**3GPP T****SG-RAN WG4 Meeting #109 R4-2320447**

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

Title: Discussion on the Maximum Aggregated Bandwidth capability signalling LS

Agenda item: 11.1.2

Source: T-Mobile USA

Document for: Approval

# 1 Background

RAN2 has sent an LS to RAN4 on the CA Aggregated BW capability signaling by the UE. This discussion document focusses on the 4th point in the LS:

1. For FDD-TDD CA band combinations (in FR1), RAN2 would like to ask RAN4 whether it is correct to assume that the application of BW for FDD and TDD are not equivalent. For example, assuming the SCSs are fixed in most deployments to 15kHz for FDD and 30kHz for TDD, and so, whether it is feasible to calculate the effective total aggregated BW by a formula as below:

**Total aggregated BW = 2\*FDD BW + 1\*TDD BW**

For example, the UE can signal the support for the total aggregated BW=160MHz, FDD maximum BW=50MHz and TDD maximum BW=100MHz, This means the UE supports the following combinations.

* FDD 30MHz + TDD 100MHz (2\*30MHz + 100MHz = 160MHz)
* FDD 40MHz + TDD 80MHz (2\*40MHz + 80MHz = 160MHz)
* FDD 50MHz + TDD 60MHz (2\*50MHz + 60MHz = 160MHz)

But the UE does not support the following.

* FDD 50MHz + TDD 80MHz (2\*50MHz + 80MHz = 180MHz > 160MHz)

It should be noted that the SCS is reported in perCC level including 15KHz, 30KHz or 60KHz for FR1, and there may be cases that different SCSs are reported for FDD bands/TDD bands. Therefore, the total aggregated BW is calculated in a different way from the example in the RAN4 LS, RAN2 seeks RAN4 input on above formula.

# 2 Discussion

During RAN2 discussion, one chipset vendor/company argued that if Total aggregated BW = 2\*FDD BW + 1\*TDD BW was not an option, the new IE of total maximum aggregated BW would be worthless.

**Observation 1: The new maximum aggregated bandwidth IEs would be useless to at least one chipset company if Total aggregated BW = 2\*FDD BW + 1\*TDD BW was not an option.**

Our understanding is that this is driving by baseband processing storage requirements, Since the 15 kHz SCS has twice as many subcarriers per MHz as the 30 kHz SCS, 2\*FDD BW +TDD BW represents the total baseband processing capacity.

**Observation 2: The need for Total aggregated BW = 2\*FDD BW + 1\*TDD BW is due to there being twice as many FDD subcarriers per MHz for FDD with 15 kHz subcarriers as for TDD with 30 kHz subcarriers.**

If Total aggregated BW = 1\*FDD BW + 1\*TDD BW was the only option for reporting supported total aggregated bandwidth, it would not be possible for some implementations to accurately signal their capabilities. For example, the magenta triangle shows the potential FDD and TDD channel bandwidths if where Total aggregated BW = 2\*FDD BW + 1\*TDD BW, and the green triangle show the potential FDD and TDD channel bandwidths Total aggregated BW = 1\*FDD BW + 1\*TDD BW was signalled,



Figure 1 Total maximum aggregated bandwidth options

**Observation 3: If a UE’s maximum aggregated bandwidth capability was a function of Total aggregated BW = 2\*FDD BW + 1\*TDD BW and only Total aggregated BW = 1\*FDD BW + 1\*TDD BW could be signalled, then it will not be possible for a UE to accurately indicate its maximum aggregated bandwidth capability.**

Although most if not all implementations today use 15 kHz SCS for FDD and 30 kHz SCS for TDD in FR1, these are not the only SCS options for NR. It might lead to problems in the future if the signalling was designed to assume that the 15 kHz SCS is always used for FDD and 30 kHz SCS is always used for TDD.

**Observation 4: Although most if not all current implementations use 15 kHz for FDD and 30 kHz for TDD in FR1, it may lead to problems in the future if the signalling assumes that 15 kHz is always the subcarrier spacing for FDD, and 30 kHz is always the subcarrier spacing for TDD in FR1.**

To make the signalling more accurate and flexible, it might be best to report the total aggregated baseband processing capacity in terms of RBs. Instead of saying that the UE has a maximum of 300 MHz = 2\*FDD+TDD, we could say the UE can handle a maximum number of RBs, like 273\*3=819 rounded to 820. 820 RBs could handle 300 MHz of TDD (3\*273) or 150 MHz of FDD (3\*270) or any split of FDD and TDD. This would be more flexible than reporting MHz, because it would also allow for the use of different subcarrier spacing for FDD and/or TDD bands.

**Observation 5: If the capacity total aggregated bandwidth capability was reported as a maximum number of RBs, it would allow for the use of different subcarrier spacing.**

**Proposal 1: Ask RAN2 to provide an option for a UE to report Total Maximum Aggregated Baseband Capacity as a number of RBs.**

**Proposal 2: RAN4 should propose potential values for total aggregated RBs for the new total aggregated RB IE.**

# 3 Conclusion

**Observation 1: The new maximum aggregated bandwidth IEs would be useless to at least one chipset company if Total aggregated BW = 2\*FDD BW + 1\*TDD BW was not an option.**

**Observation 2: The need for Total aggregated BW = 2\*FDD BW + 1\*TDD BW is due to there being twice as many FDD subcarriers per MHz for FDD with 15 kHz subcarriers as for TDD with 30 kHz subcarriers.**

**Observation 3: If a UE’s maximum aggregated bandwidth capability was a function of Total aggregated BW = 2\*FDD BW + 1\*TDD BW and only Total aggregated BW = 1\*FDD BW + 1\*TDD BW could be signalled, then it will not be possible for a UE to accurately indicate its maximum aggregated bandwidth capability.**

**Observation 4: Although most if not all current implementations use 15 kHz for FDD and 30 kHz for TDD in FR1, it may lead to problems in the future if the signalling assumes that 15 kHz is always the subcarrier spacing for FDD, and 30 kHz is always the subcarrier spacing for TDD in FR1.**

**Observation 5: If the capacity total aggregated bandwidth capability was reported as a maximum number of RBs, it would allow for the use of different subcarrier spacing.**

**Proposal 1: Ask RAN2 to provide an option for a UE to report Total Maximum Aggregated Baseband Capacity as a number of RBs.**

**Proposal 2: RAN4 should propose potential values for total aggregated RBs for the new total aggregated RB IE.**

# 4 References

[1] R4-2318023 “LS on the CA Aggregated BW capability signaling by the UE,” RAN2