**3GPP TSG-RAN WG4 Meeting #****99-e** **R4-21xxxxx**

**Electronic Meeting, 19th – 27th May 2021**

**Agenda item:** 8.29.1

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [99-e][122] NR\_BCS4

**Document for:** Information

# Introduction

This email discussion is for Rel-17 NR BCS4 which was approved in WI RP-202832 at RAN #90.

# Topic #1: General

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2110181](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110181.zip) | The signalling for BCS4 | Xiaomi | Observation 1: The signalling of channelBWs-DL/UL is only to indicate the supported CBW for each band in single band operation.Proposal 1: Send LS to RAN2 to ask RAN2 check the feasibility of whether the new signalling introducing in the Rel-17 ASN.1 can work from Rel-15 for the legacy gNB by allowing early implementation or by using a Rel-15 non-critical extension.Proposal 2: If BCS4 with signalling can’t work from Rel-15 confirmed by RAN2, we prefer to* Making BCS4 and BCS5 with new signalling as a package apply to all band combinations. Future band combinations can only apply for BCS4 and applying for BCS4 implies applying for BCS5 as well.

The original BCS0, 1, 2 or 3 are still allowed to request, if needed |
| [R4-2110407](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110407.zip) | General discussion on introduction of BCS4 | Huawei, HiSilicon | Observation 1: In order to reduce the unnecessary work for AMPR/REFSENS, RAN4 can consider not to introduce BCS4 for all the intra-band CA band combinations temporarily.Observation 2: When RAN4 introduce BCS4, the impact of specification listed above can be considered for inter-band CA and SUL band combinations.Observation 3: RAN4 need to consider how to indicate BCS4 in the band combination configurations according to option 1, option 2 or other solutions.Observation 4: From the perspective of standards and industry, it’s very important to introduce BCS4 as soon as possible.Proposal 1: The introduction of BCS4 can follow the current procedure by requesting case-by-case. Operators can start to request BCS4 for band combinations in RAN4#100 meeting.Proposal 2: BCS4 can be indicated in the configuration table for each band combinations based on operators’ request as below for example from Rel-17.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NR CA configuration | Uplink CA configuration | NR Band | Channel bandwidth (MHz) (NOTE 3) | Bandwidth combination set |
|  |  |  | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |  |
| CA\_n1A-n3A | CA\_n1A-n3A | n1 | 5 | 10 | 15 | 20 |  |  |  |  |  |  |  |  |  | 0 |
|  |  | n3 | 5 | 10 | 15 | 20 | 25 | 30 |  |  |  |  |  |  |  |  |
|  |  | See n1 and n3 channel bandwidths in Table 5.3.5-1 | 4 |

Proposal 3: When RAN4 introduces BCS4, the general description or impact of specification should be considered for both inter-band CA and SUL band combinations. |
| [R4-2110408](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110408.zip) | Discussion on UE capability for BCS4 | Huawei, HiSilicon | Observation 1: Based on the current mechanism, the networks mainly determine the CA channel BW combinations capability of UEs by *channelBWs-UL, channelBWs-DL, supportedBandwidthUL* and *supportedBandwidthDL*.Observation 2: The UE still can derive a reasonable capability by reporting the *channelBWs-UL, channelBWs-DL, supportedBandwidthUL* and *supportedBandwidthDL* without/with considering BCS capability.Observation 3: BCS4 concept can simplify the networks scheduling without considering BCS’s information.Observation 4: BCS4 reporting doesn’t mean that UEs have to support all kinds of bandwidth combinations listed in Table 5.3.5-1 from TS 38.101-1 for each band.Observation 5: It’s enough to represent UE bandwidths combinations’ capabilities for a band combination by reporting the *channelBWs-UL, channelBWs-DL, supportedBandwidthUL and supportedBandwidthDL.*Observation 6: Based on current agreements, UE is also allowed to report other BCSs except for BCS4.Observation 7: There is no adequate assessment of how much impact this will have for IoD test. It’s observed that the maximum channel bandwidth is only 50MHz or less than 50MHz for most of bands below 2.3GHz. Besides, IoDT is out of 3GPP scope and it can be addressed using other solutions instead of adding new signalling.Proposal 1: There is no big impact on both network and UE’s implementation when BCS4 concept is introduced.Observation 8: The following advantages are observed when introducing BCS4 concept without additional capabilities.1. It’s helpful to simplify the BS scheduling without considering BCS’s information.
2. UE can report BCS4 feature using release independent method from Rel-15.
3. It can minimum the spec’s impact on other working group.
4. There is no additional IE overhead.

Observation 9: The following disadvantages are observed when introducing BCS4 concept with a new capability “minimum channel bandwidth for each CC in NR band within a band combination”.1. It increases the additional IE overhead which is unnecessary.
2. It increases the complexity of NW scheduling.
3. It’s against the RAN4’s assumption that the 5MHz/10MHz are supported by default for the band combinations which have IMD exceptions. It may have an impact on the current IMD exceptions when “minimum channel bandwidth” > 10MHz
4. Based on the RANP WF [3], all bandwidths listed in TS 38.101-1 v15.0.0 Table 5.3.5-1 for each band shall be mandatory including 5/10MHz. It doesn’t make sense to abandon them in the band combinations.
5. There is no demand to abandon smaller or minimum channel bandwidth for band combinations in current spec and market. It’s observed that all the band combinations include minimum channel bandwidth for each band based on the clause 5.5A.3 from TS 38.101-1.
6. UE can only report BCS4 from Rel-17 due to the introduction of new capability without release independent method.
7. BWP is an important characteristic for 5G. If the minimum channel bandwidth can’t be supported for per band per band combination, NW can’t configure the smaller BWP flexibly for the combination to save UE power.
8. For example, it’s assumed that operator has only 5MHz BW in band n1. One UE only support 15MHz~30MHz CBW in band n1 for CA\_n1-n78. That means NW can’t configure this band combination CA\_n1-n78 for the UE, even if it can access a 5MHz NW in single band n1. It isn’t the purpose that we introduce BCS4.

Proposal 2: The first candidate method (original BCS4 method) without “minimum channel bandwidth” capability can be chosen by RAN4. |
| [R4-2110432](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110432.zip) | Discussion on BCS4 | ZTE Corporation | Observation 1: For existing configurations, the guideline in the revised WID implies the BCS4 can be applied to all combinations.Observation 2: The DL/UL configurations information can only be obtained from the configurations tableObservation 3:From RAN4 perspective, there are no differences between BCS4 and BCS5 but it might make things more complicated, and also BCS5 is out of the scope of BCS4 WIDObservation 4: No BCS information for band combinations is included in the tables in TS38.307.Proposal 1. How to apply BCS4 for intra-band NR CA needs further study.Proposal 2. - For existing band configuration, BCS4 can be applied to all combinations.- For brand new band configuration, BCS4 should be applied on a per request basisProposal 3. BCS4 needs to be indicated in the configuration tables. A new single row for BCS4 (2 bands) in tables 2. Proposal 4: For the same band combination, in case of both BCS0/1/2/3 and BCS4 exist in the WID, TP and draft CRs for BCS4 is enough, and BCS0/1/2/3 combinations are completed by default after BCS4 combinations TP/draft CR are approved.Proposal 5: if the release independent for band combination related to specific BCS, how to implement it in TS38.307 needs further discussion. |
| [R4-2110797](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110797.zip) | BCS4 discussion | Qualcomm Incorporated | Proposal 1: The type of BCS4 applying should be within the scope of BCS4 WID, i.e., introducing BCS4 for SUL, inter-band and intra-band NR-CA. If it can be extended to other type should be discussed in RAN plenary meeting.Proposal 2: RAN4 to confirm the BCS4 shall be created as the requested for band combinations. Other BCSs can be requested even if BCS4 is introduced.Proposal 3: BCS4 shall be explicitly indicated in the channel bandwidth configuration table. For example, a single row referring to the channel bandwidth of single band operation could be inserted in the corresponding tables.Observation 1: Adopting BCS4 without signalling will lose the flexibility that UE could have reported the supported CBW in a band combination via original BCSs. It will lead to the extra IoDT efforts and UE design burden. Observation 2: Especially for the case of introducing new channel BW for existing bands, UE could not report capability of supporting the related band combinations step by step. Observation 3: It is necessary to introduce new signalling, e.g., min. CBW per CC per band combination with BCS4 concept.Proposal 4: RAN4 to introduce a new signalling, e.g., min CBW per CC per band combination in Rel-17.Proposal 5: For the sake of progress, RAN4 to agree proposal 4 and further discuss the possibility of approving the BCS4 without new signalling and BCS5 with min. CBW capability signalling as a package. |
| [R4-2111482](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111482.zip) | Proposals for BCS4 Open Issues | T-Mobile USA | Proposal 1: BCS4 may be applied to inter-band NR-CA, inter-band NR-DC and SUL.Proposal 2: BCS4 to apply to all inter-band NR-CA, inter-band NR-DC and SUL combinations where the maximum channel bandwidth of each band has not increased from the existing defined BCSs.Proposal 3: The following format shall be used in to indicate support for BCS4 in the CA, DC and SUL tables: Proposal 4: For the same band combination, in case of both BCS0/1/2/3 and BCS4 exist in the WID, TP and draft CRs for BCS4 is enough, and BCS0/1/2/3 combinations are completed by default after BCS4 combinations TP/draft CR are approved.Proposal 5: The configuration tables for CA describe Bandwidth Combination Sets. Bandwidth Combination Set 4 (BCS4) contains all possible defined channel bandwidths for each CC in the combination. The fact that BCS4 contains all channel bandwidths for each band does not alter if a channel bandwidth is mandatory or optional for a given band. Bandwidths which are identified as optional for the current version of the specification in Table 5.3.5-1 are still optional even with BCS4. The channel bandwidths the UE supports for each band and the maximum bandwidth for the band in the band combination are indicated in the UE capabilities. Support for BCS4 for a given band combination is indicated by a single row in the table.Proposal 6: RAN4 will proceed with the introduction of BCS4 with no new signalling so it is release independent to Rel-15. RAN4 will continue to discuss the need for new signalling. If it is determined that new Rel-17 signalling like minimum channel bandwidth is needed, then RAN4 will introduce BCS5 which will be similar to BCS4 except that the new signalling will apply to BCS5, but not to BCS4. |

## Open issues summary

**Issue 1.2-1: Signaling**

Option 1) No new signaling
Option 2) New signaling and BCS4 only applies to Rel-17+
Option 3) No new signaling for BCS4, Continue discussion for Rel-17 signaling w/BCS5
Option 4) No new signaling for BCS4, minimum channel BW signaling in Rel-17 w/BCS5.

**Issue 1.2-2: BCS4 mandatory**

Option 1) Mandatory
Option 2) Optional

**Issue 1.2-3: How to indicate BCS4**

Single row proposal like in Huawei R4-2110407 proposal 2 and T-Mobile R4-2111482 proposal 3.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Issue 1.2-1: Issue 1.2-2:Issue 1.2-3: |
| Company B | Issue 1.2-1: Issue 1.2-2:Issue 1.2-3: |
|  |  |
|  |  |

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:* *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
|  |  |

# Topic #2: MSD

## Companies’ contributions summary

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| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2110405](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110405.zip) | Discussion on how to simplify MSD due to harmonic interference using bandwidth-agnostic approach | Huawei, HiSilicon | Observation 1: As the channel bandwidths are increasing, it’s necessary to simplify the MSD exception tables in TS 38.101-1.Observation 2: Generally, RAN4 use the minimum channel bandwidth of victim bands to evaluate the MSD value and derive values of other channel bandwidth. However, there seems to be no unified derivation method.Observation 3: It’s unnecessary to specify the different MSD levels for different DL victim channel bandwidths since the RF parameters e.g. isolation, harmonic rejection aren’t changed for different channel bandwidths.Proposal 1: It’s proposed to choose one test configuration for MSD due to harmonic interference. And the principles are shown below. #1 The minimum CBW should be chosen for DL victim band #2 The victim's RX CBW entirely overlaps the aggressor's UL harmonic #3 To specify the aggressor’s UL RB allocation so that the UL harmonic is entirely contained within the victim’s smallest Rx CBW |
| [R4-2110406](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110406.zip) | Discussion on MSD due to cross band isolation and counter intermodulations | Huawei, HiSilicon | Observation 1: Most of the band combinations which have MSD exception due to cross band isolation belong to case 3, except for a few combos, e.g. CA\_n1-n3 and CA\_n1-n40.Observation 2: Currently, UE may not always support the maximum channel bandwidth 50MHz in band n1 for CA\_n1-n3. Thus, it isn't enough to suit all kinds of UEs which support CA\_n1-n3, if we just specify one test configuration for CA\_n1-n3 using maximum channel bandwidth 50MHz in band n1.Observation 3: For case 1 or case 2, we can choose an appropriate DL Rx channel bandwidth which only overlaps with 1st or 2nd adjacent channel in Tx aggressor band.Observation 4: For case 3, since it’s assumed that PA output noise is flat in spurious emission region instead of 1st and 2nd adjacent channel, the minimum DL Rx channel bandwidth can be used for MSD (cross band isolation) test configuration instead of specifying the all different kinds of Rx channel bandwidths.Proposal 1: It’s proposed to use table 1, table 2 and table 3 as general principles to specify the MSD due to cross band isolation using full RB allocation.Table 1 Summary for CA\_n1-n3 MSD test configuration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Parameters | Test configuration A | Test configuration B | Test configuration C |
| 1 | Carrier Frequencies | The UL and DL carrier frequencies should be configured to minimize the gap separating the DL victim carrier to the UL carrier frequency. |
| 2 | UL Channel bandwidth | 50MHz | 25MHz | 5MHz |
| 3 | UL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest UL CBW, ie. fully allocated UL configuration |
| 4 | UL SCS | NR SCS should be the smallest SCS that is compatible with the configured UL CBW |
| 5 | DL Channel bandwidth | 10MHz | 10MHz | 5MHz |
| 6 | DL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest DL CBW, ie. fully allocated UL configuration. |
| 7 | DL SCS | NR SCS should be the smallest SCS that is compatible with the configured DL CBW. |

Table 2 Summary for CA\_n1-n40 MSD test configuration

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Parameters | Test configuration B | Test configuration C |
| 1 | Carrier Frequencies | The UL and DL carrier frequencies should be configured to minimize the gap separating the DL victim carrier to the UL carrier frequency. |
| 2 | UL Channel bandwidth | 80MHz | 5MHz |
| 3 | UL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest UL CBW, ie. fully allocated UL configuration |
| 4 | UL SCS | NR SCS should be the smallest SCS that is compatible with the configured UL CBW |
| 5 | DL Channel bandwidth | 20MHz | 5MHz |
| 6 | DL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest DL CBW, ie. fully allocated UL configuration. |
| 7 | DL SCS | NR SCS should be the smallest SCS that is compatible with the configured DL CBW. |

Table 3 MSD test configuration for the other band combinations which only have case 3

|  |  |  |
| --- | --- | --- |
| No. | Parameters | Test configuration C |
| 1 | Carrier Frequencies | The UL and DL carrier frequencies should be configured to minimize the gap separating the DL victim carrier to the UL carrier frequency. |
| 2 | UL Channel bandwidth | Minimum channel bandwidth for UL aggressor band |
| 3 | UL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest UL CBW, ie. fully allocated UL configuration |
| 4 | UL SCS | NR SCS should be the smallest SCS that is compatible with the configured UL CBW |
| 5 | DL Channel bandwidth | Minimum channel bandwidth for DL victim band |
| 6 | DL RB allocation | Highest possible Lcrb that is compatible with the DFT-s-OFDM 2,3,5 radix rule for the highest DL CBW, ie. fully allocated UL configuration. |
| 7 | DL SCS | NR SCS should be the smallest SCS that is compatible with the configured DL CBW. |

Observation 5: MSD due to C-IM follows the principle that the C-IM interference PSD can be increasing as the decrease of UL RB allocation for aggressor band.Observation 6: the worst MSD level can be achieved if we just allocate one RB in the edge of aggressor channel and we just test one or two RBs which is hit by the C-IM interference in the victim band.Observation 7: Since there aren’t too many band combinations which need the MSD due to CIM interference, it will not cause much test efforts.Observation 8: It’s very important to distinguish whether Rx victim band fall into 1st/2nd adjacent channel or not when RAN4 specify the MSD.Proposal 2: It’s proposed to introduce MSD due to CIM interference for inter-band CA.Table 4: Reference sensitivity exceptions (MSD) due to counter intermodulation interference for CA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| UL band | DL band | SCS of UL/DL band (kHz) | LCRB of UL band | Applicable UL BW(MHz) | DL BW (MHz) | MSD value of DL band (dB) | CIM order |
| n1 | n3 | 15 | 25 | ≥ 25 | 5 | 4.5 | CIM5 |
| n1 | n3 | 15 | 25 | 50 | 5 | 17 | CIM3 |
| NOTE 1: For CIM5, the MSD exceptions are applicable to the case that CIM5 of UL band falls into the DL channels. (The frequency of CIM5 can be expressed as $f\_{CIM5}=F\_{C\\_UL}-5(f\_{UL}-F\_{C\\_UL})$, where $F\_{C\\_UL}$ is the centre frequency of UL channel and $f\_{UL}$ is the allocated transmission frequency of UL band).NOTE 2: For CIM3, the MSD exceptions are applicable to the case that CIM3 of UL band falls into the DL channels. (The frequency of CIM3 can be expressed as $f\_{CIM3}=F\_{C\\_UL}-3(f\_{UL}-F\_{C\\_UL})$, where $F\_{C\\_UL}$ is the centre frequency of UL channel and $f\_{UL}$ is the allocated transmission frequency of UL band). |

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## Open issues summary

**Issue 2.2-1: agreement on Huawei** [**R4-2110405**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2110405.zip) **Proposal 1**It’s proposed to choose one test configuration for MSD due to harmonic interference.

**Issue 2.2-2: agreement on Huawei R4-2110406 Proposal 1**It’s proposed to use table 1, table 2 and table 3 as general principles to specify the MSD due to cross band isolation using full RB allocation.

**Issue 2.2-2: agreement on Huawei R4-2110406 Proposal 2**It’s proposed to introduce MSD due to CIM interference for inter-band CA.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Issue 2.2-1: Issue 2.2-2:Issue 2.2-3: |
| Company B | Issue 2.2-1: Issue 2.2-2:Issue 2.2-3: |
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### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Title** | **Company** | **Comments collection** |
|  |  |  | Company A |
| Company B |
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|  |  |  | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |