**3GPP TSG-RAN WG4 Meeting # 109 R4-2318133**

**Chicago, USA, November 13 – November 17, 2023**

**Agenda item: 8.4.3**

**Source:** Moderator (Ericsson)

**Title:** Topic summary for [109][127] NR\_channel\_raster\_enh

**Document for:** Information

# Introduction

This document is a summary of the proposals made in the contributions submitted under AI 8.4 for the RAN4 #109 meeting.

# Topic #1: Channel raster enhancement

This topic addresses the remaining open issues related to the channel raster enhancement. Based on the submitted contributions, the proposal is to go through:

* Mandatory vs optional aspects. It seems companies have still different views on this.
* The UE capability definition and what does it mean when this capability is not reported.
* How to capture the new channel raster in the specifications and additional clarifications.
* NTN aspects.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2318411**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318411.zip) | Apple | Proposal 1: Introduce changes to the raster table in TS 38.101-1 to indicate unambiguously which channel raster (100kHz and/or 10kHz) is applicable to a band, and whether it is mandatory or optional.  Proposal 2a: Introduce changes to the raster table in TS 38.104 to indicate unambiguously which channel raster (100kHz and/or 10kHz) is applicable to a band.  Proposal 2b: Clarify in TS 38.104 that the network should not configure the 10kHz raster if it is not supported by the band or by the UE.  Proposal 3: Introduction of the (mandatory) enhanced channel raster for the legacy band should follow the established process agreed by RAN WG4. |
| [**R4-2318412**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318412.zip) | Apple, Ligado Networks, Inmarsat, Viasat, Globalstar, Thales, Hughes/Echostar | Proposal 1: Enable the 10kHz raster as a mandatory feature for the Rel-17 NTN bands n255 and n256.  Proposal 2: Enable the 10kHz raster as a mandatory feature for the Rel-18 NTN band n254. |
| [**R4-2318710**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318710.zip) | MediaTek Inc. | **Observation 1: A legacy UE is still able to connect to a BS operating at a carrier deployed at a new channel raster entry.**  **Observation 2: Mandatory support of the new channel raster for a band for BS can be requested by an operator.**  **Observation 3: Support of the new channel raster for a band for UE is optional and does not dependent on any operator’s input or request.**  **Proposal 1: RAN4 to clarify that the operators’ input dependent optionality of the support of new channel raster only applies to BS.** |
| [**R4-2318823**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318823.zip) | Qualcomm Incorporated | **Observation 1: Intra-band contiguous CA with nested channels is not needed with the new channel raster entries.**  **Proposal 1: Do not make any changes to the channel spacing specifications.**  **Observation 2: Sync raster will not cover all the channels placed on the enhanced channel raster, however, in practice, an SSB will always fit within a channel placed on the enhanced channel raster.**  **Proposal 2: Introduce some text in the sync raster specifications to clarify that they sync raster does not cover all the channels placed on the enhanced channel raster.** |
| [**R4-2318929**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318929.zip) | CMCC | **Proposal: it is proposed that UE mandatory support new channel raster for band n3 and n28.** |
| [**R4-2319197**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319197.zip) | ZTE Corporation | ***Proposal 1: Per-band UE capability of supporting 10 kHz channel raster should be mandatory.*** |
| [**R4-2319433**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319433.zip) | Ericsson | **Proposal 1: for both the BS and UE, the enhanced raster is not defined outside the outer 100 kHz raster entries at the upper and lower edge of an operating band for which a RF channel can be located within a band with preserved internal GB for all numerologies.**  **Proposal 2: the definition of the enhanced channel raster in 38.101-1 and 38.101-5 shall also include that a UE indicating the capability supports these requirements for UE specific channel bandwidth and location configurations by *ServingCellConfig* for the DL and UL with an *offsetToCarrier* of full PRB granularity for all numerologies supported by the UE.**  **Proposal 3: for the BS, for NR *operating bands* with 100 kHz channel raster, RF channel positions *can* be shifted, if required, to align with an RF reference frequency on the enhanced channel raster. The BS shall meet the requirements on the enhanced raster if supported (declaration for conformance).**  **Proposal 4: the channel spacing to adjacent channels shall not be changed, whereas nominal CA spacing is to be amended for UE specific channel bandwidths configured within a wider carrier such that the definition of a contiguous configuration remains clear.**  **Proposal 5: the definition of the mapping of an RF channel to the channel raster in sub-clause 5.4.2.2 shall not be changed.** |
| [**R4-2319434**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319434.zip) | Ericsson | **Observation 1: for initial access before RRC setup, RAN4 has not identified any restriction on the configuration of BWP#0 size and location within the carrier resource grid for any carrier frequency on the global frequency raster other than SSB location. The UE selects a channel bandwidth autonomously in accordance with the SIB1 procedure.**  **Proposal 1: the capability indicates that the UE supports the radio requirements for UE channel bandwidths located on the enhanced channel raster of a band as specified in 38.101-1 and 38.101-5. The definition of the enhanced channel raster in these specifications shall also include that a UE indicating the capability supports these requirements for UE specific channel bandwidth and location configurations by *ServingCellConfig* for the DL and UL with an *offsetToCarrier* of full PRB granularity for all numerologies supported by the UE.**  **Proposal 2: the UE behaviour when the capability is absent is not specified, actions when the capability is absent is up to network implementation.**  **Proposal 3: UE support of the capability is mandatory for all RedCap UE in supported bands from Rel-17.**  **Proposal 4:** **support of the enhanced channel raster cannot be mandatory for the BS since handling of UEs, capable or non-capable, is up to network implementation.** |
| [**R4-2319676**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319676.zip) | Huawei, HiSilicon | Text proposal when updating TS 38.104 and TS 38.101-1 |

## Open issues summary

### Sub-topic 1-1

*Sub-topic description:* This sub-topic further discusses open issues on decision process to mandate the enhanced channel raster in a band and the criteria to decide if the support is mandatory or optional.

**Issue 1-1-1: New channel raster support – mandatory vs optional support for UE.**

* Proposals: The new channel raster for the UE shall be:
  + Mandatory for bands n3 and n28 (CMCC)
  + Mandatory for bands supporting enhanced channel raster, which are based on operators’ inputs (ZTE).
  + Mandatory for RedCap from Rel-17 (Ericsson)
  + Mandatory or optional aspect is left to UE implementation (MediaTek).
* Recommended WF
  + To be further discussed.

Qualcomm: for n28 we introduce the raster already. Do we still need it? For RedCap, we are looking into the early implementation.

CMCC: for n28, the new raster is introdueced for network. We need mandater raseter for UE from Rel-18. Support RedCap propsoal from Rel-17.

Huawei: for Rel-18, based on operator’s input we can consider to mandate some band. For proposal for Rel-17, we have already had design, and we are against to mandate it from Rel-17.

Mediatek: in our view, for UE perspectice, it should be optional rather than mandatory. It is enhanced capability from Rel-18.

Ericsson: all new UE should support these combiantion in all the bands supporting these features. For RedCap, there is no UE available. RedCap needs the smaller bandwidth of BWP. For RedCap, there should be no restriction.

Nokia: This is not discussed for RedCap WI. Is it for UE specific BWP or common BWP?

Ericsson: UE specific bandwidth also impact you allocate the BWP. It also impacts allocation of signalling.

China Telecom: we have 11MHz channel bandwidth.

**Issue 1-1-2: New channel raster support – mandatory vs optional support for BS.**

* Proposals: The new channel raster shall be optional support for the BS:
  + Agree and based manufacturer declaration (Ericsson)
  + Agree and based on operators’ inputs (MediaTek)
  + Disagree.
* Recommended WF
  + Agree, it should be based on manufacturer declaration.

Mediatek: There would be no too difference for options.

Qualcomm: This is business as usual.

Ericsson: Agree with Qualcomm.

Nokia: This new raster is introduced for 100KHz.

**Issue 1-1-3: New channel raster support – process.**

* Proposals: Introduction of the (mandatory) enhanced channel raster for the legacy band should follow the established process agreed by RAN WG4
  + Agree (Apple)
  + Disagree.
* Recommended WF
  + The agreed process should be captured in a way forward that could be as reference later.

### Sub-topic 1-2

*Sub-topic description:* This sub-topic further discusses open issues related to the UE capability.

**Issue 1-2-1: Channel enhancement capability definition**

* Proposals: Definition of the channel enhancement capability
  + The capability indicates that the UE supports the radio requirements for UE channel bandwidths located on the enhanced channel raster of a band as specified in 38.101-1 and 38.101-5 (Ericsson)
* Recommended WF
  + Agree with the definition.

Apple: the wording is confusion. Why should we mention radio requirements?

Nokia: We agreed that all the Tx and Rx requirements are applicable to UE. Need clarification.

Ericsson: RRC signaling can configure UE for this enhanced raster.

Qualcomm: we have no clear definition radio requirements.

Agreement:

* Definition of the channel enhancement capability
  + The capability indicates that the UE supports the RAN4 requirements for UE channel bandwidths located on the enhanced channel raster of a band as specified in 38.101-1 and 38.101-5

**Issue 1-2-2: UE behaviour when the channel enhancement capability is absent.**

* Proposals: The UE behaviour when the capability is absent is not specified, actions when the capability is absent is up to network implementation**.**
  + Agree (Ericsson)
  + Disagree
* Recommended WF
  + Agree

Nokia: if UE behaivor is not specified, what does it mean “by network implementation”?

T-Mobile USA: How does network react is up to network.

Apple: It seems confusion.

Mediatek: if UE does not indicate such capability, UE can use 100KHz raster. The legacy UE can be ensured to access the network.

Ericsson: we do not propose to capture the text in the RAN2.

CMCC: We have the same understanding as Ericsson. We try to avoid to state it in 38.306.

The following bullet needs more discussions:

* The UE behaviour when the capability is absent is not specified, how the network react when the capability is absent is up to network implementation**.**

### Sub-topic 1-3

*Sub-topic description:* This sub-topic further discusses open issues related to the CRs drafting.

**Issue 1-3-1: How to introduce the enhanced channel raster in TS 38.101-1**

* Proposals: Introduce changes to the raster table in TS 38.101-1 to indicate unambiguously which channel raster (100kHz and/or 10kHz) is applicable to a band, and whether it is mandatory or optional:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR operating band | NREF Step size S (kHz) | ΔFRaster  (S x 5kHz) | Uplink  Range of NREF  (First – <Step size> – Last) | Downlink  Range of NREF  (First – <Step size> – Last) |
| n1 | 20 | 100 | 384000 – <S> – 396000 | 422000 – <S> – 434000 |
| n5 | 20, 2 | 100, 10 | 164800 – <S> – 169800 | 173800 – <S> – 178800 |
| n12 | 20, 2 | 100, 10 | 139800 – <S> – 143200 | 145800 – <S> – 149200 |
| n26 | 20, 2 | 100, 10 | 162800 – <S> – 169800 | 171800 – <S> – 178800 |
| n28 | 20, 2 | 100, 10 | 140600 – <S> – 149600 | 151600 – <S> – 160600 |
| n85 | 20, 2 | 100, 10 | 139600 – <S> – 143200 | 145600 – <S> – 149200 |
| nX | 2 | 10 | XXXX – <S> – YYYY | XXXX – <S> – YYYY |

* + Yes (Apple)
  + No
* Recommended WF
  + The proposal should be agreeable. Nokia and MediaTek CR/draft CR used the same approach. This could be further discussed while drafting the CRs.

T-Mobile USA: include n25 and n66.

Apple: we does not mean cover all the bands. It is just example.

Mediatek: Changes should be minimized and clear. For table, the step size and data raster changes are redundant.

**Issue 1-3-2: How to introduce the enhanced channel raster in TS 38.104**

* Proposals: Introduce changes to the raster table in TS 38.104 to indicate unambiguously which channel raster (100kHz and/or 10kHz) is applicable to a band.
  + Yes (Apple)
  + No
* Recommended WF
  + To be aligned with issue 1-3-1.

**Issue 1-3-3: Enhanced channel raster range definition**

* Proposals: for both the BS and UE, the enhanced raster is not defined outside the outer 100 kHz raster entries at the upper and lower edge of an operating band for which a RF channel can be located within a band with preserved internal GB for all numerologies**:** 
  + Agree (Ericsson)
  + Disagree
* Recommended WF
  + Agree

Qualcomm: good to have.

Nokia: it is not only 100KHz outer. There are a lot of raster which are useless. Do we just remove 100KHz?

Apple: we needs to change the starting point and ending point in the table if agreeing with Ericsson proposal.

Mediatek: The same principle can be applicable to legacy points. It leads to a lot of impact.

Qualcomm: We can look into the proposal to capture it.

Ericsson: Agree with Qualcomm.

**Issue 1-3-4: Impacts on other sub-clauses: channel spacing.**

* Proposals: The channel spacing specifications shall not be updated:
  + Agree (Qualcomm, Ericsson)
  + No
* Recommended WF
  + Agree, the channel spacing specifications shall not be updated.

Mediatek: channel spacing means adjacent and channel spacing or both. We are OK to keep the existing nominal channel spacing.

**Issue 1-3-5: Impacts on other sub-clauses: channel spacing.**

* Proposals: The definition of the mapping of an RF channel to the channel raster in sub-clause 5.4.2.2 shall not be changed:
  + Agree ( Ericsson)
  + No
* Recommended WF
  + Agree, the definition of the mapping of an RF channel to the channel raster in sub-clause 5.4.2.2 shall not be changed:

ZTE: We want to clarify the mapping? The wording in the current spec is not clear.

Agreement:

* The definition of the mapping of an RF channel to the channel raster in sub-clause 5.4.2.2 shall not be changed

**Issue 1-3-6: Impacts on other sub-clauses (2)**

* Proposals: The nominal CA spacing is to be amended for UE specific channel bandwidths configured within a wider carrier such that the definition of a contiguous configuration remains clear.
  + Agree ( Ericsson)
  + No
* Recommended WF
  + To be further discussed.

Huawei: We need more discussion. The nominal CA spacing should be kept unchanged. Otherwise it will change contiguous and non-contiguous CA.

Nokia: It is possible to configure two UE specific channel bandwidths?

ZTE: The nominal channel spacing may need be revised.

Qualcomm: we do not need to change nominal CA spacing since the feature won’t be used for intra-band CA.

**Issue 1-3-7: Additional clarifications**

* Proposals: The following clarifications shall be added:
  + TS 38.104: The network should not configure the 10kHz raster if it is not supported by the band or by the UE (Apple)
  + Introduce some text in the sync raster specifications to clarify that they sync raster does not cover all the channels placed on the enhanced channel raster (Qualcomm)
  + the definition of the enhanced channel raster in 38.101-1 and 38.101-5 shall also include that a UE indicating the capability supports these requirements for UE specific channel bandwidth and location configurations by ServingCellConfig for the DL and UL with an offsetToCarrier of full PRB granularity for all numerologies supported by the UE (Ericsson)
  + TS 38.104: for NR operating bands with 100 kHz channel raster, RF channel positions can be shifted, if required, to align with an RF reference frequency on the enhanced channel raster. The BS shall meet the requirements on the enhanced raster if supported (Ericsson)
* Recommended WF
  + Those clarifications could be added while commenting the proposed CRs/draft CR.

T-Mobile USA: the first is contradict to the previous agreement.

Apple: We look at it from UE perspective only.

Mediatek: The first bullet is not clear.

### Sub-topic 1-4

*Sub-topic description:* This sub-topic addresses NTN related open issues.

**Issue 1-4-1: Enhanced channel raster for bands n255 and n256**

* Proposals: The 10 kHz raster shall be a mandatory feature for the Rel-17 NTN bands n255 and n256
  + Agree (Apple, Ligado Networks, Inmarsat, Viasat, Globalstar, Thales, Hughes/Echostar)
  + Disagree
* Recommended WF
  + Agree

T-Mobile USA: is it for network or UE or both.

Apple: That is at least for UE.

Qualcomm: this is for Rel-17. We have concern on doing it for old release. What is the use case?

Apple: we have provided the LS.

CHTTL: similar question as Qualcomm. CH raster enhancement is for the case when BS and UE channel bandwidths are not aligned. For NTN, do we really need it?

Apple: There would be benefit from this feature.

Medaitek: if we say it is mandatory, is it applied to Rel-17 or Rel-18 UEs?

**Issue 1-4-2: Enhanced channel raster for bands n254**

* Proposals: The 10 kHz raster shall be a mandatory feature for the Rel-18 NTN bands n254
  + Agree (Apple, Ligado Networks, Inmarsat, Viasat, Globalstar, Thales, Hughes/Echostar)
  + Disagree
* Recommended WF
  + Agree

### CRs and draft CRs to specifications

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318413 | Apple | Introduction of the enhanced channel raster to TS 38.101-5 |
| [**R4-2319165**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319165.zip) | Nokia, Nokia Shanghai Bell | CR to TS 38.101-1: Introduction of an enhanced channel raster |
| [**R4-2319196**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319196.zip) | ZTE | CR to TS38.104: Introduction of an enhanced channel raster |
| [**R4-2319677**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319677.zip) | Huawei, HiSilicon | CR to TS 38.108: Introduction of an enhanced channel raster |
| [**R4-2318711**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318711.zip) | MediaTek Inc. | DraftCR to TS 38.101-1 on system parameters for supporting enhanced channel raster |