**3GPP TSG-RAN WG2 Meeting #126 R2-24XXXXX**

**Fukuoka, Japan, 20th May– 24th May, 2024**

**Agenda Item: 7.3.1**

**Source: vivo**

**Title: Collect comments for correction on UE capabilities for NES**

**Document for: Discussion and Decision**

# Introduction

This document is for the following post-meeting email discussion:

* [POST126][010][NES] UE capabilities (Vivo)

 Intended outcom: endorse CRs

 Deadline: Friday, May 31st

The following part is the agreements and compromised solution achieved during RAN2#126:

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| (Agreements for UE capabilities supporting only single inter-band SSB-less SCell group)

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| Agreements1. Instead of reporting ‘supported’ for a band within the BC to indicate this band can be configured as the reference band for all other bands within the BC, the UE optionally reports ‘referenceBand’ or ‘scellWithoutSSB’ for a band to indicate the support of inter-band SSB-less SCell operation.2. The band indicated as ‘referenceBand’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB’.3. If the field scellWithoutSSB-InterBandCA-r18 is absent for a band, this band is not involved in the inter-band SSB-less SCell operation.4. If inter-band SSB-less SCell operation is supported between two bands, it is understood that there is no direction between the two bands, which means that the network can configure either band as the reference band and the other band as the SSB-less band. |

(Compromised solution for UE capabilities supporting multiple inter-band SSB-less SCell groups)

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| After CB **Compromise solution. CR to be agreed by email** If scheme1 (to be named) is indicated, the band indicated as ‘scheme1’ can be configured as either the reference band or SSB-less band.If scheme2 (to be named) is indicated, the band indicated as ‘referenceBand1’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB1’, and the band indicated as ‘referenceBand2’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB2’.If the field scellWithoutSSB-InterBandCA-r18 is absent for a band, this band is not involved in the inter-band SSB-less SCell operation.In a band combination, only scheme1 or scheme2 is indicated. |

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## Overall compromised solution

Since the agreements and compromised solution might still be somewhat confusing, rapporteur would like to summarize the up-to-date progress of the discussion to help companies understand the motivation of the compromised solution as drafted in the CRs, as questions had been asked offline to confirm the understanding of it.

As presented in [1], it is due to the UE capability guideline on not to use a signaled band combination to derive supported features for higher order band combinations that the NW cannot configure CA of a higher-order BC while only configuring inter-band SSB-less operation of a lower-order BC when the UE only reports ‘supported’ for this lower-order BC, RAN2 first agreed on the following proposals for UE capabilities to report for support of single inter-band SSB-less group.

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| **Agreements**1. Instead of reporting ‘supported’ for a band within the BC to indicate this band can be configured as the reference band for all other bands within the BC, the UE optionally reports ‘referenceBand’ or ‘scellWithoutSSB’ for a band to indicate the support of inter-band SSB-less SCell operation.2. The band indicated as ‘referenceBand’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB’.3. If the field scellWithoutSSB-InterBandCA-r18 is absent for a band, this band is not involved in the inter-band SSB-less SCell operation.4. If inter-band SSB-less SCell operation is supported between two bands, it is understood that there is no direction between the two bands, which means that the network can configure either band as the reference band and the other band as the SSB-less band. |

Then RAN2 discussed about the need to support the flexibility of UE capabilities reporting for multiple inter-band SSB-less groups. After several days of offline discussion with the companies, the signalling with CHOICE structure for two schemes was raised on CB session as a compromise between the two camps, where one camp does not want the signalling to mandate the support of multiple groups, and the other camp would like to keep the flexibility to support multiple groups.

From rapporteur’s understanding, scheme1 is only for support of single inter-band SSB-less group, while scheme2 enables the flexibility to support either single group or multiple groups.

**Q1-1: Do you agree with rapporteur’s understanding that scheme1 is only for support of single inter-band SSB-less group, while scheme2 enables the flexibility to support either single group or multiple groups (as drafted in v00 by rapporteur)?**

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| --- | --- | --- |
| Company | Agree/Disagree | Further comments |
| Huawei, HiSilicon | Agree |  |
| MediaTek | Agree with comment | But we shall have “both1, both2” to cover the same flexibility of scheme1.[Rapp] I response this in Q2-2, please refer to that part. Thanks. |
| Ericsson | Agree |  |
| Qualcomm | Agree w. comment | The original **agreed compromised solution** is as the follow.*scellWithoutSSB-InterBandCA-r18   ENUMERATED {referenceBand, scellWithoutSSB, both}*, where* with “*both*” indicated, any band of a band combination can be a reference band or an SSB-less band (the other band(s) of the band combination cannot be indicated with ‘*referenceBand*’ or ‘*scellWithoutSSB*’) and it is up to the network to determine and configure a band of such band combination as a reference band and the other band(s) of the band combination as SSB-less band(s);
* without “*both*” indicated, a band of a band combination can be a ‘*referenceBand*’ with the other band(s) of the band combination as ‘*scellWithoutSSB*’ with higher band entry number than the reference band and lower band entry number than the entry number of the next band indicated as ‘*referenceBand*’, if any.

With the above compromised solution split into “Scheme1” (i.e., with “both”) and “Scheme 2” (i.e., without “both”) in the short email discussion. Scheme 1 still indicates UE’s capability with any of a band combination as reference band (i.e., multi-band references) but it’s up to network’s decision which band of the band combination is used as the reference band. In our view, “Scheme 1” provides flexibility to the network and avoids product cost associated with some of undesired combination of band combinations. Alternatively, “Scheme 2” allows UE to explicitly indicate which band(s) as the reference band(s) and which band(s) as the SSB-less band(s) following the order of the band entry number. From this perspective, UE can indicate explicitly a combination of band combinations. |
| Apple | Agree with comments | Our understanding is that “Scheme 2” is designed target for multiple groups. So, we are a bit confused why Rapporteur mentioned it supports single group (“**scheme2 enables the flexibility to support either single group or multiple groups”).** Maybe, the approach is that UE only indicates “referenceBand1” or “scellWithoutSSB1” in Scheme 2 (i.e. referenceBand2/ scellWithoutSSB1 is absent)? Actually, if it is single group, “Scheme 1” is more flexible and has lower signaling overhead (3 values vs 4 values) as Qualcomm mentioned. Then, in case of single group, we don’t think UE will use “scheme 2”. Furthermore, although we understand “Scheme 1” and “Scheme 2” are outcome of compromise, we still prefer to make them have non-overlapping use case (i.e. single vs multiple group) if possible, instead of two signaling options which looks ugly. It also will make both UE and NW behavior clearer.Based on above reason, we prefer to make clear “Scheme 1” is for single group and “Scheme 2” is for multiple groups. |

If Q1-1 is agreed, from rapporteur’s point of view, this understanding does not need to be explicitly captured in the field description, as it can be implicitly revealed according to the field description itself.

**Q1-2: If Q1-1 is agreeable, do you agree that there is no need for explicitly capturing the understanding of Q1-1 to the field description, i.e. the understanding can be implicitly revealed according to the field description itself (as drafted in v00 by rapporteur)?**

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| --- | --- | --- |
| Company | Agree/Disagree | Further comments |
| Huawei, HiSilicon | Agree | The proposed 331/306 CRs by the rapporteur are sufficiently clear. |
| MediaTek | See comment | See our comment in Q1-1, we think the following requirement is also applicable to scheme2:If the UE indicates “both” for any band, the UE shall not indicate ‘referenceBand’ or ‘scellWithoutSSB’ in any other band in the band combination.[Rapp] I response this in Q2-2, please refer to that part. Thanks. |
| Ericsson | Agree, but | It would be good to change the names of scheme1 and scheme2 for mor meaningful names e.g. singleGroup and multipleGroups.[Rapp] Thanks, companies do not want scheme2 to be explained in the way that it only supports multiple groups. I’ll try another name, e.g. supportOfOnlySingleGroup (for scheme1) and supportOfSingleAndMultiGroup (for scheme2) |
| Qualcomm | Agree w. comment | The 331 CR proposed by the rapporteur is good. The 306 CR proposed by the rapporteur is OK. But would like to suggest a minor rewording as shown in red color below.“For *scheme1*, the band indicated as ‘referenceBand’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB’. The band indicated as ‘both’ can be configured as either a~~the~~ reference band or an SSB-less band. If the UE indicates “both” for any band, the UE shall not indicate ‘referenceBand’ or ‘scellWithoutSSB’ in any other band in the band combination.”[Rapp] Thanks, it is reasonable and adopted in draft\_v01. |
| Apple | Agree with comments | We agree with Ericsson’s suggestion. And on top of that, we think it is better to capture that scheme1 is for single group and scheme 2 is for multiple groups. |

As for the enumerated values of ‘scheme1’ and ‘scheme2’, rapporteur proposes as follows according to the agreements for single inter-band SSB-less group, compromise solution for support of multiple inter-band SSB-less groups at CB session, and companies understanding on how the enumerated values are used:

* For ‘scheme1’, the Enumerated values include {**referenceBand, scellWithoutSSB, both**}. The values **‘referenceBand’** and **‘scellWithoutSSB’** are used for case1. **‘both’** is used for case2 as an optimization of reporting with ‘referenceBand’ and ‘scellWithoutSSB’. Otherwise, the UE needs to report 3 entries with **‘referenceBand’** and **‘scellWithoutSSB’** as explained in [2] for case2, which may cause severe signalling overhead considering there are some other features that also require the UE to report multiple UE capabilities entries, e.g. MIMO-related UE capabilities:
* case 1: **A** can be the reference band of **B** and **C**, but **B** cannot be the reference band of **C** and vice versa. **D** is not involved in the inter-band SSB-less SCell operation;
* case 2: for **A+B+C**, either band can be the reference band of the other two bands, i.e. the operation within {**A, B, C**} is fully interchangable. **D** is not involved in the inter-band SSB-less SCell operation;
* For ‘scheme2’, the Enumerated values include {**referenceBand1, scellWithoutSSB1, referenceBand2, scellWithoutSSB2**}, where **‘referenceBand1’**, **‘scellWithoutSSB1’** are used for the first inter-band SSB-less group, and **‘referenceBand2’**, **‘scellWithoutSSB2’** are used for the second inter-band SSB-less group.

Detailed usage of the values can be referred to the field description as drafted in v00.

**Q2-1: Do you agree with the enumerated values for ‘scheme1’ and ‘scheme2’ as proposed above?**

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| Company | Agree/Disagree | Further comments |
| Huawei, HiSilicon | Agree | For scheme1, we think it’s simpler to only keep ENUMERATED {support} (for overhead reduction). We are also ok with the current signaling.[Rapp] With only ‘support’, the UE is unable to report case 1 in *scheme1*. That is the reason why we first reached the agreements for UE capabilities supporting only single inter-band SSB-less SCell group. |
| MediaTek | Agree with comment | Thanks the rapporteur for the nice explanation! So please see our comments in Q1-1 and Q1-2. We see a significant benefit to have an equivalent flexibility for scheme2 to adopt additional enumerated values “both1” and “both2”.[Rapp] I response this in Q2-2, please refer to that part. Thanks. |
| Ericsson | Agree |  |
| Qualcomm | Agree | Agree with Rapp’s view. |
| Apple | Agree | Same view as Rapporteur |

The following comment was raised by a company, the rapporteur would like to share the understanding on it.

**Comment: Does the Enumerated values for ‘scheme2’ need to include {both1, both2} for the same consideration of ‘scheme1’?**

From rapporteur’s observation, after checking with the RAN4 colleague, there is no need for ‘scheme2’ to include ‘both1’ and ‘both2’. Currently, RAN4 only specifies the support of 4-band CA. For the support of inter-band SSB-less operation, grouping among the 4 bands has only two possibilities:

* Possibility 1: {A, B, C} belongs to a group, and {D} belongs to another group.
* Possibility 2: {A, B} belongs to a group, and {C, D} belongs to another group.

For Possibility 1, the UE can use either ‘scheme1’ or ‘scheme2’ to report, as D is not involved in the inter-band SSB-less operation.

For Possibility 2, the UE use all the values from ‘scheme2’ for the 4 bands to indicate the operation for two groups, i.e. {referenceBand1, scellWithoutSSB1, referenceBand2, scellWithoutSSB2} for band A, B, C, D respectively. Since it has been agreed ‘If inter-band SSB-less SCell operation is supported between two bands, it is understood that there is no direction between the two bands, which means that the network can configure either band as the reference band and the other band as the SSB-less band.’, the NW can configure either band A or band B as the reference band within group {A, B}, and either band C or band D as the reference band within group {C, D}. The UE does not need ‘both1’ or ‘both2’ for {A, B}, {C, D}.

For future potential support of more than 4 band CA, the value can be extended if real need is identified in future releases. Rapporteur proposes not to include the values ‘both1’ or ‘both2’ for ‘scheme2’ for Rel-18 NES.

**Q2-2: Do you agree with rapporteur’s observation and proposal on not to include the values ‘both1’ and ‘both2’ for ‘scheme2’?**

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| Company | Agree/Disagree | Further comments |
| Huawei, HiSilicon | Agree | Agree with the rapporteur that there is no need for ‘scheme2’ to include ‘both1’ and ‘both2’ |
| MediaTek | Disagree | Our RAN4 colleagues indicate that there are configurations for inter-band CA (**five** bands), see the Table 5.5A.3.4-1 in TS 38.101-1 v17.8.0. For these 5 bands CA cases, it is beneficial to have ‘both1’ and ‘both2’ in scheme2 (see our previous comments).[Rapp] Thanks for the comment. Although RAN4 has defined band combination for support of up to 6 bands inter-band CA, they did not discuss any issue for support of inter-band SSB-less operation for multiple groups. Theoratically, up to 5-6 band CA or more than 2 groups for inter-band SSB-less operation may be configured, but from the opinion of the majority companies I heard during the meeting, the current signalling should be enough for the potential needed flexibility. Therefore, Rapporteur suggests to follow the majority not to include ‘both1’ and ‘both2’ for scheme2 in this release. The value can also be extended in future releases, if the real need is identified.Rapporteur has communicated with MediaTek, and MediaTek is fine with not to include ‘both1’ and ‘both2’ for scheme2. |
| Ericsson | Agree | Further flexibility can always be added with the cost of complexity, but we understand that the current version of the signaling is already a compromise between flexibility and complexity. |
| Qualcomm | Agree |  |
| Apple | Agree | As the current signaling is already a compromise between two camps on single vs multiple groups, we tend to think multiple groups with more than 4 bands is a kind of optimization.  |

## Other issues if any

If any other critical issue is identified for the current draftCR, Please provide your comments in the below table. **Rapporteur suggests to comment only on functional critical issues**, if any, as this is the last meeting for ASN.1 freeze.

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| Company | Further comments |
| MediaTek | We would like to further calibrate the understanding on the TP of ‘***scellWithoutSSB-InterBandCA-r18***’. We understand that current TP is clear to capture the applicability, but the intention is not to prohibit the necessary forms of capability reporting that consists of CA band combo part which is out of scope. For example, the network would never think the R18 NES inter-band SSB-less feature is applicable to the intra-band NCCA part even if the UE reports the capabilities as follows:

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| --- | --- | --- | --- |
| BC\_n1(2A)-n3 | n1A | n1A | n3A |
| FSperBand | scheme1.both | scheme1.both | scheme1.both |

The UE just indicates that n3 and n1 in different inter-band CA pairs both support inter-band SSB-less operation and fully interchangeable respectively.[Ericsson]Good point! We think this may not be so obvious but we agree with your interpretation that ultimately those capabilities are for inter-band and thus the NW should not consider intra-band pairs for the configuration.[Rapp] The first sentence of the FD ‘***scellWithoutSSB-InterBandCA-r18***’ has pointed out the feature is for inter-band CA, and hence further clarification is not needed. |
| Apple | We agree with MediaTek’s interpretation. |
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## Running CR review

The running CRs on UE capabilities are provided in the discussion folder. Please do not insert / make comments in the CR documents. If you have comments, please provide them in the table below. Rapporteur will provide response and decide whether to update the CRs.

**Please provide your comments before Thursday May 30th 22:00 UTC to allow the rapporteur to update the CR. Per the Chairladay’s guidance, the steady version of the CRs will be approved by email.**

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| **Company** | **Detailed comments** | **Rapporteur response** |
| MediaTek | The TP is in wrong section of 306 CR. It should have been in section 4.2.7.5. | Thanks. It is corrected in draft v01. |
| Ericsson | If our suggestion on Q1-2 is adopted (change the names of scheme1 and scheme2 for mor meaningful names e.g. singleGroup and multipleGroups) then both 38.331 and 38.306 have to be updated accordingly. | Thanks. I’ll change the name of scheme1 to supportOfOnlySingleGroup and scheme2 to supportOfSingleAndMultiGroup |
| Qualcomm | Minor rewording suggestion:“For *scheme1*, the band indicated as ‘referenceBand’ can be configured as the reference band for all other band(s) indicated as ‘scellWithoutSSB’. The band indicated as ‘both’ can be configured as either a~~the~~ reference band or an SSB-less band. If the UE indicates “both” for any band, the UE shall not indicate ‘referenceBand’ or ‘scellWithoutSSB’ in any other band in the band combination.” | Thanks. It is corrected in draft v01. |
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# References

1. R2-2405659 Discussion on UE capabilities for inter-band SSB-less SCell operation
2. R2-2405304 UE Capability for Inter-band SSB-less CA