[95e-14-RAN4-R18-HST] - Version 0.0.8
RAN

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Agenda item: 9.1.4

Source: Samsung (Email Discussion Moderator)

Title: Email discussion summary for [95e-14-RAN4-R18-HST]

Document for: Discussion/Decision

1 Introduction

This email discussion thread [95e-14-RAN4-R18-HST] intends to focus on the work item description for enhanced NR support for high speed train scenario in frequency range 2 (FR2).

As guided by RAN chair, FR2 HST enhancement is listed as one item of RAN4-led package. Specifically, the following input contributions (for agenda 9.1.4 and its subagendas) are covered:

Table 1: T-docs for FR2 HST enhancement

T-doc number	T-doc Title	Source
RP-220064	New WI: Enhanced NR support for high speed train scenario in frequency range 2 (FR2)	RAN4 chair (Huawei)
RP-220068	Summary for RAN Rel-18 Package: RAN4 Part	RAN chair (Qualcomm), RAN4 chair (Huawei)
RP-220318	New WI: Enhanced NR support for high speed train scenario in frequency range 2 (FR2)	Samsung
RP-220319	Motivation for new WI on enhanced NR support for high speed train scenario in frequency range 2 (FR2)	Samsung
RP-220659	Further discussions on FR2 HST	ZTE, Sanechips

RP-220773	Views on RAN4 Rel-18 scope	Intel Corporation

2 Initial Round

The initial round will focus on providing feedback on the WID draft based on the detailed scope provided by the RAN4 Chair (RP-220064).

2.1 Collection of company views

2.1.1 Justification

The following paragraphs are provided in RP-220064 for justification part:

Table 2: Justification Section

In Rel-17 work item on NR support for high speed train scenario in frequency range 2 (FR2), RAN4 has focused on train roof-mounted high-power devices for NR SA single carrier scenario in FR2, by studying the FR2 HST deployment scenario and specifying the channel modelling, RF, RRM and demodulation requirements for FR2 HST. During the Rel-17 work item, most of focus was devoted into open space deployment scenarios (Scenario-A and B, differentiated by D_{min}, which is the perpendicular distance between RRH site and railway track), while limited study was provided on the tunnel scenario due to the limited Rel-17 effort and relative prioritization, which is identified by operators as important high speed train scenario. [Based on the requested scenario from operators, it is also of importance to support the scenario with mixed near-to-track (*i.e.* Scenario-A with D_s = 700m and D_{min} = 10m) and far-from-track (*i.e.* Scenario-B with D_s = 700m and D_{min} = 150m) RRH deployment. Furthermore, the intra-band carrier aggregation (CA) operation and the feasibility of supporting high-speed-train velocity of up to a maximum of 500kmph are also of interests to operators, which is not yet covered in Rel-17 work item scope.] In the Rel-17 WI, similar as FR2 handheld and other UE types, the single active panel operation was focused, *i.e.* only one active antenna panel at a time as baseline antenna assumption. Based on the Rel-17 conclusion, two panels shall be physically installed to flexibly support either forward or backward incoming signal direction; however the restriction of only one active antenna panel limits utilizing two neighbouring RRHs to serve one HST UE in the bi-directional RRH deployment scenario. Accordingly, it is of importance to introduce the support of simultaneous reception with maximum 2 active panels at the train roof-mounted FR2 high power devices for the bi-directional RRH deployment scenario. [Another issue identified in Rel-17 work item is the large propagation delay difference from neighbouring RRHs to UE. For example in the uni-directional RRH deployment, it is identified that the signal propagation delay difference can be as much as 2.5us, which is much larger than CP length with 120kHz subcarrier spacing. In Rel-17 work item, the larger autonomous timing adjust step T_q is specified for FR2 HST UE, and the RAN4-based solutions for the uplink timing issue are focused, while other solutions involving other RAN working groups are not fully studied.]

Feedback Form 1: Any comments on the justification of WID?

1 – Ericsson France S.A.S

The sentence "Based on the requested scenario from operators, it is also of importance to support the scenario with mixed near-to-track (*i.e.* Scenario-A with Ds = 700m and Dmin = 10m) and far-from-track (*i.e.* Scenario-B with Ds = 700m and Dmin = 150m) RRH deployment." Should be removed if the mixed scenario objective is removed (Mixed scenario is already possible for Rel-17 anyhow)

2 – Qualcomm Incorporated

Corresponding changes are needed following the objective discussion.

3 – Apple GmbH

Justification can be updated later if new agreements are made on the objectives.

4 – Verizon UK Ltd

Agree with Apple! Let the objectives be approved first before updating the justification!

5 – Huawei Technologies France

Agree to focus on the objectives discussion first and then update the justification accordingly.

6 – Samsung Electronics GmbH

We agree with the comment above, and it is straightforward that the justification will be changed accordingly after the objectives are confirmed.

7 – China Mobile Com. Corporation

The justification may need to be updated pending on the conclusion on objectives on mixed scenario with mixed near-to-track and far-from-track RRH deployment, and the objectives on new uplink timing adjustment mechanism.

8 – Nokia Corporation

We notice that the justification includes the [] around the last section: '[Another issue identified in Rel-17 work item is the……]'. We suggest removing these brackets. We see that there is still justification for RAN4 to work on the large propagation delay difference from neighbouring RRHs to UE.

Hence, the Justfication part would need to be updated removing the brackets:

~~[~~Another issue identified in Rel-17 work item is the large propagation delay difference from neighbouring RRHs to UE. For example in the uni-directional RRH deployment, it is identified that the signal propagation delay difference can be as much as 2.5us, which is much larger than CP length with 120kHz subcarrier spacing. In Rel-17 work item, the larger autonomous timing adjust step Tq is specified for FR2 HST UE, and the RAN4-based solutions for the uplink timing issue are focused, while other solutions involving other RAN working groups are not fully studied. ~~]~~

9 – China Unicom

The justification text is very clear, we are fine with it.

10 – vivo Mobile Communication (S) The justification is clear and can be updated based on objectives that are included in Rel-18.

2.1.2 Objectives with converged view

The following objectives are provided in RP-220064, which are relative stable with converged view during the previous discussion:

- Only train roof-mounted high power devices with target applicable carrier frequency up to 30GHz are considered in this WI
- Specify the RF requirements for intra-band carrier aggregation (CA) scenario, and investigate and specify the RRM requirements for intra-band carrier aggregation (CA) scenario
- Study on reference tunnel deployment scenario for FR2 HST and specify the channel model and corresponding core requirements if any
- Specify the requirement for simultaneous multi-panel operation for train roof-mounted FR2 high power devices [RAN4]:
    - Maximum 2 active panels supporting the multi-panel simultaneous reception.
    - NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception

Feedback Form 2: Any further refinement needed on the above objectives?

1 – Ericsson France S.A.S OK for us
2 – Qualcomm Incorporated Further clarification is needed for the justification of study tunnel scenario. In R17 we already have Dmin = 10m study which leads to 2Rx beam based requirement. Further reducing to 1Rx is unlikely due to two directions coverage. Moreover, we don't have multi-path requirement specified for tunnel scenario in FR1 HST which is more likely to have more reflection paths. Given that we have studied single path with small Dmin and FR1 HST works well without multi-path requirement specified for tunnel scenario, it's not clear to us what needed to be studied for tunnel scenarios.
3 – Verizon UK Ltd We are fine with the objectives! The tunnel development scenario(s) could be different from open space (on both Ds and Dmin). For FR2, it is unclear if there are additional requirements needed. RAN4 should study this in Rel-18.

4 – ZTE Corporation

We are fine with the objectives.

Whether Rel-17 Dmin=10m could be applicable for FR2 HST in tunnel scenario, this should still depend on the discussion and therefore the basic study for tunnel scenario is still needed in Rel-18 timeframe.

5 – China Telecom Corporation Ltd.

OK with the objectives which are stable after the February email discussion.

6 – Huawei Technologies France

Fine with the objectives.

7 – China Mobile Com. Corporation

OK with the objectives

8 – KT Corp.

KT is fine with current wordings.

9 – Nokia Corporation

The above objectives are agreeable to us as a baseline. However, based on the experience from Rel-17 work we also believe we need to allow for possible RAN1 and/or RAN2 impacts if such needs materialise during the course of the WI. Hence, we suggest adding:

Impacts on RAN1/2 are not precluded

Or similar wording like used in other WIDs: 'Note: RAN1/RAN2 work can be triggered by RAN4 LS'

10 – Samsung Electronics GmbH

We agree that tunnel scenario needs to be studied further to investigate

- Whether or not a new channel model is needed, i.e., the existing channel model can be representative enough for tunnel. For FR2, it is still not clear.
- For the number of beams and other core requirement, whether or not the existing Rel-17 requirement is applicable to tunnel scenario is still FFS.

Given the above comment, we think the current objective of tunnel should be okay include the study and also specification impact if it is identified.

11 – China Unicom

We support the objectives.

12 – vivo Mobile Communication (S)

The objectives are in general fine.

Clarfiication on the last bullet may be needed.

Specify the requirement for simultaneous multi-panel operation for train roof-mounted FR2 high power devices [RAN4]:

Are the requirements for RF and/or RRM?

2.1.3 Objectives expected for further refinement

The following bullets are provided in RP-220064 expected to be further refined.

- [Study the feasibility, and if feasible enable supporting HST velocity of up to a maximum of 500km/h, with carrier frequency up to 30GHz]
- FFS other core requirements considering the following potential objectives for the corresponding scenarios below
  - Specify the requirements to support the scenario with mixed near-to-track (i.e., Scenario-A with Ds = 700m and Dmin = 10m) and far-from-track (i.e., Scenario-B with Ds = 700m and Dmin = 150m) RRH deployment
  - Specify the new uplink timing adjustment mechanism for FR2 HST scenario with large propagation delays from different TRPs to UE

Based on companies' input (RP-220773), it is proposed that there is no strong motivation for additional studies on the objective of the mixed near-to-track and far-from-track scenarios.

Based on companies' input (RP-220659), it is proposed that FFS can be removed to confirm the objective of the new uplink adjustment mechanism for FR2 HST scenario.

Feedback Form 3: Any comments on the above objectives?

1 – Ericsson France S.A.S

We agree with the proposals to remove the mixed scenario and we are OK to remove the FFS from the timing adjustment objective. We also propose to remove the 500km/h objective, as it is not high priority now and considering workload.

2 – Qualcomm Incorporated

We support to remove the mixed scenario and 500km/h. For UL timing adjustment mechanism, clarification on the motivation and scope of this objective is needed. This issue has been extensively discussed in R17 and resolutions including network based and UE autonomous adjustment based approaches are agreed. Minor changes to the agreed resolutions should be done in R17 maintenance stage. We also don't see significant improvement can be achieved on top of the R17 agreed schemes except a few obvious change on UE capability and delay which can be discussed in maintenance stage. Clarifications on expected im-

provement and potential schemes will be helpful to understand the motivation. In addition, purely RAN4 based resolutions without other WG impact were discussed in R17 already, and we don't see the benefit of repeating the R17 discussion. If companies see significant performance improvement opportunities, which we don't so far based on the discussion, at least other WGs should be included in this objective to ensure meaningful discussion.

3 – Apple GmbH

If there is no strong commercial need for 500km/h in FR2, we shall not put that in the WID. However, it is important to have a target speed in the WID since it will impact the requirements design. It could be good to have more input from operators. If no specific demand, maybe we can focus on the speed discussed in R17 FR2 HST.

Regarding UL timing adjustment, given that we already have solutions in R17, we expect more justification on the necessity of new solution.

4 – Verizon UK Ltd

It is fine for us to remove the 500km/h objective.

We suggest removing 'FFS' from below sentence

– ~~FFS~~ other core requirements considering the following potential objectives for the corresponding scenarios below

5 – ZTE Corporation

For up to 500km/h, the market demand should be also clarified especially from interested operators whether this would be typical deployment. If there is no strong market demand on the support of 500km/h in FR2, then this could be de-prioritized compared with other topics.

For UL timing adjustment, during Rel-17, two candidate solutions were discussed including PDCCH order triggered RACH and one-shot TA adjustment to address UL timing issue caused by large propagation delay difference. However due to no RAN1/2 TU allocation, so only very limited NW signalling was introduced in HST FR2 in Rel-17, some extra NW assistance signalling which will benefit UL timing could be further studied during Rel-18.

6 – Intel

We support the further proposals from moderator to remove mixed scenarios.

Regarding UL timing, our view is that we need to clarify the scope in details.

Regarding 500km/h feasibility, we are open to discuss it. One clarification question: what are the expected deliverables from the study? A TR capturing feasibility study?

7 – China Mobile Com. Corporation

For the objectives on mixed scenario with mixed near-to-track and far-from-track RRH deployment, and the objectives on new uplink timing adjustment mechanism, considering the work in Rel-17, we are fine to remove them.

8 – Huawei Technologies France

We support to remove the mixed scenarios considering that requirements for both Scenario A and Scenario B have been defined in Rel-17, we did not observe any necessity to introduce requirements for mixed scenarios.

It is fine for us to keep the UL timing adjustment to do some further study.

9 – KT Corp.

KT prefers to remove mixed scenario and 500km/h.

10 – Nokia Corporation

We support to specify requirements covering following scenario:

· new uplink timing adjustment mechanism for FR2 HST scenario with large propagation delays from different TRPs to UE

From Rel-17 outcome it is clear that the aspect of UL timing adjustment is still an aspect that needs further work in Rel-18. Having robust UL timing maintenance is crucial for robust operation as otherwise the link may break due UL RLF.

We do not see a strong view to work on maximum velocity of 500kmh.

11 – Samsung Electronics GmbH

For the HST velocity of 500kmph, it is originally proposed to match the FR1 counterpart in Rel-17 FR1 HST enhancement. But considering the business requirement is not clear and urgent, we are open with the proposal of removing 500kmph objective bullet.

For mixed scenario, considering the last RAN4 meeting's proposal, UE needs to support both Scenario-A (Dmin = 10m) and Scenario-B (Dmin = 150m), so the mixed scenario sub-bullet is not that needed. With that, we are also okay remove the sub-bullet of mixed scenario.

For UL timing adjustment sub-bullet, in Rel-17 discussion, there are generally two ways to solve the large propagation delay difference between two RRHs:

(1) UE-based UL timing adjustment, conditioned on the timing difference value between two RRHs, which is completed in Rel-17 already;

(2) explicit NW indication, based on which UE is performed UL timing adjustment, which is not included in Rel-17 due to limited timeline.

However, we also see the input on (2), which can be introduced and discussed in Rel-18.

We are also open to discuss and clarify the detailed scope of this new UL timing adjustment mechanism.

2.1.4 Objective of performance part

The following bullets are provided in RP-220064 performance part.

- Specify the RRM test cases, and investigate and if needed specify the demodulation performance requirements for intra-band carrier aggregation (CA) HST scenario.
- Specify the necessary demodulation performance requirements for simultaneous multi-panel reception.
    - NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception
- Specify the other necessary RRM and demodulation performance requirements depending on the outcome of core part.

Feedback Form 4: Any comments on the objectives of performance part

1 – Verizon UK Ltd We are fine for these objectives!
2 – Huawei Technologies France fine with the objectives
3 – China Unicom We support the objectives listed above.

2.1.5 Others

Comments are collected on other part of WID (RP-220061).

Feedback Form 5: Any comments on the other part of WID?

2.2 Moderatory summary and recommendation for further discussion

The follwoing give the summary of the initial round of discussion.

2.2.1 Justification

For justificaiton part of WID, totally 10 companies provided their views. All companies believe the wording is okay, but it is also proposed by nearly all companies that the justification should be updated accordingly after the objectives are confirmed. Considering the discussion on the objective part, the potential change includes:

- The sentence for ”mixed near-to-track and far-from-track RRH deployment”
- The sentence for ”500kmph maximum speed”.
- The paragraph for ”UL timing adjustment mechanism”
- Corresponding brackets needs to be removed if the corresponding objective is confirmed.

So the moderator propose to the following WF:

- Justfication can be updated accordingly after the objectives are confirmed.

With that, the moderator think there is no need for further discussion on the justficaiton part of WID.

2.2.2 Objectives with Converged View

For the objectives with converged view, there are totally 12 companies provided their views. Among them, 9 companies are okay with the these objectives. For some final refinement of these objectives, the following additional questions are raised:

Question-1: Whether or not the study on tunnel scenario is needed?

- Initial round status:
  - One company question the necessity of tunnel sceanrio. The concerns and argument comes from (1) no tunnel scenario for FR1 counterpart; (2) it is possible no core requirement impact even considering tunnel scenario.
  - All other companies are okay to have furhter study on this tunnel scenario in Rel-18 work item.

Question-2: Whether or not the following bullets needs to be added, by considering potential RAN1/2 impact

- ”Impacts on RAN1/2 are not precluded”
- ”Note: RAN1/RAN2 work can be triggered by RAN4 LS”

Question-3: Whether or not the objective on multi-panel operaiton needs clarification, i.e., for RF or/and RRM?

With that, the moderator propose to further discuss the above issues, based on companies’ input in the initial round.

2.2.3 Objectives expected to be further refined

For the objectives expected to be further refined, there are totally 11 companies provided their views. Issues are raised on the following aspects:

(1) The objective of 500kmph maximum speed: 9 companies proposed to remove or depriotize the 500kmph objective, while the business importance is not identified.

(2) The objective of the scenario with mixed near-to-track and far-from-track RRH deployment: 7 companies are okay to remove the mixed scenario objective, considering the lastest progress achieved by RAN4#102-e.

(3) The objective of new UL timing adjustment mechanism: 3 companies asked for clarification about the scope and justificaiton of further studying new UL timing adjustment mechanism. 4 company explicitly proposed that Rel-18 further study is needed while 1 company propose to remove it.

Considering the above initial round discusison, moderator proposed the following WF to be further checked and discussed in the intermediate round:

- Remove the objectives:

- 500kmph maximum speed
- the scenario with mixed near-to-track and far-from-track RRH deployment

– The objective of new UL timing adjustment mechanism:

- Further clarification on the expected mechanism by considering the potential benefits.
- Whether or not the objective has RAN1/2 involvement.

2.2.4 Objective: Performance part

For the objective of perforamnce part, there are 3 companies providing supportive views in the initial round. So there is no need for further disucssion on the objective of performance part, unless issue identified.

2.2.5 Others

No comments received on the other parts of WID, so there is no need for further discussion on the other part of WID, unless issue identified.

3 Intermediate Round

3.1 Collection of company views

3.1.1 Objectives with Converged View

The following quesitons are further proposed in the initial round, on which moderator encourage companies to further provide their views.

Question-1: Whether or not the study on tunnel scenario is needed?

Question-2: Whether or not the following bullets needs to be added, by considering potential RAN1/2 impact?

– ”Impacts on RAN1/2 are not precluded”

– ”Note: RAN1/RAN2 work can be triggered by RAN4 LS”

Question-3: Whether or not the objective on multi-panel operaiton needs clarification, i.e., for RF or/and RRM?

Feedback Form 6: Further views on the above 3 further questions on the objectives with converged view.

1 – Qualcomm Incorporated

Question 1: justification is needed to approve the tunnel scenario study

We reviewed the comments in the first round, but we still can’t find the solid justification of tunnel scenario study except that ”tunnel scenario hasn’t been studied in FR2 HST”. Note that there are many WIs and

objectives to be discussed in RAN4 and we want to emphasize the importance of efficient use of RAN4 discussion time.

”Tunnel scenario hasn’t been studied in FR2 HST” is not enough to justify a discussion given that tunnel scenario has been studied in FR1 HST and no additional requirement except a smaller Dmin test in demod, and FR2 HST already specified a set of requirements targeting small Dmin scenario. We additionally identify a possible difference in tunnel scenario: potential of rich reflection paths, but this has more impact on FR1 than in FR2. However, RAN4 concluded that no need to specify additional multipath requirement targeting tunnel scenario for FR1, then from this perspective, the conclusion should directly apply to FR2.

Therefore, to justify the study, the following question need to be answered in addition to ”Tunnel scenario hasn’t been studied in FR2 HST”:

What are the characteristics in FR2 HST tunnel scenario that not covered in FR1 tunnel scenario and R17 FR2 HST open space study?

Question 2: It’s a reasonable note from the discussion of the UL timing objective.

Question 3: We don’t see the impact of multi-panel on RRM, and the scope should be on RF only.

2 – ZTE Corporation

For Question 2, we also think that it’s reasonable to include that generic Note especially considering the UL timing adjustment and also CA related feature.

For Question 3, if the multiple panel will enable the reduced Rx beam numbers, then there would also RRM impacts.

3 – Verizon UK Ltd

Question 1: It is good RAN4 had reached a conclusion that FR1 HST has no additional requirement needed. For the FR2 HST, a similar conclusion is expected and it needs a study. The study could be very quick and at the end RAN4 may conclude to not have additional requirement too. The important point here is we need a RAN4 common understanding on this. Thus, in our view a conservative way is to mention “tunnel scenario hasn’t been studied in FR2 HST” in the justification.

4 – Samsung Electronics GmbH

Question-1: Whether or not the study on tunnel scenario is needed?

Samsung: FR1 and FR2 for tunnel scenario is different. For FR1, usually the leaky cable will be used. Based on LTE experience, leaky cable is more friendly to UE side, for which UE receiver is even easier, so that is one of the major reason tunnel scenario for FR1 is not specified. For FR2, there is no leaky cable can be used, and accordingly the study is necessary. Again, based on the current objective, it is not precluded that the existing requirement can still works and no additional requirement is needed, but this conclusion should be based on study.

Question-2: Whether or not the following bullets needs to be added, by considering potential RAN1/2 impact?

- ”Impacts on RAN1/2 are not precluded”
- ”Note: RAN1/RAN2 work can be triggered by RAN4 LS”

Samsung: We agree the RAN1/2 impact is better to be clearly specified. But for the “objective with converged view” here, there is no other working group expected to be involved. Open to discuss other working groups’ impact for the “objective expected to be further refined” in the next section.

Question-3: Whether or not the objective on multi-panel operation needs clarification, i.e., for RF or/and RRM?

Samsung: Both RF and RRM core requirement impacts are expected. This is comparable to the WI on Requirements for NR frequency range 2 (FR2) multi-Rx chain DL reception, i.e., email thread of [95e-05-RAN4-R18-FR2MultiRx]. There is RRM requirement impact for that WI, and it should be comparable and similar here.

5 – Ericsson France S.A.S

Regarding the tunnel scenario, we commented in the earlier e-mail discussion that in a tunnel there will be LoS from the BS to the UE, there will not be any significant delay spread and the behavior and demodulation will be exactly the same as Scenario A. In our understanding, this was discussed earlier in the Rel-17 WI. So we don't see a need for the objective. However, in the earlier e-mail discussion we compromised to include it.

Regarding the RAN1/2, we could add the note. Adding text about work not precluded seems a bit strange in a WID; RAN should decide work is needed or not. The WID could be revised later on if some larger RAN1/2 aspect would be identified that cannot just be handled by LS.

Regarding the multi-panel operation, it is OK without clarification and RRM can identify if there is any impact or not in RAN4.

6 – China Telecom Corporation Ltd.

Q1: We agree with Verizon's point that, even if no new requirements are needed, we still need a study to draw such conclusion in Rel-18.

Q2: Only keeping the following NOTE could be enough.

Note: RAN1/RAN2 work can be triggered by RAN4 LS if needed

Q3: Both RF and RRM are involved.

7 – China Mobile Com. Corporation

Answer to Q1: No strong view

Answer to Q2: we are fine to add the note considering the potential RAN1/2 impact.

Answer to Q3: no strong view, slightly prefer the original wording in RP-220064, which is more general.

8 – Apple GmbH

Regarding Q3, we can see some potential impact on RRM from multiple panels operation. Some study is needed before we conclude the impact.

9 – Intel

Question 1: We support the study on tunnel scenario since we recognize the importance to infrastructure side. Companies expressed their interests in this scenario and we don't a reason to exclude it in the item.

Question 2: If the group agrees to keep UL timing objective in the item the notes are needed.

Question 3: We need to consider both potential RRM and RF impacts. Let's not restrict anything at this stage. There is nothing to be decided here and it is rather a technical discussion in the WI phase.

10 – Huawei Technologies France

Q1: We are fine to do some investigations to conclude whether additional new requirements are needed for tunnel scenario considering that it is deprioritized and no further discussion in Rel-17 WI

Q2: We don't think those bullets are needed. By default RAN4 LS can be triggered based on discussion as usual. If impact that LS can't be handled, WID can be revised to include RAN1/2 later.

Q3: From our understanding, both RF and RRM could be impacted. Some potential RRM impacts can be observed. We can involve RRM in, the detailed impacts can be further discussed in RAN4.

11 – Nokia Corporation

Question-1: Whether or not the study on tunnel scenario is needed?

Considering studying the tunnel scenario our understanding is that the one main difference will be the reduced Dmin. Reduced Dmin might possibly impact the robustness of the TCI state switch and HO between cells if HO will happen in a tunnel. As the Dmin is reduced the time window available for performing TCI switch or HO will further be reduced (e.g., when the train travelling direction is opposite ot the serving beam orientation).

For tunnel scenarios, Dmin, RRH height and Ds parameters may be different from the non-tunnel scenario, which was not discussed in Rel-17. Presently, it is not clear how the RRH beam coverage differs from the non-tunnel scenario. Beam coverage does have impact on RRM requirements as discussed in Rel-17.

Hence, we are fine to study whether any new requirements will be needed for the tunnel scenario in HST FR2.

Question 2: We believe it should be reasonable to have a note in case RAN4 identifies a need to involve other RAN WGs (we see this as rather normal procedure which in fact wouldn't need to be specifically listed in the WID). It was clear from Rel-17 discussions, there were impacts on other RAN WGs.

Question 3: We prefer to clarify that this may impact RF and RRM. Hence, RAN4 should include RF and RRM.

12 – vivo Mobile Communication (S)

Q2: Adding the note would be enough.

Q3: It is majority view that multi-panel operation has impact on both RF and RRM though further study is needed. Then we perfer this part is explicitly listed in the WID so that RAN4 has clear understanding that both of RF and RRM study is needed.

3.1.2 Objectives expected to be further refined

Considering the above initial round discusison, moderator proposed the following WF to be further checked and discussed in the intermediate round:

- Remove the objectives:
  - 500kmph maximum speed
  - the scenario with mixed near-to-track and far-from-track RRH deployment

– The objective of new UL timing adjustment mechanism:

- Further clarification on the expected mechanism by considering the potential benefits.
- Whether or not the objective has RAN1/2 involvement.

Feedback Form 7: Views on the above WF including removing two objectives and further discussion on the objective of new UL timing adjustment mechanism.

1 – Qualcomm Incorporated

Based on the first round discussion, we don't see the potential enhancement beyond R17 agreed mechanism except signaling assistance. Then it is better to revise the objective as:

Specify the new uplink timing adjustment mechanism "with signaling assistance" for FR2 HST scenario with large propagation delays from different TRPs to UE

And RAN2 should be listed in the impact WG.

Support to remove the other two objectives.

2 – ZTE Corporation

The updated objectives from Qualcomm is fine for us. Given UL timing adjustment in FR2 HST in Rel-17, we still prefer to have further discussion in Rel-18 especially for one-shot UL timing adjustment.

3 – Samsung Electronics GmbH

As we comment in the initial round, 500kmph and mixed scenario objective can be removed.

For the detailed objective for UL timing adjustment mechanism, we are open to discuss. Here is the proposed revision based on QC's comment by specifying the impacted WG specifically:

- Specify the new uplink timing adjustment mechanism with signaling assistance for FR2 HST scenario with large propagation delays from different TRPs to UE **[RAN4, RAN2]**

4 – China Mobile Com. Corporation

For the new UL timing adjustment mechanism, if there are potential benefits/necessity, we are fine to include it.

5 – Intel

We accept removing the objectives proposed by moderator.

Regarding the objective of UL timing adjustment, we appreciate much on clarifications to the scope: explicitNWindication,basedonwhichUEisperformedULtimingadjustment,whichisnotincluded inRel-17duetolimitedtimeline. If this objective is kept, let's go with the clarified wording. We are neutral on whether to keep this bullet.

6 – Apple GmbH

We also support removing 500km/h. Is it common understanding that the highest velocity would be 350km/h? It is better to clarify this in the justification part as usual since this impacts requirements design.

Regarding UL timing adjustment, more justification is needed to introduce new mechanisms given that we already have solutions in R17. We are also fine with removing it.

7 – Huawei Technologies France

We support to remove mixed scenario, also fine to remove 500km/h velocity. As commented by Apple, if the highest velocity is agreed to be 350km/h, it should be clearly specified in the justification and objective.

For the UL timing adjustment, the rewording from Samsung is fine for us.

8 – Nokia Corporation

We can support removing the objectives addressing 500kmh and mixed near-to-track and far-from-track RRH deployment.

Regarding the objective of new UL timing adjustment mechanism, we think that signalling assistance should be included as one of the concrete objectives. However, following the Rel-17 discussions, we can observe that even though the main directions (i.e., UE-based and NW-based) were already considered, the solutions were strongly limited by the WI timeline and the lack of possibility/time to involve other WGs. We see it beneficial to work further on the more generic solution without the constraints listed above.

A clarification like proposed by Qualcomm looks like reasonable as starting point. We also suggest:

'Study and specify UL timing adjustment solution, including signalling assistance, for FR2 HST scenario with large UL/DL propagation delay difference between serving and target RRH/TRP.'

We believe it is best to list both RAN1 and RAN2 WG involvement.

3.2 Moderatory summary and recommendation for further discussion

The following gives the summary of the intermediate round of discussion.

3.2.1 Objectives with converged view

In the intermediate round discussion, totally 12 compines provide the views on the three questions provided by moderator, as summaried below respectively.

Question-1: Whether or not the study on tunnel scenario is needed?

[Moderator] Among all comments, expect 1 company, all other companies are okay to have the bullet for study on tunnel scenario. Considering the current objective is open to all the study on the tunnel scenario discussion on (a) even smaller value of Dmin, (b) a proper Ds and other beam/cell coverage perspective analysis which has not yet done in Rel-17, and (c) whether or not existing requirements needs enhancement, **it is suggested to be included in WID as the way forward, and the original wording can be followed.**

Question-2: Whether or not the following bullets needs to be added, by considering potential RAN1/2 impact?

”Impacts on RAN1/2 are not precluded”

”Note: RAN1/RAN2 work can be triggered by RAN4 LS”

[Moderator] Among all 10 comments on Q1, expect 1 company considering the Note is not necessary since “By default RAN4 LS can be triggered based on discussion as usual. If impact that LS can’t be handled, WID can be revised to include RAN1/2 later.”, all others (9 companies) are okay to have the Note. Considering it is not harmful to be included if it is business as usual, **we suggest to include the following note as a major bullet, as the way forward.**

- **”Note: RAN1/RAN2 work can be triggered by RAN4 LS”**

Question-3: Whether or not the objective on multi-panel operation needs clarification, i.e., for RF or/and RRM?

[Moderator] Among all replies, 8 companies are clearly identifying the impact of RRM, and 2 companies don’t have strong view, while one company think no RRM impact. Considering the original bullet is general enough, **we think it is reasonable to follow the original wording.**

- **Specify the requirement for simultaneous multi-panel operation for train roof-mounted FR2 high power devices [RAN4]:**
  - **Maximum 2 active panels supporting the multi-panel simultaneous reception.**
  - **NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception**

3.2.2 Objectives expected to be further refined

Totally, 8 compainies provided their further view in the intermediate round.

In summary, for removing the objectives of 500kmph maximum speed and mixed scenario, no objection received, so it is believed removing these two objectives are acceptable.

For new UL timing adjustment mechanism, discussion is focused on how the detailed objective should be drafted, while no objection on including this objective and more companies express their support to include it. Considering the comments received, including more clarification on signaling assistance, other working group impact and delay ”difference”, **the objective is suggested to be revised to**:

- Specify UL timing adjustment solution, including explicit NW signalling assistance, for FR2 HST scenario with large UL/DL propagation delay difference from different RRHs/TRPs to UE [RAN4, RAN2].

4 Final Round

4.1 Collection of company views

4.1.1 WID Final Version

Regarding the WID, companies please check the updated WID in the following link. **If you have any comments on the WID, please directly provide your revisions in the draft inbox**:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_95e/Inbox/Drafts/%5B95e-14-RAN4-R18-HST%5D/Revision%20of%20RP-220064_WID-RAN4-R18-HST_v00.doc

4.1.2 TU

It is believed the TU sheet can be drafted based on the endorsed RP-220068.

Feedback Form 8: If you have different view on TU, pls. provide views here.

4.1.3 Supporting list

Check preference to be included in supporting list, if not yet expressed in offline manner.

Feedback Form 9: Is it preferred to be added in the supporting list?

1 – Qualcomm Incorporated QC would like to be added to the supporting list
2 – Verizon UK Ltd Verizon would like to be added on the supporting list
3 – Huawei Technologies France Huawei and HiSilicon would like to be added into the supporting company list.
4 – SoftBank Corp. SoftBank Corp. would like to be added to the supporting list.

5 – Intel Intel Corporation would like to be one of the supporting IMs.
6 – Ericsson France S.A.S Please add Ericsson to supporters
7 – Nokia Corporation Please add Nokia and Nokia Shanghai Bell as supporting companies
8 – China Unicom Please add China Unicom as supporting company.

4.2 Moderatory summary and recommendation for further discussion

Considering the discussion in the final round, in which some editorial changes are further provided (based on draft directly), and the following version of WID and the accompanying TU planning are stable:

- https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_95e/Inbox/Drafts/%5B95e-14-RAN4-R18-HST%5D/RP-22xxxx_New%20WID%20on%20NR%20FR2%20HST%20enh_v04_Huawei2_Moderator.doc

Within the v04 version, the justification and objective parts are copied as below for informaiton purpose:

Justificaiton Part:

In Rel-17 work item on NR support for high speed train scenario in frequency range 2 (FR2), RAN4 has focused on train roof-mounted high-power devices for NR SA single carrier scenario in FR2, by studying the FR2 HST deployment scenario and specifying the channel modelling, RF, RRM and demodulation requirements for FR2 HST.

During the Rel-17 work item, most of focus was devoted into open space deployment scenarios (Scenario-A and B, differentiated by D_{min}, which is the perpendicular distance between RRH site and railway track), while limited study was provided on the tunnel scenario due to the limited Rel-17 effort and relative prioritization, which is identified by operators as important high speed train scenario. Furthermore, the intra-band carrier aggregation (CA) operation is also of interests to operators, which is not yet covered in Rel-17 work item scope.

In the Rel-17 WI, similar as FR2 handheld and other UE types, the single active panel operation was focused, *i.e.* only one active antenna panel at a time as baseline antenna assumption. Based on the Rel-17 conclusion, two panels shall be physically installed to flexibly support either forward or backward incoming signal direction; however the restriction of only one active antenna panel limits utilizing two neighbouring RRHs to serve one HST UE in the bi-directional RRH deployment scenario. Accordingly, it is of importance to introduce the support of simultaneous reception with maximum 2 active panels at the train roof-mounted FR2 high power devices for the bi-directional RRH deployment scenario.

Another issue identified in Rel-17 work item is the large propagation delay difference from neighbouring

RRHs to UE. For example in the uni-directional RRH deployment, it is identified that the signal propagation delay difference can be as much as 2.5us, which is much larger than CP length with 120kHz subcarrier spacing. In Rel-17 work item, the larger autonomous timing adjust step T_q is specified for FR2 HST UE, and the RAN4-based solutions for the uplink timing issue are focused, while other solutions, including involving other RAN working groups, are not fully studied.

Objective of Core Part:

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

Objective of Performance Part:

- Specify the necessary RRM test cases based on the outcome on corresponding core part.
- Investigate and if needed specify the demodulation performance requirements for intra-band carrier aggregation (CA) HST scenario.
- Specify the necessary demodulation performance requirements for simultaneous multi-panel reception.
    - NOTE: Focus on FR2 HST specific requirements, and avoid the overlap with the scope of FR2 multi-Rx DL reception
- Specify the other necessary RRM and demodulation performance requirements depending on the outcome of core part.