3GPP TSG-RAN WG2 #116 electronic R2-20xxxxx

e-Meeting, Nov1st– 12th 2021

Agenda Item: 8.24.1

Source: ZTE, Sanechips

Title: Summary of offline [AT116-e][024][NR17] BCS4/5 (ZTE)

Document for: Discussion, Decision

# 1 Introduction

This contribution summarizes the following discussion:

* [AT116-e][024][NR17] BCS4/5 (ZTE)

Scope: Treat R2-2110387, R2-2110512

Intended outcome: Report

Deadline: Friday W1 (CB online)

Your comments before the Nov-4 10:00 UTC would be appreciated.

**Contact form**

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# Discussion

## 2.1 R2-2110387

[**R2-2110387**](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110387.zip) **Consideration on the BCS4/5 Supporting ZTE Corporation, Sanechips**

|  |
| --- |
| Proposal 1: Once the BCS4 was indicated by the UE, the network that support BCS4 can further determine the supported bandwidth based on the {channelBWs-UL/DL, supportedBandwidthDL/UL}.  Proposal 2: If the BCS4 was supported for a BC, the UE shall also indicate the other BCS (0~3) that have been included in the RAN4 spec.  Proposal 3: In Rel 17, if the BCS5 was supported for a BC, the UE shall also indicate the other supported BCS (0~3).  Proposal 4: Ran 2 to discuss the relationship between the minimum supported bandwidth that determined baded on {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)} and the reported minimum bandwidth of the BCS5.  Proposal 4.1: Ran2 to confirm that the reported minimum bandwidth of the BCS5 can be larger than the minimum supported bandwidth that determined by {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)}.  Proposal 4.2: The R17 gNB would determine the supported bandwidth that lower than the reported minimum bandwidth of the BCS5 based on {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)}, meanwhile determine the supported bandwidth that no less than the reported minimum bandwidth of the BCS5 based on{channelBWs-UL/DL, supportedBandwidthDL/UL, minsupportedBandwidthDL/UL}.  Proposal 5: Ran2 confirm that the below conclusion still work even the BCS4/5 was indicated:  The channel bandwidths of a (not signaled) fallback BC are determined by the bandwidth combination set (BCS) that the UE supports for the explicitly signaled parent BC. |

In the current spec, the UE would determine the supported bandwidth based on the {*supportedBandwidthCombinationSet , channelBWs-UL/DL, supportedBandwidthDL/UL}.* Meanwhile*,* BCS4 would be introduced to define a new type of BCS that would include all of the channel bandwidths that the UE supports for a given band in the band combination. Thus, in the paper R2-2110387, it proposes that once the BCS4 was indicated, the network that support BCS4 can further determine the supported bandwidth based on the {channelBWs-UL/DL, supportedBandwidthDL/UL}.

**Q1: Do companies agree with the proposal 1 as below in R2-2110387 ?**

Proposal 1: Once the BCS4 was indicated by the UE, the network that support BCS4 can further determine the supported bandwidth based on the {channelBWs-UL/DL, supportedBandwidthDL/UL}.

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| --- | --- | --- |
| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes |  |
| OPPO | Yes |  |
| Xiaomi | Partially Yes | Comment 1: Wait for RAN4 feedbacks, as RAN4 is discussing whether BCS4 is still needed, based on the LS from RAN2, given that BCS5 can already serve the purpose of BCS4. But we are ok to discuss the BCS4 function based on previous RAN4 LS for now.  [ZTE(wenting)] Thanks for the comments. For the comments 1, we think we can add a condition to this proposal e.g. “If RAN4 confirm that the BCS4 was needed”.  Comment 2: The bandwidth indicated by the UE can also include “channelBW-90mhz”, but not “fr1-100mhz” which is only applicable for IAB.  [ZTE(wenting)] Thanks. The proposal can be further modified as below:  If RAN4 confirm that the BCS4 was needed,once the BCS4 was indicated by the UE, the network that support BCS4 can further determine the supported bandwidth based on the {channelBWs-UL/DL, supportedBandwidthDL/UL,channelBW-90mh }. |
| Huawei, HiSilicon | Partially Yes | Agree with Xiaomi that the “channelBW-90mhz” also needs to be considered. And we’d better wait for RAN4 feedback. |
| Nokia | Partially yes | In addition to the above comments, the support for the channel bandwidths 25/35 MHz may also have to be comprehensively checked as the BCS4 entry in RAN4 spec may contain those channel bandwidths for which there is no explicit enumeration in RAN2 but are signalled by the UE by indicating the next higher CBW. Is our understanding correct that network is required also to check this?  [ZTE(wenting)] Yes. |
| MediaTek | Yes |  |
| Ericsson | Yes | Agree that also “channelBW-90mhz” needs to be considered.  Note that the NW must also take the bandwidth class into account when configuring contiguous CA: E.g. if the UE indicates support for CA\_n78C, the NW may configure two carriers only if their aggregated bandwidth is greater than 100 MHz (38.101-1, table 5.3A.5-1). By only looking at the allowed channel bandwidths (Table 5.3.5-1) one might have assumed that 60+60 MHz is also allowed.  So far (before BCS#4) this information was entirely available in the BCS (e.g. Table 5.5A.1-1 for intra-band contiguous). |
| Apple | Similar views as Xiaomi | Its better in RAN2 to make an informed agreement after RAN4 concludes. |
| Intel | Yes | It is aligned with the current principle defined in TS38.306 and it should be applied for BCS5. |
| T-Mobile USA | Yes | 1. T-Mobile disagrees with Apple and Xiaomi, RAN plenary approved CR’s at RAN#93 using BCS4 for EN-DC combinations. Therefore, RAN2 must consider the use of BCS4 in our specifications.   We agree with Ericsson that RAN4 needs to clarify if BCS4 includes the optional channel BW’s such as 35 & 45 MHz. |
| ZTE | Yes(Proponent) |  |
| Samsung | Yes in principle | We have assumed that P1 can be a baseline to indicate BCS4 to legacy gNBs.  The exceptional cases, e.g. channelBW-90mhz, may be further considered. |
| vivo | Yes |  |

According to [3], BCS4 means all the possible bandwidth configurations for each band in a band combination would be supported. For that the legacy R15/R16 gNB may not support BCS4 feature, even the UE report the BCS4, these legacy gNBs can’t understand the meaning of the BCS4, in R2-2110387, it proposes that to make sure the legacy gNBs can work normally, the UE shall also indicated its supported BCS0/1/2/3 in the supportedBandwidthCombinationSet to the network.

**Q2: Do companies agree with the proposal 2 as below in R2-2110387 ?**

Proposal 2: If the BCS4 was supported for a BC, the UE shall also indicate the other BCS (0~3) that have been included in the RAN4 spec.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | No | This is over-specifying the UE behaviour, and is subject to compatibility issues in the feature. There could be cases where RAN4 defines BCS0 and 4 first for a band combination and then BCS1 later. The UE supporting the “first” version of the standard only indicates BCS0 and 4, which would not be compliant to the second version of the standard. We have been straggling with this kind of cases in these bandwidth businesses in the past and we should not repeat it.  Whether the UE indicate a legacy BCS or not, it does not cause any interoperability problems. The network simply picks a BCS the UE and the network supports. |
| OPPO |  | We see a point in the reply by QC above for the case where BCS4 is introduced first and later BCS 0/1/2/3. At least this should be excluded from the proposal above. |
| Xiaomi |  | Wait for RAN4 feedbacks, as RAN4 is discussing whether the traditional BCSs are needed if BCS4/5 is reported.  Our understanding is as follows:  For Rel-15/Rel-16 band combinations, if needed, the traditional BCSs are allowed. For a new band combination in Rel-17 and onwards, if the BCS4/BCS5 are requested, traditional BCSs are not needed, the network is demanded to recognize the BCS4/BCS5. |
| Huawei, HiSilicon |  | In our understanding, for legacy BC with BCS0~3 defined, the UE reporting BCS4/5 can also indicate BCS0~3 if it supports. For new BC with BCS4/5 defined, the NW can comprehend the BC and BCS4/5 at the same time. Agree with QC that whether the UE indicate a legacy BCS or not, it does not cause any interoperability problems. If the legacy NW cannot find a valid BCS, the NW may consider this BC is an invalid BC. |
| Nokia | No | RAN4 needs to tell us how BCS4/5 interwork with other BCS Till then we should wait |
| MediaTek |  | The intention to avoid interoperability issue from ZTE paper is oaky but QC’s comment also got some point. We would suggest to change the wording as Huawei’s comment – “for legacy BC with BCS0~3 defined, the UE reporting BCS4/5 can also indicate BCS0~3 if it supports”. |
| Ericsson | Almost | We agree with QC that we get into trouble if the NW makes assumptions based on such rules.  However, the we probably all agree that **for backwards compatibility, *a UE that indicates BCS#4 for a band combination should also indicate the other BCS that it supports for this band combination***.  But in-line with QC’s comment, the network should not assume that the UE supports e.g. BCS#2 unless the UE really sets that bit. The network configures only what the UE supports according to its signaling.  @Xiaomi: When it comes to forward/backwards compatibility, RAN2 should preferably not rely on RAN4. |
| Apple | Agree with Qualcomm’s comments |  |
| Intel |  | We tend to agree with QC that we can leave it to the implementation. In addition, BCS signaling is assumed to be release independent. If we start the support of backward compatibility, it would cause another confusion. |
| T-Mobile USA | Yes | UE indicates all of the BCS values it supports and the network uses the BCS value that the network and UE support. |
| ZTE | Yes(Proponent) | Based on the comments from other companies, we also agree with Ericsson’s wording below:  For backwards compatibility, *a UE that indicates BCS#4 for a band combination should also indicate the other BCS that it supports for this band combination*. |
| Samsung |  | Anyway, we should discuss how to handle the existing *supportedBandwidthCombinationSet*, when BCS4 or 5 is reported. Note that the *supportedBandwidthCombinationSet* is mandatory for specific cases, from TS38.306. |
| vivo | Share the view of Huawei |  |

Similar to Q2, the Q3 is for the BCS5 for the Rel17, to make sure that the legacy gNB can understand the supported bandwidth correctly, when reporting BCS5, the UE shall also indicate the other supported BCS (0~3).

**Q3: Do companies agree with the proposal 3 as below in R2-2110387 ?**

Proposal 3: In Rel 17, if the BCS5 was supported for a BC, the UE shall also indicate the other supported BCS (0~3).

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | No | Same comment as Q2. |
| OPPO |  | Same reply as in Q2. |
| Xiaomi |  | Same comment as Q2 |
| Huawei, HiSilicon |  | Same comment as Q2. |
| Nokia | No | See comment to Q2 |
| MediaTek |  | Same comment as Q2 |
| Ericsson | Almost | See comment in Q2. |
| Apple | No |  |
| Intel |  | Same comment as Q2. |
| T-Mobile USA | Yes | Same comment as above, I don’t see a case were the use of BCS5 overwrites UE capabilities expressed within the other BCS values supported by the UE. |
| ZTE | Yes(Proponent) | Anyway, we can accept the wording similar to the Q2 |
| Samsung |  | See comment in Q2 |
| vivo |  | Same comment as in Q2. |

The Q4 is about how to determine the supported bandwidth when the UE report both BCS5 and legacy BCS, e.g. BCSx(0~3).

**Q4: Do companies agree with the proposal 4/4.1/4.2 as below in R2-2110387 ?**

Proposal 4: Ran 2 to discuss the relationship between the minimum supported bandwidth that determined based on {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)} and the reported minimum bandwidth of the BCS5.

Proposal 4.1: Ran2 to confirm that the reported minimum bandwidth of the BCS5 can be larger than the minimum supported bandwidth that determined by {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)}.

Proposal 4.2: The R17 gNB would determine the supported bandwidth that lower than the reported minimum bandwidth of the BCS5 based on {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)}, meanwhile determine the supported bandwidth that no less than the reported minimum bandwidth of the BCS5 based on{channelBWs-UL/DL, supportedBandwidthDL/UL, minsupportedBandwidthDL/UL}.

Proposal 4.2\_ModifiedEri: The R17 gNB would determine the UE’s support   
1) for a bandwidth that is lower than the reported minimum bandwidth of the BCS5 based on {channelBWs-UL/DL, supportedBandwidthDL/UL, BCSx(0~3)},   
2) for a bandwidth that equal to or larger than the reported minimum bandwidth of the BCS5 based on{channelBWs-UL/DL, supportedBandwidthDL/UL, minsupportedBandwidthDL/UL}.

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| **Company** | **Agree P4** | **Agree**  **P4.1** | **Agree**  **P4.2** | **Comments** |
| Qualcomm Incorporated | Yes | Yes, but | Yes, but | We do not see why it is necessary for the network to look at BCS0-3 together with BCS5. Can the proponent clarify?  Fine with the proposals for other UE capability parameters. |
| OPPO |  | Yes | Yes | P4 is for R2 to discuss so nothing to agree?  Our reading of the proposals of P4.1/2 is basically to make the usage of minimum BW for BCS5 independent of legacy BCS (which is fine for us)? If yes, some rewording may be helpful to avoid mis-reading. |
| Xiaomi | Yes, but | Yes, but | Yes, but | We are open to discuss P4, but would like to wait for the RAN4 feedbacks on the legacy BCS0-3. |
| Huawei, HiSilicon | Yes, but | Yes, but | Yes, but | We are also not sure why BCS0-3 is necessary and prefer to wait RAN4 feedback first. |
| Nokia | Yes, but this is RAN4 job to tell RAN2 what the interpretation should be. RAN2 should not be doing RAN4’s work. | Yes, but this depends on how RAN4 first answers the coexistence of BCS4/5 with other BCS | Yes, but this depends on how RAN4 first answers the coexistence of BCS4/5 with other BCS | We are not sure what the proponent company aims to do when trying to solve RAN4 specific issues in RAN2. Why can’t we just allow RAN4 discussions to complete and then allow the signalling in RAN2 rather than discuss functionality aspects which are RAN4 discussions. |
| MediaTek | Yes, but |  |  | Similar comment. It seems that R4 should tell us how to interpret the co-exist of BCS4/5 with other BCS |
| Ericsson | Yes, OK to discuss | Yes, but the min-BW indicated for BCS#5 has no meaning for other BCSs | Yes, if the intention is in line with the reformulated text. | We tried to clarify P4.2 with Proposal 4.2\_ModifiedEri above. If this is what was meant, we agree.  In other words: Even if a UE does not support a certain (low) carrier bandwidth according to (BCS#5 + minSupportedBandwidthDL), it might still support it according to the definition of another BCS (0-3) for which minSupportedBandwidthDL does not need to be taken into account. |
| Apple | Same view as Nokia/MediaTek |  |  | RAN4 should inform how to interpret this. |
| Intel |  |  |  | We have the same view other companies that we need to first clarify whether BCS0-3 should be reported with BCS5. |
| T-Mobile USA | Yes, OK to discuss | Yes, but the min-BW indicated for BCS#5 has no meaning for other BCSs | Yes, if the intention is in line with the reformulated text. | Agree with Ericsson’s comments |
| ZTE | Yes | Yes | Yes | We want to clarify that these proposals are for legacy BCs with BCS0~3 defined. For these BC, if the UE only report BCS5, for the legacy gNB that didn’t implement BCS5 feature may misunderstand the supported bandwidth of the corresponding BC, thus as discussed in Q2, the UE shall report it’s supported legacy BCS(0~3). |
| Samsung | Yes, but | Yes, but | Yes, but | As mentioned above by a few companies, it is unclear on the consideration of the legacy BCS 0 ~ 3. For BCS5, new signaling would be allowed unlike BCS4. |
| vivo | Same view as MediaTek |  |  |  |

**Q5: Do companies agree with the proposal 5 as below in R2-2110387 ?**

Proposal 5: Ran2 confirm that the below conclusion still work even the BCS4/5 was indicated:

The channel bandwidths of a (not signaled) fallback BC are determined by the bandwidth combination set (BCS) that the UE supports for the explicitly signaled parent BC.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes | Fallback band combination is well defined concept. We do not think additional clarification is necessary in the standard. |
| OPPO | Yes |  |
| Xiaomi | Yes | RAN4 is not redefining the fallback BC. Nothing needs to be changed in the specification. |
| Huawei, HiSilicon | Yes | The current spec is clear. |
| Nokia | Yes | There should not be an impact to specification due to this. |
| MediaTek | Yes |  |
| Ericsson | Yes | No need for clarifications. |
| Apple | Yes |  |
| Intel | Yes |  |
| ZTE | Yes(Proponent) |  |
| Samsung | Yes |  |
| Apple | Yes |  |

## 2.2 R2-2110512

[**R2-2110512**](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110512.zip) **Introduction of BCS4 and BCS5 Qualcomm Incorporated discussion**

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| --- |
| Proposal 1: RAN2 to confirm the introduction of BCS4 and BCS5 does not cause a backward compatibility problem, and the signalling can be introduced within the existing band combination list, i.e. no need to introduce a new band combination list.  Proposal 2: BCS4 and BCS5 are applicable to DAPS.  Proposal 3: Fallback per CC feature set is not applicable to the supported minimum bandwidth of BCS5. |

The UE may signal its capability for legacy BCS(s) together with BCS4 or BCS5. The network not implementing BCS4/5 then can use bandwidth combinations according to the legacy BCS(s) supported by the UE.

In the future, we may see cases where a new band combination is defined only with BCS4 and/or BCS5. Any network supporting such band combination shall also support BCS4/5. The legacy network will just ignore the band combination.

**Q6: Do companies agree with the first part proposal 1 as below in R2-2110512 ?**

First part of the Proposal 1: RAN2 to confirm the introduction of BCS4 and BCS5 does not cause a backward compatibility problem.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes | Proponent |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Nokia | Yes |  |
| MediaTek | Yes |  |
| Ericsson | Yes |  |
| Apple | Yes |  |
| Intel | Yes |  |
| ZTE | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |

**Q6a: Do companies agree with the second part proposal 1 as below in R2-2110512 ?**

Second part of the Proposal 1:RAN2 to confirm the signalling can be introduced within the existing band combination list, i.e. no need to introduce a new band combination list.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes | Proponent |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Nokia | Yes |  |
| MediaTek | Yes |  |
| Ericsson | Yes |  |
| Apple | Yes |  |
| Intel | Yes |  |
| ZTE | Yes |  |
| Samsung | Yes |  |
| vivo | Yes |  |

DAPS feature leverages the UE capability for CA which is used to express UE’s capability for source cell and target cell configurations during DAPS handover. BCS is not an exception there. We simply propose to keep the principle and allow the use of BCS4 and BCS5 for the purpose of DAPS handover.

**Q7: Do companies agree with the proposal 2 as below in R2-2110512?**

Proposal 2: BCS4 and BCS5 are applicable to DAPS.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes | Proponent |
| OPPO | See comment | BC-entry for DAPS actually includes multiple BC(s) due to the usage of FSC for DAPS, and good to check the applicable of P2 respectively:  1) Obviously, the BCS (not only the newly added BCS 4/5 but also the legacy BCS values) is not applicable to **intra-frequency** DAPS;  2) For the **inter-frequency DAPS** where the BW of source and target cells are **overlapping** with each other, we understand the BCS (not only the newly added BCS 4/5 but also the legacy BCS values) is not applicable to intra-frequency DAPS, but we can wait for R2 confirm / conclusion on the paper of 9395.  3) for the **inter-frequency** DAPS where the BW of source and target cells are **NOT** **overlapping** with each other, we agree with the applicability of BCS4/5. |
| Xiaomi | Yes | BCS4/5 is only a new capability signaling indicating the supported bandwidth for a band combination, alike other extensions (e.g. channelBW-90mhz). We do not think the BCS4/5 indication impacts other high layer functions, including DAPS. |
| Huawei, HiSilicon |  | It is still unclear whether legacy BCS can be applicable to DAPS, the BCS4/5 can follow the same principle as the legacy BCS. |
| Nokia | No | DAPS should be for single CC at source and target PCell so we are not sure what the proponent company means by BCS being applicable to DAPS? |
| MediaTek |  | Better to clarify how legacy BCS apply to DAPS and BCS4/5 could follow the same rule |
| Ericsson | Yes | We agree with Xiaomi that there is no difference to other BCSs. |
| Apple | Similar views as Nokia |  |
| Intel | Yes | DAPS support can be indicated per BC although CA/DC is not supported for DAPS. If the number of CCs within a band combination is more than two, UE shall support DAPS handover between every CC pair.  The introduction of BCS4/5 should not affect DAPS support. |
| ZTE | Yes | Our understanding is that, BCS4/5 could follow the same rule as the legacy BCS, how legacy BCS apply to DAPS should be discussed in the DAPS session (which have been touched in the offline [012]) |
| Samsung | No | Agree that DAPS capability is based on CA capability framework. But, it seems pre-matured to decide it now. Furthermore, RAN4 input may be required. |
| vivo | Share the views of Huawei and MediaTek |  |

RAN2 agreed to introduce the solution 2 in the RAN4 LS [1]; The UE signals supported minimum bandwidth in feature set per CC. Since it defines the lowest bound of UE capability, the concept of “Fallback per CC feature set” (see below, from 38.306) should not apply.

* **Fallback per CC feature set:** A feature set per CC that has lower capabilities of UE supported MIMO layers and BW while keeping the numerology and other parameters the same from the reported feature set per CC for a given carrier per band.

**Q8: Do companies agree with the proposal 3 as below in R2-2110512 ?**

Proposal 3: Fallback per CC feature set is not applicable to the supported minimum bandwidth of BCS5.

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| **Company** | **Agree**  **(Yes or No)** | **Comments** |
| Qualcomm Incorporated | Yes | Proponent |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Nokia | Yes | Logically yes |
| MediaTek | Yes |  |
| Ericsson | Yes |  |
| Apple | Yes |  |
| Intel | Yes |  |
| ZTE |  | Logically yes. The latest definition (38306) is as below  **Fallback per CC feature set:** A feature set per CC that has same or lower capabilities than the capabilities of UE (e.g. supported MIMO layers, BW, modulation order) while keeping the numerology the same from the reported feature set per CC for a given carrier per ban  Then we want to know whether some spec modification/clarification needed |
| Samsung | Yes |  |
| vivo | Yes |  |

# 3 Conclusion

# 4 References

1. [R2-2110387](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110387.zip) Consideration on the BCS4/5 Supporting ZTE Corporation, Sanechips discussion Rel-17 NR\_BCS4-Core
2. [R2-2110512](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2110512.zip) Introduction of BCS4 and BCS5 Qualcomm Incorporated discussion Rel-16 NR\_BCS4-Core
3. R2-2106957 LS on NR CA capability for BCS5 Ran 4 To:Ran2 Xiaomi
4. R2-2109073 Reply LS for NR CA capability for BCS5 RAN2 LS out