3GPP TSG-RAN WG2 Meeting #120 Electronic R2-220xxxx

Toulouse, France, 14 – 18 November 2022

**Agenda item: 6.21.1**

**Source: Qualcomm (Rapporteur)**

**Title: [Post120][052][NR17] higher granularity per-FR gap capability**

**WID/SID: TEI17**

**Document for: Discussion and Decision**

# 1 Introduction

This document is kick off the post meeting discussion [052]:

Per-FR Gap

[R2-2212388](file:///C:\Users\johan\OneDrive\Dokument\3GPP\tsg_ran\WG2_RL2\RAN2\Docs\R2-2212388.zip) Capability for per-FR gaps Ericsson discussion

[R2-2211620](file:///C:\Users\johan\OneDrive\Dokument\3GPP\tsg_ran\WG2_RL2\RAN2\Docs\R2-2211620.zip) Discussion on per-FR gap Intel Corporation discussion Rel-17 TEI17

[R2-2211363](file:///C:\Users\johan\OneDrive\Dokument\3GPP\tsg_ran\WG2_RL2\RAN2\Docs\R2-2211363.zip) More granular per-FR gaps Nokia, Nokia Shanghai Bell discussion Rel-17 TEI17

[R2-2212526](file:///C:\Users\johan\OneDrive\Dokument\3GPP\tsg_ran\WG2_RL2\RAN2\Docs\R2-2212526.zip) Higher granularity for per-FR gap capability discussion Qualcomm Incorporated discussion Rel-17 TEI17

* [Post120][052][NR17] higher granularity per-FR gap capability (Qualcomm)

Scope: Based on R2-2212527, R2-2212528, Review and update if needed, for agreement. Include also determination whether inter-node signalling is needed, and if so update CRs to include inter-node signaling.

Intended outcome: Tech Endorsed 38.331 38.306 CRs (for TSG RAN)

Deadline: Short

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
| Company | Name | Email Address |
| Qualcomm (Rapporteur) | Mouaffac | [mambriss@qti.qualcomm.com](mailto:mambriss@qti.qualcomm.com) |
| MediaTek | Felix Tsai | Chun-fan.tsai@mediatek.com |
| Ericsson | Mattias Bergström | mattias.a.bergstrom@ericsson.com |
| Huawei, HiSilicon | Yiru Kuang | kuangyiru@huawei.com |
| Nokia, Nokia Shanghai Bell | Tero Henttonen | tero.henttonen@nokia.com |
| Apple | Yuqin Chen | yuqin\_chen@apple.com |
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# 3 Discussion

The intention behind this discussion is to:

1. Check the draft CRs and provide feedback:
   * Modify the cover page of the CR to include (NG)EN-DC architecture.
   * Modify the capability CR to ensure *independentGapConfig* (legacy capability) and *independentGapConfig-maxCC-r17* (new capability) are mutually exclusive.
2. Check if there is a need to enhance the inter-node messaging to ensure proper coordination between MN and SN when this feature is supported.

One item still not agreed on, is the starting/ending range value for the N1/N2/N3. Some companies prefer it to start from [0..31], other from [1..32].

**Question 1**: please provide your preference for the N1/N2/N3 range:

Option-1: range is [0..31]

Option-2: range is [1..32]

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| Answers to Question 1 | | |
| Company | Selected Option | Please provide the technical Arguments behind your preference |
| Qualcomm Inc | 1 | This will allow the UE to provide value “0” to indicate that independentGapConfig is not supported when configured cells are:   * all FR1 cells (N1 = 0) * or FR2 cells (N2 = 0) * or mix of FR1 and FR2 cells (N3 = 0)   Subsequently when UE provides a N1/N2/N3 values > 0, then *independentGapConfig* will be supported when configured cells are:   * all FR1 cells and number of serving cells <= N1 🡪 in this case, per 38.133 UE is expected to support gapless measurement on FR2 * all FR2 cells and number of serving cells <= N2 🡪 in this case, per 38.133 UE is expected to support gapless measurement on FR1 * FR1+FR2 serving cells <= N3 🡪 2 independent gap configurations is supported on FR1 and FR2 cells.   [QCOM] indeed the greater sign was a typo, sorry for the confusion. |
| MediaTek | Option 1, but please see comments | There is no need indicates (N1 = 0, N2 = 0, N3 = 0) which implies no support of per-FR gap at all.  We need to clarify the meaning of N1, N2, and N3.  Our understanding is   * If the NW configures only FR1 serving cells and the configured FR1 serving cells **<=** N1, the UE supports FR2 gapless measurement. * If the NW configures only FR2 serving cells and the configured FR2 serving cells **<=** N2, the UE supports FR1 gapless measurement. * If the NW configures both FR1 and FR2 serving cells, the configured FR1 serving cells **<=** N1, the configured FR2 serving cells **<=** N2, and the configured FR1 + FR2 serving cells **<=** N3, the UE supports two independent measurement gap configurations for FR1 and FR2. (Note: We are open to discuss whether the highlighted condition is needed)   [QCOM] I can see your concern, but the assumption here that UE when providing its capability, the values advertised are always:   * N1 >= N3, & N2>=N3 * therefore if FR1+FR2 <=N3 then definitely FR1 < N1 & FR2 < N2.   If needed we can clarify this assumption or we can added as a restriction in the spec (may be in the 331 spec in the field description) |
| Ericsson | 1 | This should make field description easier since behaviour should be clearer from ASN1. |
| Huawei, HiSilicon | 1 with comments | It would be good to use value “0” to indicate that per-FR-gap is not supported, and if we go for option1, it is suggested to capture what the value “0” means in TS 38.306 to make it clear. However, for FR1+FR2 case, the value “1” causes confusion since there are at least 2 serving cells, then it is unclear what value “1” means, does it also mean that per-FR-gap is not supported or UE cannot signal “1” for FR1+FR2 case?  [QCOM] agree, value “1” for N3 is meaningless … can be clarified in the description of the field. |
| Nokia, Nokia Shanghai Bell | 1 with comments | Adding optionality bits will increase the size of the signalling, so slight preference to keep the codepoint zero. However: It should be made clear that UE indicating this capability **shall** also indicate at least one non-zero value – i.e.at least one of the N1, N2 or N3 > 0.  [QCOM] I can see your point, but even if UE broadcasted the support of this capability, with all N’s = 0, although it’s not expected, but it should not cause any confusion at the network, as network either way needs to inspect eah N independently … so I would rather not adding this restriction as we already have many restrictions per the above feedbacks.  then we should NOT call these with generic names such as N1, N2 and N3: That’s just bad coding practice. Something like fr1-Only, fr2-Only and fr1And2 could be used – that’s much clearer at a glance.  [QCOM] agree, we can change the names as suggested above. |
| Apple | 1 | We agree with the analysis from companies above on the meaning of 0.  In addition, regarding MediaTek’s question, our understanding is if UE indicates all N1/N2/N3, then all conditions should be met for UE to support per FR gap. But we should allow UE only indicate one or two values among N1/N2/N3. Thus, we propose to make them optional. The absence of one field means there is no limitation on this specific CC number configuration. |
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**Summary 1**: there is a consensus on having the values of the new fields to range from [0..31], however there no consensus yet on the interpretation of these values. This item is furtherly discussed in section “4”.

**Proposal 1**: TBD.

**Question 2**: is there a need to enhance the current inter-node messaging to ensure proper coordination exists between the MN and SN when this feature is supported?

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| Answers to Question 2 | | |
| Company | Yes/No | Please provide the technical Arguments that supports your claim |
| Qualcomm |  | It seems a minor introduce of 2 indications in both directions (MN🡨🡪SN) may be needed. |
| MediaTek | No strong view |  |
| Ericsson |  | We think the field for scellFrequenciesSN-NR could be used in that case. Even if it does not include SCells without SSB, the network would not measure on those, so we understand that the UE capability would anyway not be limited by configured cells without SSB (this could also be clarified in 38.306 field description).  [QCOM] UE will be impacted by the number of serving cell, irrespective if these serving cells have an SSB or not, therefore inter-node messaging needs to be enhanced. |
| Huawei, HiSilicon |  | We prefer to use the legacy signalling, as given by Ericsson. |
| Nokia, Nokia Shanghai Bell | Yes | The less coordination we allow the more problems we create: For example, currently MN may not be aware of all configured SN serving cells. We don’t see a blocking point to allow this communication. |
| Apple | Tend to Yes | We are not quite certain about Ericsson’s comments on “the UE capability would anyway not be limited by configured cells without SSB”. From our understanding, the reason why UE cannot make use of per FR gap is because the processing on serving cells occupies the hardware which is supposed to perform measurement on another FR. Regardless the presence or absence of SSB on serving cells in SN, UE would spare certain processing capacity. Thus, it seems the scellFrequenciesSN-NR may be not sufficient.  Without new info, MN is not able to know the exact number of serving cells configured by SN, in consequence the eventual configuration may exceed UE capability. |
| Qualcomm | Yes | After further discussion, we see the need for this inter-node coordination. |
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**Summary 2**: this discussion is about introducing minor enhancement for the inter-node messages to ensure proper communication exist between SN and MN when this feature is supported. The results were as follow:

* 3 supports the enhancement the inter-node messaging, where one company (Qualcomm) deems this enhancement is necessary, as current inter-node messages will only provide the number of frequencies with SSB. SSB-less frequencies are not considered.
* 1 no strong view
* 2 companies don’t see the need to do so, as current signaling is good enough

**Proposal 2**: to agree on the inter-node messaging enhancement to ensure proper support for the per-FR capability.

**Question 3**:do companies agree with the suggested inter-node messaging by ZTE (please check draft CR)

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| Answers to Question 2 | | |
| Company | Yes/No | Please provide the technical Arguments that supports your claim |
| Ericsson | No | See comments to the previous questions, we do not think new signaling is needed. But if we ever introduce new signaling, the NW should be able to differentiate between FR1 and FR2 cells, so two fields should be needed, i.e. one for FR1 cells and on for FR2 cells.  [QCOM] make sense to differentiate, |
| Huawei, HiSilicon | No | See comments to the previous questions, we prefer the legacy signalling. |
| Nokia, Nokia Shanghai Bell | Partly | No strong view where to introduce this, but as Ericsson points out we need separate counts for FR1 and FR2 cells. Otherwise the coordination doesn’t work. So something like the following (to use the MCG->SCG example) is needed:  CG-Config-v17xx-IEs ::= SEQUENCE {  scg-FR1-Carriers-r17 INTEGER (0..31) OPTIONAL,  scg-FR2-Carriers-r17 INTEGER (0..31) OPTIONAL,  nonCriticalExtension SEQUENCE {} OPTIONAL  } |
| Apple | Tend to Yes | We are fine to have one for FR1 and one for FR2. |
| Qualcomm | Yes |  |
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**Summary 3**: this question is related to the previous one. The objection is not about the change itself rather on the concept of enhancing the signaling. In addition, based on the received feedback, further enhancement to the signaling is required. These suggestions have been reflected in the latest CR.

**Proposal 3**: to agree on the latest signaling enhancement for the inter-node messaging to support the per-FR gap.

# 4 Pending Items

Please provide your feedback for the pending items in the tables below.

1. Item raised by Apple to make these fields optional, so when absent it would indicate support of per FR gap irrespective of the number of configured CC (for all CCs). This approach will allow us to use the entire 32 values to indicate the number of configured CCs.

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| Pending Item #1 | | |
| Company | Yes/No | Please provide the technical Arguments that supports your claim |
| Qualcomm Inc | Yes but modified | It seems that we missed the fact If value “0” is used to indicate no support for the per FR gap, then we will be short by 1 value to cover all the 32 CCs.  Therefore taking advantage of the absence of the field to indicate that **per FR gap is not supported** (different from Apple proposal), in addition:   * Value “0” would indicate per-FR gap is supported when PCell is configured with “0” additional CC * Value “1” would indicate per-FR gap is supported when PCell is configured with “1” additional CC, and so on … |
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**Summary 4**: TBD.

**Proposal 4**: TBD.

1. Items raised by HW
2. Modifying the coversheet, to clarify the significance of the fields’ values clarification
3. Second change is related to the description of the inter-node message field.

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| Pending Item #2 | | |
| Company | Yes/No | Please provide the technical Arguments that supports your claim |
| Qualcomm Inc | * 2-a maybe * 2-b yes | * For 2-a, once we converge on item-1, we can have it clarified in the spec instead in the coverage sheet * For 2-b, we are fine with it. |
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**Summary 5**: TBD.

**Proposal 5**: TBD.

1. Item raised by Nokia, to **conditionally** allow UE to advertise both capabilities, if both are supported, and UE sets the fields’ values to max for the new capability.

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| Pending Item #3 | | |
| Company | Yes/No | Please provide the technical Arguments that supports your claim |
| Qualcomm Inc | Prefer not | It will add complexity when advertising the capability by the UE, for small benefit at the NW.  this might open the door to some erroneous cases and confusion at the network when UE doesn’t abide to the spec condition, i.e., UE advertises both capabilities with values for new capability are set to **less** than max |
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**Summary 6**: TBD.

**Proposal 6**: TBD.

# 5 Conclusion

TBD.