3GPP TSG-RAN WG2 Meeting #113bis-e R2-21xxxxx

Online, April 12 – April 20, 2021

**Agenda item: 4.5**

**Source: Nokia**

**Title: Summary and discussion on [Post113-e][206][LTE] Clarification to Fallback band combination definition (Nokia)**

**WID/SID: TEI16 - Release 16**

**Document for: Discussion and Decision**

# Introduction

TS36.306 defines ‘Fallback band combination’ term, that specifically refers to ‘each band’ in terms of determining bandwiths supported by the UE by the obtained fallback band combination from the parent (for the fallback) band combination.

RAN2 discuss, since RAN2#111e, how to interpet the definition and pertaining UE capabilities on bandwiths supported by the UE by the obtained fallback band combination. The interpretation appeared umbiguous as the fallback band combination granularity (‘each band’) can be understood as a ‘carrier’ or ‘band entry’.

This document collects observations and clarifications made so far. Further it aims to collect and conclude companies views on fallback combination definition, and a need to clarify its interpretation in TS36.306, based on the following schedule:

* [Post113-e][206][LTE] Clarification to Fallback band combination definition (Nokia)

Scope: Clarify what is the right interpretation of fallbacks in RAN2. Should clarify if this can impact also NR.

 Intended outcome: Discussion report + agreeable LTE CRs (if any)

 Deadline: Long

# 2 Background

The issue has been originally identified in the input document to RAN2#111e in [R2-2007518](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_111_e/Docs/R2-2007518.zip). Since there was no conclusion on the subject, the same CR has been further provided to RAN2#113e in [R2-2100606](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113_e/Docs/R2-2100606.zip).

The CR motivation explains that existing definition of ‘Fallback band combination’ in TS36.306 use reference to “each band” in a way that contradicts with TS36.101 concept on bandwidths’ grid:

* TS36.306 states: “A fallback band combination and the parent band combination support the same bandwidths for each band of the fallback band combination.”
* While the definition makes a reference to a ‘band’ of a bandwidth (which in the light of RRC signalling would refer to a ‘band entry’), in TS36.101, the BCS is based on “Channel bandwidths for carrier”

That remains unclear what ‘band’ means and may leads to various interprations e.g. bandwidth of the band may refer to the Aggregated Bandwidth of all the CCs in this band or to the bandwidth of a single carrier in that band.

# 3 Interpretation issue

As per the last discussion on the topic (RAN2#113-e report in [R2-2101951](http://3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2101951.zip)), RAN2#113-e observed the reference to ‘each band’ in the fallback band combination definition seem to have two possible interpretations:

Alternatives

1) From RAN2 viewpoint, "band" means "band entry" - Nokia, LGE

2) From RAN2 viewpoint, "band" means "one carrier" - OPPO, Ericsson

The bandwidth of a ‘band’ obtained as the fallback band combination may lead to various interpretations e.g. bandwidth of the band may refer to:

* the aggregated bandwidth of all the component carriers in this band or,
* the bandwidth of a single carrier in that band.

‘Band’ normally may refer to intra-band contiguous CCs and intra-band non-contiguous CCs. Thus, it remains open for interpretation if the fallback band combination may concern only subsets of the parent band combination or can it be also implying any band combination which bandwidth equals to the parent bandwidth.

**Example 1:** UE supports inter-band contiguous CA: CA\_1A-3C (see Table 1 in the Annex).

The parent band combination is CA\_1A-3C: Let’s assume, in particular, supported parent bandwidths: 1A(20MHz)-3C (20MHz, 10Mhz).

In that case a fallback combination (supporting one SCG release) could be CA\_1A-3A, where particular carriers used in fallback band combinations can differ:

Fallback Option 1: CA\_1A(20MHz)-3A(20Mhz)

Fallback Option 2: CA\_1A(20MHz)-3A(10Mhz).

According to the definition a fallback band combination can be a combination that supports the same bandwidths as parent for ‘each band’.

Possible interpretation of ‘bandwidth for each band’ in the **fallback** combination is:

* 20MHz for first band entry/carrier
* 20MHz or 10MHz for second band entry/carrier

Possible interpretation of ‘bandwidth for each band’ in the **parent** combination is:

* 20MHz for first band entry/carrier
* 30MHz aggregated bandwidth for second band entry, while 10MHz for first carrier, 20MHz for second carrier.

**Example 2 (Ericsson)**: CA\_1A-3C but with actual carrier bandwidths as defined in 36.101, see Annex.

By resolving the dependencies between the inter-band and intra-band table, one gets the following possible configuration options supported by a UE that advertises “CA\_1A-3C”:

* band 1:
	+ band parameter A
		- variant 1.A.a:
			* carrier 1.A.a.X: 5, 10, 15, 20 MHz
* band 3:
	+ band parameter C
		- variant 3. C.a:
			* carrier 3.C.a.X: 5, 10, 15 MHz
			* carrier 3. C.a.Y: 20 MHz
		- variant 3. C.b:
			* carrier 3. C.b.X: 20 MHz
			* carrier 3. C.b.Y: 5, 10, 15, 20 MHz

The “variant” entries reflect that for some (intra-band) entries not all combinations of carrier bandwidths are supported. Within a “variant”, the eNB may choose all combinations of carrier bandwidths. Across bands (bands parameter entries) the “variants” (and carrier bandwidth options) are independent of each other. Given this table the eNB could e.g. configure the following serving cells...

* [15 MHz @ B1] + [5 MHz @ B3 + 20 MHz @ B3]
* [20 MHz @ B1] + [10 MHz @ B3 + 20 MHz @ B3]
* [5 MHz @ B1] + [20 MHz @ B3 + 10 MHz @ B3]
* ... (and many more)

The configurations shown above make use of the signalled “parent band combination”, i.e., they configure all carriers that the UE supports according to the signalled BC CA\_1A-3C.

If the eNB decides to configure only two carriers on those two bands and if the UE omits the fallback BCs in its signalled capabilities, the eNB must still choose the carrier bandwidths within the limits set by the signalled parent BC. Hence, it may e.g. configure any of the following...

* [15 MHz @ B1] + [5 MHz @ B3 ~~+ 20 MHz @ B3~~]
* [20 MHz @ B1] + [~~10 MHz @ B3~~ + 20 MHz @ B3]
* ~~[5 MHz @ B1] +~~ [20 MHz @ B3 + 10 MHz @ B3]
* ... (and many more)

But it may still not configure something like...

* [**3** MHz @ B1] + [5 MHz @ B3 ~~+ 20 MHz @ B3~~]
* ~~[5 MHz @ B1] +~~ [**5** MHz @ B3 + **5** MHz @ B3]
* [**3** MHz @ B1] ~~+ [5 MHz @ B3 + 20 MHz @ B3]~~

... since those cannot be created by not configuring some cells that are allowed according to the parent BC. If the UE wants to support any of those configurations, it must explicitly signal the corresponding BC that supports those bandwidths (if RAN4 defined it).

While for the simple cases with a single carrier, the distinction between carrier and band entry does not make any difference, for bandwidths aggregated from more than two component carriers the interpretation of a bandwidth for each band/carrier vs. bandwidth for each band entry takes different meaning. It also depends on whether the bandwidth concern original band combination or fallback band combination.

The Example 1 makes it clearer that the given fallback band combinations do not support exactly the same or fully aggregated “bandwidths” sets as the parent band combination. The supported “bandwidths” in the fallback band combination are subset of the parent “bandwidths”.

In case “Bandwidths” are considered in terms of a:

* carrier: bandwidths supported in the Fallback Band Combinations are the same (as for parents) but only for these carriers that are used in the fallback.
* band entry: bandwidths supported in the Fallback Band Combinations are the same (as for parents) for each band entry, but also only for these components that are used in the fallback.

In result, not all parent carriers are defining a fallback subset. This leads to considerations, that besides ambiguity on ‘a band’ additional controversy arises due to the use of ‘each’ band in the definition.

Therefore, it remains to be clarified what the ‘each band’ in 36.306 definition refers to.

In order to achieve a common understanding on the definition meaning, companies are asked to provide answers to the following questions:

**Q1: Is the ‘each band’ in the TS36.306 definition referring to ‘each carrier’ or ‘each band entry’?**

|  |  |
| --- | --- |
| **Company** | **View** |
| Ericsson | “the same bandwidths for each band” refers to “the same **carrier** bandwidths for each band”. See further in Q2. |
| OPPO | Same view as EricssonOPPO (2): same view as Ericsson that1. “The carrier BWs of BCSx for a parent BC could correspond to BCSy of a fallback BC.”
2. So there is no point to use BCSx of child BC to prevent the usage of BW combo of BCSx of parent BC
 |
| MediaTek | Same view as Ericsson. We are aligned with Example 2.  |
| Huawei, HiSilicon | For the understanding of "band", similar view as Ericsson. Besides, we would like to indicate that the NW also needs to consider BCS. For example:CA\_8A-40A-41A| BCS 0 8A: {1M, 3M, 5M, 10M}, 40A: {5M, 10M, 15M, 20M}, 41A: {5M, 10M, 15M, 20M}CA\_8A-41A| BCS 0 8A: {1M, 3M, 5M, 10M}, 41A: {10M, 20M}The UE can support 5M for carrier@41A in BC CA\_8A-40A-41A, but cannot support 5M for carrier@41A in fallback BC CA\_8A-41A, since the BWs for BCS 0 are not the same. The NW should also consider the BCS to further determine the bandwidths supported by the UE for each carrier in a fallback BC.Huawei, HiSilicon (2): from the UE perspective, if UE is ok to support the same BWs as for the parent BC, we are fine with that the NW reconfiguration is not required for the fallback band combination. |
| Ericsson (2) | We provide some additional comments to discuss the input by Huawei, HiSilicon.We do not share the view that nw need to do a BCS look-up in RAN4 tables for the BWs that UE support for a fallback BC. We consider this is clear from the fallback definition under discussion.In addition to the fallback definition, we have this in 36.306:While PCell is not changed, the UE shall support release of any SCell(s) or any uplink configuration of SCell(s) without requiring reconfiguration of parameters related to UE radio access capabilities for the remaining serving cell(s) in the fallback band combination, except for release of an SCell from a contiguous CA band configuration that results in a non-contiguous CA band configuration.The quoted text above indicate that for a fallback BC, UE is expected to support also the same BWs as for the parent, no reconfiguration is required. There should be no reason why the UE supporting three carriers (8A, 40A, 41A) with all the bandwidths according to the BCS of this parent BC would not support them when 40A is missing.Furthermore, it is known (and has been discussed before) that RAN4 tables are not consistent on BCS numbering. The carrier BWs of BCSx for a parent BC could correspond to BCSy of a fallback BC.Of course, the UE can explicitly signal a lower-order BC, in case it supports more BWs (and also fewer BWs, or would like to advertise some other specific capability (combination) as compared to the parent BC). But UE is still required to support the fallback BC as derived from the parent BC. And the Nw is not required to use this explicitly signalled lower-order BC. |
| Nokia | We agree the fallback definition (first sentence) is essential to understand the overall concept for fallback band combinations use. I.e. releasing any of SCell(s) should not require reconfiguration of the parameters. Given that, we share the view that fallback combinations are chosen based on carrier bandwidths options. The carrier bandwidth options cannot be exchanged across bands.Therefore, we understand the ‘each band’ term in the 36.306 is misleading and should be clarified to make the reference clear to ‘a carrier’. Even though, not ‘each carrier’ may pop up in a fallback set. |
| CATT | We share the understanding of Ericsson regarding understanding of ‎‘each band’ in the TS36.306 definition. ‎ |
| Apple | Same view as Ericsson.On the question rasied by Huawei, we are fine with Ericsson’s understanding that NW does not need to consider the child BC’s BCS in deciding the fallback band combination.  |

**Conclusion 1:**

**Proposal 1:**

**Q2: Is it necessary to clarify the existing definition on Fallback band combination in the TS36.306?**

|  |  |
| --- | --- |
| **Company** | **View** |
| Ericsson | Most important is that companies confirm how fallback BCs are derived from the parent BC, see our added example 2.Since RAN4 36.101 does not use “carrier bandwidth”, but instead “channel bandwidth for carrier”, we should instead use this term. This would better couple/link the fallback definition in 36.306 to the RAN4 spec.If companies consider wording improvement is needed, we propose to use this:**Fallback band combination:** A band combination that would result from another band combination (parent band combination) by releasing at least one SCell or uplink configuration of SCell. A fallback band combination support the same channel bandwidths for each carrier as its parent band combination. An intra-band non-contiguous band combination is not considered to be a fallback band combination of an intra-band contiguous band combination. |
| OPPO | Same view as Ericsson, and we are also fine to keep the current pec as it is. |
| MediaTek | The wording provide by Ericsson seems more clear. We are okay to keep original text or have the wording improvement proposed by Ericsson. |
| Huawei, HiSilicon | Please see our comments for Q1. |
| Nokia | Yes, we think it’s worth clarifying. We support Ericsson’s suggestion on wording. |
| CATT | We don’t see the original text broken, so similar as MTK commented we are OK to keep it as is. But if there is strong support to change we are also fine. So maybe one possible way to change, if we have to, is to reuse old text as much as possible like the following**Fallback band combination:** A band combination that would result from another band combination (parent band combination) by releasing at least one SCell or uplink configuration of SCell. A fallback band combination and the parent band combination support the same **channel** bandwidths **for carriers** ~~for~~ **in** each band of the fallback band combination. An intra-band non-contiguous band combination is not considered to be a fallback band combination of an intra-band contiguous band combination. |
| Apple | Also support Ericsson’s wording. |

**Conclusion 2:**

**Proposal 2:**

**Q3: If the answer to Q2 is yes: from which release onwards the clarification should be introduced?**

|  |  |
| --- | --- |
| **Company** | **View** |
| Ericsson | Rel-16 should be enough. |
| OPPO | Rel-16 if RAN2 conclude some change is needed |
| MediaTek | No strong view |
| Huawei, HiSilicon | Rel-16 if RAN2 conclude some change is needed. |
| Nokia | Rel-16 |
| CATT | no strong view.  |
| Apple | Rel-16 |

**Conclusion 3:**

**Proposal 3:**

# 3 Conclusion

**Conclusion 1:**

**Proposal 1:**

**Conclusion 2:**

**Proposal 2:**

**Conclusion 3:**

**Proposal 3:**

# Annex

The issue has been raised in the input document to RAN2#113e in [R2-2100606](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113_e/Docs/R2-2100606.zip). The CR led to the suggestion to include clarification on the fallback band combination in TS36.306 as follows:

# Excerpt from 36.306 CR:

## 3.1 Definitions

**Fallback band combination:** A band combination that would result from another band combination (parent band combination) by releasing at least one SCell or uplink configuration of SCell. A fallback band combination supports the same bandwidth(s) for a band entry as the parent band combination of the fallback band combination. An intra-band non-contiguous band combination is not considered to be a fallback band combination of an intra-band contiguous band combination.

# Excerpt from 36.101:

|  |
| --- |
| E-UTRA CA configuration / Bandwidth combination set |
| E-UTRA CA Configuration | Uplink CA configurations (NOTE 4) | E-UTRA Bands | 1.4MHz | 3MHz | 5MHz | 10MHz | 15MHz | 20MHz | Maximum aggregated bandwidth[MHz] | Bandwidth combination set |
| CA\_1A-3A | CA\_1A-3A | 1 |  |  | Yes | Yes | Yes | Yes | 40 | 0 |
| 3 |  |  | Yes | Yes | Yes | Yes |
| 1 |  |  | Yes | Yes | Yes | Yes | 40 | 1 |
| 3 |  | Yes | Yes | Yes | Yes | Yes |
| CA\_1A-1A-3A | - | 1 | See CA\_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3 | 60 | 0 |
| 3 |  |  | Yes | Yes | Yes | Yes |
| CA\_1A-1A-7A | CA\_1A-7A  | 1 | See CA\_1A-1A Bandwidth combination set 0 in Table 5.6A.1-3 | 60 | 0 |
| 7 |  |  | Yes | Yes | Yes | Yes |
| CA\_1A-1A-7C | CA\_7C | 1 | See CA\_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 | 80 | 0 |
| 7 | See CA\_7C in Table 5.6A.1-1 of 36.101 Bandwidth combination set 2 |
| CA\_1A-3A-3A | CA\_1A-3A | 1 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |
| CA\_1A-1A-3A-3A | - | 1 | See CA\_1A-1A Bandwidth Combination Set 0 in Table 5.6A.1-3 | 80 | 0 |
| 3 | See CA\_3A-3A Bandwidth Combination Set 0 in Table 5.6A.1-3 |
| CA\_1A-3C | CA\_1A-3A, CA\_3C | 1 |  |  | Yes | Yes | Yes | Yes | 60 | 0 |
| 3 | See CA\_3C Bandwidth Combination Set 0 in Table 5.6A.1-1 |

Table 1: Excerpt from the TS36.101 Table 5.6A.1-2: E-UTRA CA configurations and bandwidth combination sets defined for inter-band CA (two bands)

|  |  |  |
| --- | --- | --- |
|  |  | E-UTRA CA configuration / Bandwidth combination set |
| E-UTRA CA configuration | Uplink CA configurations(NOTE 3) | Component carriers in order of increasing carrier frequency | Maximum aggregated bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |
| CA\_1C | CA\_1C | 15 | 15 |  |  |  | 40 | 0 |
| 20 | 20 |  |  |  |
| 5, 10, 15 | 20 |  |  |  | 40 | 1 |
| 20 | 5, 10, 15, 20 |  |  |  |
| CA\_2C |  | 5 | 20 |  |  |  | 40 | 0 |
| 10 | 15, 20 |  |  |  |
| 15 | 10, 15, 20 |  |  |  |
| 20 | 5, 10, 15, 20 |  |  |  |
| CA\_3B |  | 5 | 3 |  |  |  | 10 | 0 |
| 3, 5 | 5 |  |  |  |
| CA\_3C | CA\_3C | 5, 10, 15 | 20 |  |  |  | 40 | 0 |
| 20 | 5, 10, 15, 20 |  |  |  |

Table 2: Excerpt from the TS36.101 Table 5.6A.1-1: E-UTRA CA configurations and bandwidth combination sets defined for intra-band contiguous CA