NR HST** *Type: CR For: Agreement 38.133 v17.5.0 CR-2384 rev Cat: B (Rel-17) Source: Nokia, Nokia Shanghai Bell***Abstract:** **Decision: Postponed.**  |

## Summary for 1st round

Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
| **Sub-topic** | **Status summary**  |
| **Sub-topic #2-1:** TBA | **Issue 2-1-1: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA**Issue 2-1-2: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA |
| **Sub-topic #2-2: TBA** | **Issue 2-2-1: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA**Issue 2-2-2: TBA***Background:*TBA*Tentative agreements:*TBA*Candidate options:** Option 1:
* Option 2:

*Recommendations for 2nd round:*TBA |

CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on HST FR2 RRM Core Requirement Maintenance | Nokia, Nokia Shanghai Bell |  |
|  |  |  |  |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-2211597 |  | CR: FR2 HST Scheduling restriction on SSB | Qualcomm, Inc. | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2211676 |  | CR on RRM core requirements for measurement procedure requirements for HST FR2 | CATT |  |  |
| R4-2213399 |  | CR to 38.133 on UL Transmit Timing in HST FR2 Scenario | Nokia, Nokia Shanghai Bell |  |  |
| R4-2213891 |  | CR to TS 38.133: Clarification of intrafrequency cell identification for FR2 HST  | Nokia, Nokia Shanghai Bell |  |  |
| R4-2213892 |  | CR to TS 38.133: SSB-based L1-SINR measurements for FR2 NR HST | Nokia, Nokia Shanghai Bell |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents