**3GPP TSG-RAN WG2 Meeting #119bis R2-22xxxx**

**e-Meeting, 10-19 October 2022**

**Source: Qualcomm Incorporated**

**Title: [DRAFT] Summary of email discussion [AT119bis-e][010][NR17] FBG5 BW Classes (Qualcomm)**

**Document for: Decision**

**Agenda Item: 6.24.1**

# Introduction

This document provides a summary for the following email discussion.

* [AT119bis-e][010][NR17] FBG5 BW Classes (Qualcomm)

Scope: Treat R2-2209347, R2-2209621, R2-2209622, R2-2210540, R2-2210244, R2-2210662, R2-2210701, R2-2210539, R2-2209384. Determine agreeable parts, Based on agreeable parts, progress CRs, LS out if applicable

Intended outcome: Report, Agreed-in-principle CRs, Approved LS out if applicable.

Deadline: In time for CB W2 Mon (if CB is needed)

# Discussion

Companies providing input to this email discussion are requested to leave contact information below.

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| --- | --- | --- |
| **Company** | **PoC** | **Email** |
| Qualcomm Incorporated | Masato Kitazoe | mkitazoe@qti.qualcomm.com |
| Huawei, HiSilicon | Tong Sha | shatong3@hisilicon.com |
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* 1. Phase 1

[Intended deadline for phase 1 discussion is Wednesday October 12, 1000 UTC.]

* + 1. Understanding RAN4 solution

Based on the submitted company documents, email discussion rapporteur observe that companies have different understanding on the solution RAN4 is referring to in their LS R2-2209347 (main body reproduced in Annex). It is therefore proposed that phase 1 of this email discussion focus on building common understanding on the solution. As a starting point for discussion, rapporteur would like to provide his understanding on RAN4 solution below.

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Let’s take an example for the case the UE supports bandwidth class R6 (600MHz ≤ BWChannel\_CA ≤ 1200MHz, 6CCs).

In the existing UE capability framework, the UE can signal the following CC/bandwidth combinations, by means of feature sets (and feature sets per CC therein).

1. 6x100MHz
2. 4x100MHz + 1x200MHz
3. 2x100MHz + 2x200MHz
4. 3x200MHz

The cases 1, 2, 3 and 4 correspond to bandwidth classes R6, R5, R4 and R3 respectively. Note that they are all 600MHz in terms of the aggregated CA bandwidth. So the UE is indicating the capabilities for R6 and its fallback bandwidth classes while keeping the aggregated CA bandwidth to its supported maximum. It should be noted that the UE also supports R2 as a fallback CA of case 4.

The key idea of RAN4 solution is reduce the number of CC/bandwidth combinations (feature sets) for the case other UE capabilities except for CC bandwidth within the feature set are the same for all CCs. In that case, it is possible to declare the UE capability with a single feature set by additionally indicating maximum aggregated bandwidth, as follows.

a. 6x200MHz / Maximum aggregated bandwidth =600MHz

The network can configure any CC bandwidth as long as it satisfies both the maximum CC bandwidth and the maximum aggregated bandwidth limitations as signalled by the UE. It can be seen that the new signalling covers all cases 1 to 4 above (bandwidth classes R6, R5, R4 and R3) and 2x200MHz (R2).

**Question 1:** Do companies have the same understanding on the RAN4 solution as outlined above?

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| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | See comments | The clarification from the Rapp reflects the basic solution in the RAN4 LS, but we understand the overall mechanism is still not so clear from RAN2 perspective.  Talking about the solution, we understand this solution requires all of the capability fields in the FeatureSet are the same among all of the CC bandwidth combinations, otherwise, it is not workable. While merging multiple CC combinations in one FeatureSet changes the original understanding of a FeatureSet. Besides, it is also not a bit clear how to understand the fallback of the maximum aggregated bandwidth. These questions are discussed in our paper in R2-2210539. |
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* + 1. Backward compatibility

The following documents additionally discusses the backward compatibility of FBG5.

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| [R2-2210662](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210662.zip) | Consideration on the FR2 Fallback Group 5 | ZTE Corporation, Sanechips |
| [R2-2210701](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_119bis-e/Docs/R2-2210701.zip) | (Draft)Reply LS on new contiguous BW classes for legacy networks | ZTE Corporation, Sanechips |

Some observations are made in the first document.

**Observation 1: The <Aggregated channel bandwidth, Number of contiguous CC> of FBG 2 bandwidth classes are covered by that of FBG 5 bandwidth classes.**

**Observation 2: The <Aggregated channel bandwidth, Number of contiguous CC> of FBG 3 bandwidth classes are partly overlapped with that of FBG 5 bandwidth classes.**

**Observation 3: The old gNB can’t understand FBG 5 bandwidth class (e.g. when the UE get the UE capabiliy from a R17 gNB then handover to an old gNB, or when the UE move to an old gNB at idle state and then establish connection with old gNB), then the network may ignore the BC with FBG 5 bandwidth class.**

**Question 2:** Do companies agree to the observations above?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | Yes but | We agree that FBG5 BW classes themselves can only be understood by an upgraded gNB but not a legacy gNB. From the agreement in RAN2#119e, there is no inter-operability issue with legacy gNB for FBG5 BW classes although it cannot be identified by the legacy gNB.   * [023] RAN2 agrees there is no backward compatibility issue for network in introducing new FR2 FBG5 BW classes in the CA-BandwidthClassNR field (proposed in CR R2-2208511). |
| OPPO | Yes | O1 and O2, agree  O3 although we understand the backwards compatibility issue is somewhat independent of whether we use an existing FBG (but with new BW-Class) or a new FBG, we rely on infra-vendor to decide. |
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Based on the observation 1, the document asks the following question.

* **whether the BC with FGB2 bandwidth class can be seen as a fallback of a BC with FBG5 bandwidth class.**

**Question 2:** Companies are requested to provide their view on the question above.

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| **Company** | **Comment** |
| Huawei, HiSilicon | We understand a BC with FBG5 BW class cannot fallback to a BC with FBG2 BW class, but can fallback to a BC with lower order of BW classes in FBG5. |
| OPPO | Firstly, we do not know what is the definition of ‘fallback’ here  We raised the Q in our paper 09384,  Proposal 1       R2 clarifies how to interpret “It is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration within a fallback group.”, i.e., whether it is applicable to the BW-combo and/or maximum aggregated BW. And if needed, confirm with R4 using LS.  We suggested to discuss the issue here, as included in the scope of this offline discussion. |
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* 1. Phase 2: Signalling solution

[Intended deadline for phase 2 discussion is Friday October 14, 1000 UTC.]

[Intended to collect companies views on the benefit of solution, discuss signalling details and so on.]

# Conclusion

# References

[1] R2-2209347 LS on new contiguous BW classes for legacy networks RAN4 (To: RAN2)

[2]

# Annex: Main body of RAN4 LS [1]

RAN4 have agreed new FR2 CA BW classes for supporting operator block sizes up to 2400 MHz with a mix of 100 MHz and 200 MHz carriers and agreed to introduce new CA BW classes as shown in the table below:

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| --- | --- | --- | --- |
| NR CA bandwidth class | Aggregated channel bandwidth | Number of contiguous CC | Fallback group |
| A | BWChannel ≤ 400 MHz | 1 | 1,2,3,4,5 |
| (unchanged legacy FBG2,3,4) | | | |
| R2 | 200 MHz ≤ BWChannel\_CA ≤ 400 MHz | 2 | 5 |
| R3 | 300 MHz ≤ BWChannel\_CA ≤ 600 MHz | 3 |
| R4 | 400 MHz ≤ BWChannel\_CA ≤ 800 MHz | 4 |
| R5 | 500 MHz ≤ BWChannel\_CA ≤ 1000 MHz | 5 |
| R6 | 600 MHz ≤ BWChannel\_CA ≤ 1200 MHz | 6 |
| R7 | 700 MHz ≤ BWChannel\_CA ≤ 1400 MHz | 7 |
| R8 | 800 MHz ≤ BWChannel\_CA ≤ 1600 MHz | 8 |
| R9 | 900 MHz ≤ BWChannel\_CA ≤ 1800 MHz | 9 |
| R10 | 1000 MHz ≤ BWChannel\_CA ≤ 2000 MHz | 10 |
| R11 | 1100 MHz ≤ BWChannel\_CA ≤ 2200 MHz | 11 |
| R12 | 1200 MHz ≤ BWChannel\_CA ≤ 2400 MHz | 12 |
| NOTE 1: Maximum supported component carrier bandwidths for fallback groups 1, 2, 3, 4 and 5 are 400 MHz, 200 MHz, 100 MHz, 100 MHz and 200 MHz respectively except for CA bandwidth class A. For CA bandwidth classes of fallback group 5, requirements apply for non-interlaced 100 MHz and 200 MHz channel bandwidths (each CA bandwidth class consisting of up to two contiguous sub-blocks each with component carriers of a single channel bandwidth).  NOTE 2: It is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group.  NOTE 3: In this release of the specification, the minimum requirements for intra-band contiguous CA configurations apply for aggregated channel bandwidths up to 1600 MHz (this note is not relevant for UE capability parsing by the network). | | | |

The new fall-back group 5 contains classes with up to 2400 MHz aggregated bandwidth with 12 carriers. The new classes in FBG5 are different from legacy FBGs, because the aggregated channel bandwidth ranges overlap between adjacent classes.

RAN4 have also determined that some UEs have enhanced aggregated bandwidth capability for fallback BW classes compared to the ‘dropping CCs’ interpretation of the BW class fallback rule. Specifically, some UEs have independent maximum limits on number of carriers and aggregated bandwidth. For example: a UE can support R8 to R12 with a 1600MHz aggregated channel bandwidth. RAN4 understanding is that the BW capabilities of such UEs can be indicated by different feature sets of a band combination. RAN4 would like to respectfully request RAN2 to check if a new IE could reduce signaling overhead without potential co-existence issue with the legacy fallback rule and without inter-operability issue if it were introduced with the following characteristics :

1. The new IE is optional for a UE to signal. When the IE is not signalled, legacy operation is assumed:
   1. the UE can still communicate to the network the maximum aggregated BW limitation using the existing framework.
   2. The network understands that the UE supports the legacy fallback BW classes.
2. The new IE applies to intra-band carrier contiguous aggregation as well as an intra-band contiguous carrier aggregation component within an inter-band carrier aggregation. The new IE is separately applicable to each, UL, and DL.
3. When signalled for an explicitly supported BW class in FBG5:
   1. It is in addition to the existing signaling for that BW class.
   2. The network understands that the UE has independent maximum limits on number of CCs and max. aggregated bandwidth for that band. For example, when the UE indicates explicit support for R12 and a max. aggregated bandwidth of 1600Mhz using the new IE, it not only means the max. aggregated bandwidth 1600MHz applies to 12 CCs, but also applies to lower order classes, i.e., 11CCs, 10CCs, and so on.
   3. The IE conveys the max. aggregated bandwidth value for each FeatureSetListPerUplink(Downlink)CC. for example, in each FeatureSetUplink(Downlink).
   4. A band may have multiple values of max. aggregated bandwidth associated with different FeatureSetListPerUplink(Downlink)CC.

RAN4 defers to RAN2’s decision on whether to introduce an IE as proposed above depending on feasibility and benefit.