**3GPP TSG-RAN WG2 Meeting #117 electronic R2-22xxxxx**

**Online, February 21 – March 3, 2022**

**Agenda item: 8.24.1**

**Source: Nokia**

**Title: [AT117-e][057][NR17] FR2 HST (Nokia)**

**WID/SID: NR\_HST\_FR2\_enh**

**Document for: Discussion and Decision**

# Introduction

* [AT117-e][057][NR17] FR2 HST (Nokia)

Scope: Treat R2-2202167, R2-2203187, R2-2203188, R2-2202867,. Ph1 Determine agreeable parts and converge on discussion points if any, Ph2 agree CRs (and Reply LS only if needed).

Intended outcome: Report, Agreed CR 38331, endorsed UE cap CRs (or draft CRs) (38306, 38331) for Merge.

Deadline: Schedule 1

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# Discussion

RAN4 sent LS on FR2 HST:

R2-2202167 LS on network signaling for Rel-17 NR FR2 HST RRM (R4-2202765; contact: Nokia) RAN4 LS in Rel-17 To:RAN2

It indicates following:

*In the Rel-17 work item on NR support for high-speed train scenarios in FR2 (NR\_HST\_FR2), RAN4 has agreed to specify 2 sets of enhanced NR RRM requirements for UE moving at speed up to 350 km/h. Network signaling assistance is needed to indicate the UE which one of the 2 sets to apply. The per cell signaling is provided to UE in both idle mode and connected mode.*

*Additionally, in FR2 (NR\_HST\_FR2), RAN4 has agreed to introduce following:*

* *network assistance to inform UE on the FR2 HST deployment type (uni-directional or bi-directional), and*
* *network signaling flag to enable/disable large one shot UE autonomous uplink transmit timing adjustment.*

*Thus, network signalings are needed respectively for indicating to UE of the FR2 HST deployment type and whether one step large UE autonomous UL transmit timing adjustment is enabled or not. The per cell signalings are provided to UE in both idle mode and connected mode.*

*RAN4 has also agreed to introduce a new power class for FR2 HST UE, which is numbered as UE power class 6 and the UE type is high speed train roof-mounted UE.*

*It should be noted that the above network signalings except deployment type are applicable to FR2 power class 6 UE, which is FR2 UE type for high speed train roof-mounted UE, and*

*The R16 FR1 HST signaling design can be considered as a reference framework.*

*RAN4 kindly requests RAN2 to define network signalings to support the above-mentioned functionalities for Rel-17 FR2 HST.*

Then there are 2 38.331 CRs provided to the meeting trying to capture RAN4 agreements:

R2-2203187 HST on FR2 Nokia, Nokia Shanghai Bell CR Rel-17 38.331 16.7.0 2933 - B NR\_HST\_FR2 Late

R2-2202867 On the signaling for RRM enhancements for Rel-17 FR2 HST Huawei, HiSilicon draftCRv Rel-17 38.331 16.7.0 B NR\_HST\_FR2

and a 38.306 CR:

R2-2203188 HST on FR2 Nokia, Nokia Shanghai Bell CR Rel-17 38.306 16.7.0 0692 - B NR\_HST\_FR2 Late

## HighSpeedConfig

*In the Rel-17 work item on NR support for high-speed train scenarios in FR2 (NR\_HST\_FR2), RAN4 has agreed to specify 2 sets of enhanced NR RRM requirements for UE moving at speed up to 350 km/h. Network signaling assistance is needed to indicate the UE which one of the 2 sets to apply. The per cell signaling is provided to UE in both idle mode and connected mode.*

*Additionally, in FR2 (NR\_HST\_FR2), RAN4 has agreed to introduce following:*

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* *network signaling flag to enable/disable large one shot UE autonomous uplink transmit timing adjustment.*

*Thus, network signalings are needed respectively for indicating to UE of the FR2 HST deployment type and whether one step large UE autonomous UL transmit timing adjustment is enabled or not. The per cell signalings are provided to UE in both idle mode and connected mode.*

Both [1] and [2] have pretty similar proposal how to capture these three different parameters i.e. in the *HighSpeedConfig* IE. There is small difference in the coding of the fields. To the rapporteur [1] looks more in line with condign style of ASN.1 currently used but both coding will work.

Rapporteur would also think having different name for FR2 *HighSpeedConfig* to separate from FR1 as proposed in [2] would be practical i.e. *HighSpeedConfig-FR2.*

**Q1: Are you fine with [1] style of coding or prefer [2] style of coding for *HighSpeedConfig IE*? Or any combination of two. Also would you be fine to have FR2 high speed parameters as new IE *HighSpeedConfigFR2?* And provide any other comments on ASN.1 on these fields/IEs.**

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| **Company** | **Comments** |
| Huawei, HiSilicon | Proponent of [2].  So we prefer to have separate IE for FR2 as proposed by [2]. But are fine to follow the majority.  Suggest to add “*highSpeed*” before *deploymentTypeFR2-r17* and *largeOneStepUL-timingFR2-r17* in [1] as we did for Rel-16.  For the field description of *highSpeedMeasFlagFR2****,*** according to RAN4 LS, this parameter just to indicate which set of RRM enhancement to apply, there seems no requirement on the support of “*MeasurementEnhancementFR2-r17*”. Actually there is no such UE capability in the RAN4 feature list. So we suggest to delete “and UE supports *MeasurementEnhancementFR2-r17*” from the field description |
| Nokia | We agree that separate FR2 IE makes sense for this. But probably it does not matter much in the end. But if no opposition then we would be good to have FR2 specific IE.  Adding “highSpeed” in front of parameter names is fine to align naming.  We agree “UE supports….” can be removed. In fact RAN4 has just agreed more about capabilities. See in the capability section more. |
| Samsung | We are fine to go with separate FR2 IE, but for the actual coding, we slightly prefer [1] which saves one bit for each field. We are also fine with updated field name from Huawei for the clarity. |
| ZTE | We also support to have a separate FR2 IE. And [1] style of coding with the updated field name and field description is fine to us. |
| vivo | Agree with HW’s comment to align the rule of name with Rel-16. But the value range in [1] can reduce the signalling overhead from 2 bits to 1 bit. Thus we prefer to combine the two, i.e., value range in [1] and IE name in [2].  HighSpeedConfig-FR2-r17 ::= SEQUENCE {  HighSpeedMeas-FR2-r17 ENUMERATED {set1, set2} OPTIONAL, -- Need R  HighSpeedDeploymentType-FR2-r17 ENUMERATED {uni-directional} OPTIONAL, -- Need R  HighSpeedTimeAdjust-FR2-r17 ENUMERATED {enabled} OPTIONAL, -- Need R  ...  } |
| Ericsson | No strong view really, perhaps the Nokia CR would be baseline as they were contact company (if that way of working still applies). Anyway:  The ASN.1 of [2] does not compile, e.g. the fields in "*HighSpeedConfig-FR2-r17*" are using capital letters.  In [1] the "default" is bi-directional, it seems? Meaning that a NW that doesn’t indicate "unidirectional" would be considered bi-directional. But is that really the intended behaviour? Would it not be so that a NW that doesn’t support this feature at all (e.g. a NW that is not even high speed) would be considered to indicate bi-directional? Is that really the intention? Perhaps the safest is to explicitly indicate both, and in absence of this field, the NW is neither uni- nor bi-directional. Maybe in the future RAN4 will also come up with something different than uni/bi-directional, so perhaps it is safes to have explicit signalling also from this point of view?  [Huawei HiSilicon] we tend to share similar view as Ericsson and that’s the intention we use two bits, but it is not clear how UE interprets if this indication is absent. Not sure how RAN4 understands… |
| CATT | Share the same view with Samsung and ZTE to have separate FR2 IE and be fine to [1] style of coding with the updated field name and field description. |
| Qualcomm | Also prefer separate FR2 IE. Slight preference for the Nokia coding. |
| Apple | We prefer to have the separate FR2 IE. For the detailed coding, and we are fine with [1] with the changes as below.  HighSpeedConfig-v17xy ::= SEQUENCE {  highSpeedMeasFlagFR2-r17 ENUMERATED {set1, set2} OPTIONAL, -- Need R  highSpeedDeploymentTypeFR2-r17 {uni-directional, bi-directional } OPTIONAL, -- Need R  highSpeedLargeOneStepUL-timingFR2-r17 ENUMERATED {true} OPTIONAL, -- Need R  ...  } |
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**Summary:**

It seems generally there is support to have separate FR2 IE for *HighSpeedConfig.* For the field coding also [1] style has more preference but field naming should include “highSpeed”. Also it was commented that on should explicitly configure bi/uni-directional with optional field for deployment type field.

**Proposal:** Define separate FR2 IE for *HighSpeedConfig* with coding style of [1] but renaming fields to start with “highSpeed”.explicitly configure bi/uni-directional with optional field for deployment type field. This leads somewhat to following coding:

HighSpeedConfigFR2-r17 ::= SEQUENCE {

highSpeedMeasFlagFR2-r17 ENUMERATED {set1, set2} OPTIONAL, -- Need R

highSpeedDeploymentTypeFR2-r17 {uni-directional, bi-directional } OPTIONAL, -- Need R

highSpeedLargeOneStepUL-timingFR2-r17 ENUMERATED {true} OPTIONAL, -- Need R

...

}

Whether one needs to capture in RAN2 that deployment type is not meant to be configured to PC6 UE. From rapporteur point of view it would not harm to capture limitation not to allow configuring deployment type for PC6 but it should be noted that this would also depend on capability signaling part of this email discussion.

**Q1: Do you think we need to capture not allowing of configuring deployment type for PC6 UE?**

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| **Company** | **Comments** |
| Huawei, HiSilicon | Yes. In RAN4 LS, it is clearly stated that  *It should be noted that the above network signalings except deployment type are applicable to FR2 power class 6 UE, which is FR2 UE type for high speed train roof-mounted UE*  So this should be reflected in the field description. |
| Nokia | We assume that RAN4 will capture this limitation as they will not make requirements for this. But fine to add limitation in the field description – anyway it was clearly stated in the LS. If RAN4 makes any changes we can reflect them later. |
| Samsung | We are okay to capture it in the field description. |
| ZTE | We are fine to clearly capture the limitation in the field description. |
| vivo | Fine to reflect the restriction in field description. |
| Ericsson | OK to capture this in the field description. But [2] captures it like:  *Network does not configure this field for high speed train roof-mounted UE with power Class 6 as defined in TS 38.101-1 [15].*  But is it not so that the NW can signal this in system information as well and hence we should rather talk about that the field is not applicable to UEs of PC6? Like the LS-text itself pasted above by Huawei.  [Huawei HiSilicon] Fine with Ericsson’s suggestion and this is aligned with the wording we discussed in section 2.4 of [056]. |
| CATT | Ok to capture it in the field description. |
| Qualcomm | Good to capture in the field description. Agree with Ericsson on changing the applicability clause. |
| Apple | The restriction is unclear to us. We would like to understand the restriction first before capturing it in the spec.  According to the PC6 capability discussion in Q3, the UE supporting PC6 shall always support FR2-HST feature. Following this logic, the deployment type configuration should be applicable for the PC6 UE. Otherwise, we donot know what’s the usage of the deployment type config. |

**Summary:**

There is majority wanting to capture limitation of PC6 not being applicable for PC6 UE. But like Apple mentioned interaction with RAN4 agreements on capability discussion is not very clear. Based on Ran4 agreements FR2-HST is only supported by PC6 UEs so it leads one to wonder what is usage of the parameter. But LS clear stated that field is not applicable for PC6 UE – if RAN4 does not see need for parameter and indicates so to us then we can later remove the parameter.

**Proposal:** capture limitation of highSpeedDeploymentTypeFR2-r17 not being applicable for PC6 UE. If Ran4 later indicates parameter is not used – RAN2 can remove/dummify the parameter.

## PC6

[4] also indicated:

*RAN4 has also agreed to introduce a new power class for FR2 HST UE, which is numbered as UE power class 6 and the UE type is high speed train roof-mounted UE.*

*It should be noted that the above network signalings except deployment type are applicable to FR2 power class 6 UE, which is FR2 UE type for high speed train roof-mounted UE, and*

In [1] PC6 was captured *ue-PowerClass-v17xy* i.e. as extension of existing power class signaling. As the power class 6 is only supposed to be in one carrier deployments as RAN4 has agreed in R17 not to introduce inter-RAT and inter-frequency requirements, i.e., it is assumed that only one carrier is deployed i.e. no need to capture power class in band combination signaling.

**Q2: Are you fine with [1] style of coding PC6 capturing? Please note this assumes as per RAN4 discussion that in R17 PC6 will only consider stand alone deployment without inter-RAT/frequency requirements i.e. we do not need power class signaling in band combination signaling in release 17.**

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| **Company** | **Comments** |
| Huawei, HiSilicon | We think it seems too early for us to capture this capability since this is still under RAN4 discussion. It is quite possible RAN4 will send us a feature list including this capability after this meeting and we can add this part after that. |
| Nokia | This makes me bit puzzled. How would this be early? PC6 has been agreed and need to be captured. At minimum it needs to be captured for stand-alone deployment as shown in [1]. If more is needed RAN4 will agree and we will capture those later. Would this be fine?  [Huawei HiSilicon] Yes, after some further check with RAN4, we agree it is per band capability. So fine to capture as in [1]. |
| Samsung | We are fine to capture it as in [1]. |
| ZTE | We are fine to capture it as in [1]. |
| vivo | Fine to introduce a new PC type and the following description shall be revised to reflect the demodulation capability.  UE indicating support for pc6 supports the enhanced intra-NR RRM requirements and demodulation processing to support high speed up to 350 km/h as specified in TS 38.133 [5] and TS 38.101-4 [18]. |
| Ericsson | [1] Seem to be how RAN4 intended it. |
| CATT | We are fine to capture it as in [1]. |
| Qualcomm | Fine with [1] approach. |
| Apple | We are fine to capture it as in [1]. |
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**Proposal:** Capture PC6 as described in [1] . Note capability part of CR is going to have separate CR from rest of 38.331 changes.

## Capabilities

[1] assumes style of assuming PC6 support implicitly indicates support for FR2 HST as this was source companies understanding of RAN4 discussions i.e. PC6 is enough to identify the support for HST FR2 in HST FR2 deployment, and no capability was agreed in RAN4 separately.

There seems to be bit of conflict in RAN4 status as how one can configure deployment type for UE if it is not meant for PC6 UE but there is no capability to indicate support for that. Companies are invitied to check with their RAN4 colleagues what is the RAN4 intention.

**Q3: Do you agree RAN4 current status on not needing separate capability signaling for FR2 HST but it is implicitly supported by PC6 UE? Any other comments on 38.306/38.331 capability part of CRs?**

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| **Company** | **Comments** |
| Huawei, HiSilicon | Similar comment as Q-2.2. Support to wait for RAN4. |
| Nokia | RAN4 has agreed – below link to meeting minutes  [RAN4\_102-e\_RRM\_session\_report\_01\_Feb\_21docx.docx](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Chairman_Notes/RAN4_102-e_RRM_session_report_01_Feb_21docx.docx)   * Agreement:   + The following UE feature list description for feature “x-1 Support of FR2 HST operation” is endorsed in the RRM session. Further confirmation in the RAN4 Main and Demod session is required.  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional | | x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC6  2) Support of enhanced RRM requirements for FR2 HST (except the requirement for one shot large UL timing adjustment)  3) Support of demodulation processing for FR2 HST | [R15 RAN4 feature group:  Support of FR2 UE power class 6] | Yes | No | UE does not meet FR2 high speed train scenario | Per Band | No | Applicable to FR2 only | N/A | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signaling |   So PC6 is used to indicate support for this feature group. So it should be fine to capture that we do not need separate capability, right?  [Huawei HiSilicon] Yes, we agree. |
| Samsung | We share the view with Nokia. |
| ZTE | Agree with Nokia. |
| vivo | Agree with Nokia, with the note ‘FR2 UE power class PC6 signalling is used to indicate support of feature group’. |
| Ericsson | Agree with Nokia. |
| CATT | Agree with Nokia. |
| Qualcomm | Agree on implicit support suggested by Nokia. |
| Apple | Agree with Nokia. |

**Proposal:** No need for separate capability to indicate FR2 HST support i.e. PC6 UE will support FR2 HST

## Other

**Q5: Any other issues needing discussion?**

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| **Company** | **Comments** |
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# Summary

# References

[1] R2-2203187 HST on FR2 Nokia, Nokia Shanghai Bell. Nokia, Nokia Shanghai Bell

[2] R2-2202867 On the signaling for RRM enhancements for Rel-17 FR2 HST. Huawei, HiSilicon

[3] R2-2203188 HST on FR2 Nokia. Nokia Shanghai Bell

[4] R2-2202167 LS on network signaling for Rel-17 NR FR2 HST RRM