**3GPP TSG-RAN WG4 Meeting # 104-e R4-22xxxxx**

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

**Title: WF on HST FR2 RRM Core Requirement Maintenance**

**Agenda Item:** 9.7.5?

**Source:** Nokia, Nokia Shanghai Bell

**Document for:** Approval

# UL timing

## Large one-step UL timing adjustment

**[Issue 1-1-1] <Way forward/Agreement> on Large one-step UL timing adjustment**

Open issue needs further discussion:

* Option 1[Nokia, Samsung, ZTE]: Clarify the requirement if target TCI state is not in the active TCI state list and the DL timing difference is larger than [CP/4]
	+ Option 1a [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.
	+ Option 1b [Ericsson]: Same as above, but Tssb is used instead of Trs
	+ Option 1c [QC]: Tq requirement in 7.1.2.1 applicable to UL slots except the first after TCI state switch.
	+ Option 1d [GtW]: The gradual timing adjustment step of Tq shall be applied after the one shot uplink timing adjustment after TCI state switch.
	+ Other options are not precluded
* Option 2 [QC, OPPO, Huawei]: Keep current specification as it is.

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| *Background:*The current formulation of UL timing adjustment requirements for HST FR2 scenario:

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| **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. |

One group of companies thinks that it could be possible to keep the requirements in Clause 7.1.2.3 without changes to give more implementation flexibility and because it is not easy specify when UE can follow again the requirements in 7.1.2.1 again after the TCI state switch. Still, many of the companies acknowledge that there is an ambiguity in the formulation of transmit timing requirement after the TCI state switch, especially in the case when target TCI state is not in the active TCI state list and the DL timing difference is larger than [CP/4]. In this case, a relaxation of transmit timing accuracy is allowed and it is not clear how and when the requirement in 7.1.2.1 is applicable again. It is mentioned that a clarification or an additional requirement would help to close the loop.One additional identified issue is that immediately after the TCI state switch the reference point for UL transmit timing is . Wherease for gradual timing adjustment in 7.1.2.1, the reference timing shall be before the downlink timing of the reference cell.*Recommendation for the second round:*Continue the discussion of the options and resolution of newly raised issues. |
| *QC* | We support option 2. As explained in the first round comment and GTW, Te from 7.1.2.1 is not applicable to 7.1.2.3 because the reference timings are different. We can compromise to have Tq in 7.1.2.1 applicable to UL slots besides the first UL slot after detected cross-RRH TCI state switch, but not Te. |
| *Ericsson* | We agree on above analysis by moderator. The issue is reference point of 7.1.2.1 is untrusted after cross-RRH TCI state switch as refence of UL timing accuracy. It’ unclear to us how to deal with the observation.If no clear solution can be raised, maybe Option2 is a choice just to leave the issue there. |
| *Nokia* | The main issue is what requirement shall be applied after large one-shot timing adjustment has been performed?We raised this problem of mismatch in UL timing advance value in between the NW and the UE after the TCI state switch with large one-step timing adjustment back at RAN4#101bis-e.Immediately after the TCI state switch, the reference point for UL transmit timing is T\_new - (N\_TA + N\_TA\_offset) + 2\*(T\_old - T\_new). Whereas, for gradual timing adjustment in 7.1.2.1, the reference timing shall be (N\_TA + N\_TA\_offset) before the downlink timing of the reference cell.We cannot expect that the NW can infer what timing adjustment was performed at the UE side (i.e., what is the value of 2\*(T\_old - T\_new)).Moreover, the update of N\_TA value at the NW side without signaling TAC to the UE is not possible either.Therefore, one way to follow back the 7.1.2.1 requirement after the TCI state switch could be to use T\_new - (N\_TA + N\_TA\_offset) + 2\*(T\_old - T\_new) as a new reference for gradual timing adjustment after the TCI state switch.Option 1e: The gradual timing adjustment in 7.1.2.1 with reference timing T\_new - (N\_TA + N\_TA\_offset) + 2\*(T\_old - T\_new) is applicable to UL slots except the first after TCI state switch. |
| ZTE | We agree with the above analysis by moderator, especially on how to specify when UE can follow again the requirements in 7.1.2.1 after the ‘immediately’ case. Since we do not have good solution to deal with reference timing pointed out by QC, so maybe Option 2 is the helpless choice at this stage.About Option 1e given by Nokia, we believe after the ‘immediately’ case, the reference timing for both Te and gradual timing adjustment can only be T\_new - (N\_TA + N\_TA\_offset) + 2\*(T\_old - T\_new). |
| Huawei | We support option 1d achieved in GTW. After one shot UL timing adjustment, UE shall perform gradual UL timing adjustment with Tq step (as legacy requirements).  |

**[Issue 1-1-2] <Way forward/Agreement> on the value of relaxed UL transmit timing accuracy**

Open issue needs further discussion:

* Option 1 [QC, ZTE, OPPO, Samsung]: Remove square brackets and use ±7Ts as relaxed UL transmit timing accuracy in the current requirement.
* Option 1a [Ericsson]: Remove square brackets and use ±7\*64\*Tc as relaxed UL transmit timing accuracy in the current requirement.
* Option 2 [Huawei]: Do not distinguish the case “new target TCI state is not in the active TCI state list” and “in the active TCI state” and use ±7Ts accuracy for both.

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| *Background:*The current requirement in 7.1.2.3 states thatThe 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 .In general, the specification text above is based on the agreement at RAN4#103-e [WF, R4-2210608]:

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| Sub-topic 1-2: UL transmit timing accuracy**GtW Agreement**:If new TCI state within active TCI state list: Adopt ±Te immediately after TCI state switch as the accuracy otherwise ±[7Ts] adopted. |

*Recommendation for the second round:*In Moderator’s view Option 1a is better aligned with existing accuracy requirements in table 7.1.2-1 and can be considered for agreement.Option 2 is a new option that requires revision of the previous agreement. Companies are encouraged to comment whether such a revision is needed. |
| *QC* | Option 2 has correct technical reasoning to support it. The reasoning behind option 2 is that we need to count the timing error contribution on as well as given that UL timing is computed based on both, and their errors can add up. This is a technically correct observation and wasn’t addressed in the previous discussion. Adding up to the calibration error we discussed in the previous meeting, maybe more than 7Ts error margin is needed, but we don’t want to further complicated issue so we assume UE can absorb calibration error into this double DL timing error, and we can stick to option 2.We understand this is different than the compromise we agreed in the previous meeting, we are open to discuss keep the previous agreement, but we need to understand the feasibility: Te is the minimum timing error on DL that is achievable (UL timing directly follows current DL timing), however, given that UL timing is derived from the difference of two DL timings, how can UE achieve the same timing as following just current DL timing? |
| *Ericsson* | We suggest to keep Option 1 even it isn’t perfect. |
| *Nokia* | Regarding Option1, we think that Optoin1a is a more proper way to define the accuracy. However, we cannot agree on the removal of square brackets before it is clarified how and when gradual timing adjustments in 7.1.2.1 are applicable again after the large one-shot timing adjustment.Regarding Option 2, we have similar concern as discussed in Issue 1-1-1. If UL transmit timing accuracy is released immediately after the TCI state switch, then the UE still shall be able to follow DL timing accurately again with Te accuracy. When UE is capable of time/frequency tracking of target TCI state, then why it cannot adjust UL timing back within Te with gradual timing adjustment?With current formulation ,what stops UE from following the release accuracy requirement for the whole period after the TCI state switch? |
| ZTE | We need to respect the previous agreements, so we prefer to keep Option 1 or Option 1a.  |
| Huawei | In technical, option 2 is correct. The reason is even if new target TCI state is in the active TCI state list, considering the equation , the double Te error from Tnew and Told are supposed to be introduced, that’s 2\*Te=2\*3.5=7Ts.We also understood that the current agreement is made based on some compromise. We can also go to option 1 and option 2. |

## Other remaining UL transmit timing issues

**[Issues 1-2-1 & 1-2-2 & 1-2-3] <Way forward/Agreement> on UL timing requirement when large one-step mechanism is disabled**:

Open issue needs further discussion:

* Option 2 [Ericsson, QC, Samsung, OPPO]: No impact on UE behavior (no additional requirements)
* Option 4 [CATT, ZTE, Nokia]: 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 6 [Nokia]: Power Class 6 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 7 [Ericsson, Nokia, ZTE]: Introduce a DL timing difference threshold when highSpeedLargeOneStepUL-TimingFR2 is disabled.
* Other options are not precluded

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| *Background:*This second-round discussion combines Issues 1-2-1, 1-2-2, 1-2-3 because the main goal of all of them is related to the definition of requirements on UL transmit timing when large one-step timing adjustment is disabled.In general, one group of companies thinks that there is no need to introduce any additional requirement (Option 2).Then, there are several alternative ways to introduce the requirement:* Specifically for the case when large one short timing adjustment is disabled (Option 4)
* As a general requirement for all PC 6 UEs, and then consider Clause 7.1.2.3 as a special case (Option 6)
* Introduce a DL timing difference threshold when highSpeedLargeOneStepUL-TimingFR2 is disabled (Option 7) to give a UE a possibility to distinguish intra-RRH TCI state switch (DL timing difference below the threshold, and PRACH is not needed) from inter-RRH TCI state switch (DL timing difference is above the threshold, PRACH is needed, and UE should not transmit before timing adjustment).

*Recommendation for the second round*:Companies are encouraged to discuss further the candidate options and indicate compromises, if any. |
| *QC* | Option 2. We compromised to remove our option which can correctly resolve the problem to simplify the system design, and we expect option 4 proponents can also compromise to option 2 given that it can’t resolve the issue while our proposal is able to, based on the fact that UE shouldn’t receive DL signal from network before RACH after cross-RRH TCI state switch.We can’t agree option 6 as explained in the first round comment.We also explained why option 7 is not feasible in the first round comment, and in fact if we agree with option 2, option 7 is not needed. |
| *Ericsson* | Support Option2, not to introduce more complex conditions.Regarding Option 7, we slightly support it because it may help network and UE evaluate that the TCI state switch occurs within RRH or cross RRH. |
| *Nokia* | Our primary preference is Option 6. If narrowed down to PC6 UEs, then we do not see an issues with the applicability scope of this requirement anymore.Option 6 established a common ground for UL timing accuracy after the TCI state switch.Then, the clause 7.1.2.3 is still valid and describes the requirements specifically for the case when Large one-shot timing adjustment in used.Options 4 and Option 7 are also acceptable for. They are beneficial to describe requirements in the case when Large one-shot timing adjustment in not used. |
| ZTE | In our opinion, Option 2 is one choice, Option 4+Option 7 is another choice.We further considered the issue raised by QC, in fact not any option can resolve the issue. So, our preference is Option 4+ Option 7, but we can compromise to Option 2.Regarding to Option 6, based on the analysis by moderator, it seems which is aligned with current 7.1.1.1 and 7.1.2.3, we are fine with it. |

# Other remaining issues in RRM CORE maintenance

**[Issue 2-1] <Way forward/Agreement> on L1-SINR reporting with CSI-RS based CMR and no dedicated IMR configured**:

Open issue needs further discussion:

* 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 measurements with SSB-based CMR and dedicated IMR
* Option 2a [Samsung]: For FR2 PC6 UE which support Rel-16 L1-SINR measurement, it can rely on legacy Rel-16 test cases to verify the performance.

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| *Background:*The moderator’s understanding is that the Issue is related only to requirements in Clause 9.8.4.2 L1-SINR reporting with SSB based CMR and dedicated IMR configured and introduced in R4-2213892.Note, that the Table 9.8.4.2-3 was already implemented in the TS by mistake.*Recommendation for the second round*:Discuss further the candidate options in the second round. |
| *QC* | Option 2. We haven’t seen valid use cases for L1-SINR. Given the agreed SSB scheduling restriction and fixed deployment and trajectory, L1-RSRP is sufficient given that interference is either known (fixed deployment and trajectory) or not existing (SSB can’t be overlapped and next to each other). Option 2a has no spec impact and therefore we support it as a compromise. |
| *Ericsson* | Support Option 2. What’s the typical use case of L1-SINR in HST FR2 scenario? |
| *ZTE* | We can support Option 2a as a compromise. |
| Huawei | Same view as QC and Ericsson. Doubt L1-SINR has use case in high speed train scenario. |
| CATT | Support option 1. As same in HST FR1, L1-SINR can be used for beam management. Compared with L1-RSRP, it is better because sinr reflects the interference. For option 2a, we can agree first half pat. But we have questions on “it can rely on legacy Rel-16 test cases to verify the performance”. L1-SINR requirements include delay requirements and accuracy requirements. do you mean the delay requirements are FR1 requirements without considering scaling factor N? which we don’t think so.  |
| Nokia | Share the same view as CATT. In addition, it is important to note that L1-RSRP and L1-SINR requirements are not mutually exclusive. Both requirements are applicable to FR2 HST since there is no applicability rule defined in the current specification specifically for L1-SINR. Hence, network is not restricted to choose L1-RSRP and not L1-SINR for FR2 HST. Further, operators may configure their networks to use L1-SINR instead of L1-RSRP |

**[Issue 2-2] <Way forward/Agreement> on SMTC length in HST FR2 enhanced requirements**:

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.

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, TSSB\_measurement\_period\_intra is given in Table 9.2.5.2-2.

The addition of the clarification note needs further discussion:

* Option 2 [Nokia, Samsung]: Add Notes in the TS:
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.

Note: Operation with TSSB\_measurement\_period\_intra in Table 9.2.5.2-2 may not be guaranteed for the maximum speed under high-speed deployment scenarios.

* Option 3 [QC, CATT]: Add Notes from Option 2 in the WF.
* Option 4 [Ericsson, ZTE, CATT]: Do not add any notes.

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| *Background:*Seems that the companies do not object removal of square brackets in the requirement applicability rule:[otherwise, TPSS/SSS\_sync\_intra (T SSB\_measurement\_period\_intra) is given in Table 9.2.5.2-1(2).]However, further discussion whether and how to define the clarification notes is still needed.*Recommendation for the second round:*Agree on the removal of square brackets in the requirements.Discuss further the addition of clarification notes. |
| *QC* | Option 3. WF seems to be a better document to capture it, and can seems to be a better compromised option between option 2 and 4. Note that similar discussion appeared in FR1 HST, and the concern raised then is on the phrase like “maximum speed” in a WID/release specific information that may not be appropriate for specification. |
| *Ericsson* | We can support 3 or 4 |
| *ZTE* | We can compromise to Option 3. |
| CATT | As mentioned in 1st round, in similar situation before, option 3 is better. We prefer option 4 and can accept option 3 as compromised.  |
| 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, it is different from FR1 HST and we conclude that the note is useful and added for clarification. We are fine to further 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.
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**[Issue 2-3] Agreement on Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps for power class 6 UEs**:

Define Mpss/sss\_sync\_w/o\_gaps = 24 and Mmeas\_period\_w/o\_gaps = 24 for PC 6 UEs in Clause 9.2.5.

NOTE 3 from tables Table 9.2.5.1-11 and Table 9.2.5.2-7 can be removed.

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| *Background:*In Moderator’s understanding the core of the proposal is to add the definition of Mpss/sss\_sync\_w/o\_gaps and Mmeas\_period\_w/o\_gaps as follows: 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. For a UE supporting FR2 power class 6, 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. For a UE supporting FR2 power class 6, Mmeas\_period\_w/o\_gap=24.*Recommendation for the second round*:Check whether tentative agreement is agreeable. |
| *Ericsson* | Support tentative agreement |
| *ZTE* | Fine with the tentative agreement. |
| *CATT* | Agree with tentative agreement.  |
| Nokia | “When highspeed flag is not configured” should added otherwise it is not clear. |

**[Issue 2-4] Agreement on requirement for intra-frequency measurement with measurement gaps**:

Apply two agreements above for intra-frequency measurement without measurement gaps to the requirements with measurement gaps.

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| *Background:*The Issue is the extension of the agreements in the two pervious Issues, applied to the measurements without gaps.The issue is pending on the agreements is the corresponding issues.*Recommendation for the second round*:Agree on the agreement taking into account that the agreement in Issue 2-2 and 2-3 are achieved. |
| *Ericsson* | Recommendation is fine with us. |
| *ZTE* | Fine with the recommendation. |
| *CATT* | Agree with tentative agreement.  |
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**[Issue 2-5] Agreement on applicability of enhanced requirements for other PCs**:

When HST FR2 flags are configured for other power classes other than PC6, the legacy requirements should be used.

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| *Recommendation for the second round*:Companies are encouraged to describe what are the expected specification impacts and to agree on the tentative agreement. |
| *Ericsson* | Agree on the tentative agreement. |
| *ZTE* | Fine with the tentative agreement. |
| *CATT* | Agree with tentative agreement.  |
| Nokia | Our question in the first round has not been answered. It is not clear whether such an agreement is needed. FFS |