**3GPP TSG-RAN WG4 Meeting #98-e R4-21xxxxx**

**Electronic Meeting, 25 January – 5 February 2021**

**Agenda item:** 9.30.1

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [98e][128] NR\_BCS4

**Document for:** Information

# Introduction

This email discussion is for Rel-17 NR BCS4 which was approved in WI [RP-202832](ftp://ftp.3gpp.org/TSG_RAN/TSG_RAN/TSGR_90e/Docs/RP-202832.zip) at RAN “90.

# Topic #1: General

## Companies’ contributions summary

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| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2101817](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101817.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. |
| [R4-2102187](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102187.zip) | Templates for BCS4 configurations for inter-band NR CA | ZTE Corporation | Proposal 1. Using the templates in Table 1-3 and Table 1-4, Table 1-5 and Table 1-6 for xUL/2DL and 1UL/3DL&/2UL/3DL NR CA/DC BCS4 band combination configurations requesting, respectively.  Proposal 2. For the same band combination, in case of both BCS0/1/2/3 and BCS4 are existed 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 3. It is needed to include BCS4 configurations in configurations tables in the 38.101-1 (clause 5.5A.3.1) and TS38.101-3(clause 5.5A.1). The templates in Table 1-4 and Table 1-6 without SCS column can be applied |
| [R4-2102150](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102150.zip) | Discussion on BCS4 | T-Mobile USA | Proposal 5: RAN4 to discuss the need for A-MPR analysis for the new channel bandwidths in the BCS4 configurations.  Proposal 6: RAN4 needs to decide on how to handle the documentation of support for BCS4 for NR CA and SUL band combinations. |
| [R4-2100088](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100088.zip) | Required changes to the original BCS4 idea | Nokia, Nokia Shanghai Bell | Observation 1: Optional CBWs for a NR band is explicitly defined in TS38.101-1. The other CBWs are mandatory support for the NR band.  Observation 2: There is no agreement that the 5MHz/10MHz is supported by default for all the band configurations.  Observation 3: In order for a UE to support a certain CBW for a band within a band configuration, the UE shall support the CBW for the band for single band operation, but the converse is not true  Observation 4: Method 3(Feature Set with BCS4 + Max and Min CBWs) is the most flexible and can realize what Method 3(traditional BCS + Max CBW) can do. Method 2(BCS4 + Max and Min CBWs) is the next flexible method and Method 1(the original BCS4 + Max CBW) is the least flexible.  Observation 6: Introduction of Method 3(Feature Set with BCS4 + Max and Min CBWs) requires that of Method 2(BCS4 + Max and Min CBWs). |
| [R4-2102502](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102502.zip) | Discussion on candidate methods for BCS4 | Qualcomm Incorporated | Observation 2: The supported CBW configurations for the bands in a band combination are per request from the proponents which means the supported CBW by UE in the single operation shall be supported in the band combination.  Observation 3: With Method 1, RAN4 will allow new BCSs to be created as requested for band combinations to ease IoDT efforts. That will lead to more RAN4 workload in which both original BCSs and BCS4 might be requested by proponents.  Observation 4: Method 2 can provide more flexible CBW reporting than Method 1 which can kind of solving the concerns on IoDT efforts. But Method 2 doesn’t work for the case if some of CBWs between maximum and minimum CBW are not supported in a band combination. |

## Open issues summary

### Sub-topic 1-1: BCS4 for all combinations or only requested combinations

* + Discuss and agree if BSC4 should be introduced for all combinations or if only for requested combinations

### Sub-topic 1-2: Configuration tables

* Proposals
  + Proposal 1. Using the templates in Table 1-3 and Table 1-4, Table 1-5 and Table 1-6 for xUL/2DL and 1UL/3DL&/2UL/3DL NR CA/DC BCS4 band combination configurations requesting, respectively.
  + Proposal 2. For the same band combination, in case of both BCS0/1/2/3 and BCS4 are existed 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 3. It is needed to include BCS4 configurations in configurations tables in the 38.101-1 (clause 5.5A.3.1) and TS38.101-3(clause 5.5A.1). The templates in Table 1-4 and Table 1-6 without SCS column can be applied
* Recommended WF
  + Agreement on proposal 1, 2 and 3 above

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| **Company** | **Comments** |
| ZTE | Out intention is to provide some guidance for future BCS4 configurations requesting/TP/draft CR. |
| Huawei | Sub-topic 1-1:  If “BCS4” is based on the request from operators, the specific issue can be solved one by one. It seems to be compatible with current procedure.  If “BCS4” is introduced for all band combinations, not sure RAN4 can reach an agreement in short term. If not, operators may have to request more BCSs before the agreement is reached.  Sub-topic 1-2:  For proposal 2, I wonder why are BCS0/1/2/3 combinations completed by default after BCS4 combinations TP/draft CR are approved? If new band combination with only BCS4 is requested, how can we know what the BCS0/1/2/3 are? I prefer to handle this case by case. |
| T-Mobile USA | Sub-Topic 1-1: Is this for existing combinations, or for new requests? We think that BCS4 should be the default for new requests, but other BCSs are still allowed. For existing combinations, we would prefer BCS4 apply to all combinations, but because of the MSD analysis we understand if it has to be by request. Will we make BCS4 requests for existing combinations via the existing baskets?  Sub-Topic 1-2: The proposals look reasonable. |
| Xiaomi | Sub-topic 1-1: BCS4 should be introduced for all combinations, the purpose of introducing BCS 4 is to avoid creating new BCSs for band combs again and again, if BCS 4 is just for some requested combs, other band combs also need different BCSs according to different request, RAN4’s workload will increase not reduce.  Sub-topic 1-2: prefer to assume BCS 4 is available for all band combs, I think it is no necessary to introduce BCS4 configurations in the configuration table in the Spec. |
| ZTE | Sub-Topic 1-1:  So far it seems there were no agreements that BCS4 is mandatory to be used for new combination requesting, so we need clear agreement here. We agree that BCS4 is used for new combination requesting after the BCS4 feature are introduced completely in the spec.  Before that, we think traditional BCS should be used, this is also the agreements in last RANP meeting. It should be noted that the overlapping work have been already happened in this meeting, so it is urgent to introduce BCS4 in the spec asap.  For the existing requested combinations, whether traditional BCS or BCS4 are use depend on the proponent which was agreed in last RANP meeting.  Sub-topic 1-2:  Response to Huawei：It is for “in case of both BCS0/1/2/3 and BCS4 are existed in the WID”, for example, CA\_nX-nY\_BCS0/1 and CA\_nX-nY\_BCS4 are existed in the WID, we don’t think it is needed to provide TP/draft CR for CA\_nX-nY\_BCS0/1, only CA\_nX-nY\_BCS4 is enough, and when CA\_nX-nY\_BCS4 TP/draft CR is approved, then CA\_nX-nY\_BCS0/1 combinations are completed by default. Otherwise, CA\_nX-nY\_BCS0/1 combinations can never be completed since no contributions input. We should treat the leftover BCS0/1/2/3.. combinations.  Response to Xiaomi: if no BCS4 in the configurations, how do we know the band configurations with BCS4? For example, for a brand new band combination with BCS4 requested, we should add such information in the configuration table. |
| Qualcomm | Sub-topic 1-1:  Per our understanding, BCS4 is applied for all the new requests. Other BCSs are allowed to request for the new requests. For the exciting band combinations, the current BCSs still work. If BCS4 can be used for the band combo depends on if MSD for all the possible band configurations are done. It would be check case by case. |
| Xiaomi | To ZTE: I agreed your comments, I just considered that the Clause 5.2A operating bands for CA has introduced the band combs, I ignored there is no detail configurations, i.e., UL configuration, and detail combinations. Therefore, for Sub-topic 1-2: I agree proposal 1. |
| CHTTL | subtopic 1-2  Thanks for providing the guidance, for clarification, the template is for BCS4 request, and the BCS0/1/2/3 can still be requested based on the existing form, is it correct understanding? |
| Ericsson | We agree with the Xiamo view on sub-topic 1-1: BCS4 should be introduced for all combinations, the purpose of introducing BCS 4 is to avoid creating new BCSs for band combs again and again, if BCS 4 is just for some requested combs, other band combs also need different BCSs according to different request, RAN4’s workload will increase not reduce.  Sub-topic 1-2: The proposals look reasonable. |
| Skyworks | 1-1: BCS4 should not apply to all combination blindly as some BW combination cases may not have a concrete deployment scenario. In some cases (either a new lowest or a new highest BW) is introduced in a band every combinations will see changed MSD (WC with lowest BW in harmonics or IMDs, or WC with largest BW for cross band), These worst cases may not represent any deployment MSD. We believe BCS4 should be requested. Adding BCS4 blindly will also increase the conformance test cases and in some cases not correspond to any deployment.  1-2: We do not see that BCS4 should take precedence over any other requested BCS. Anyhow if there is a specific request BSC4 or not it can be treated |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

Moderator: No CRs/TPs in this AI

## 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:None*  *Candidate options:Same as before*  *Recommendations for 2nd round:Continue the discussion* |

*Recommendations on WF/LS assignment*

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

### Sub-topic 1-1: BCS4 for all combinations or only requested combinations

* + Discuss and agree if BSC4 should be introduced for all combinations or if only for requested combinations

### Sub-topic 1-2: Configuration tables

* Proposals
  + Proposal 1. Using the templates in Table 1-3 and Table 1-4, Table 1-5 and Table 1-6 for xUL/2DL and 1UL/3DL&/2UL/3DL NR CA/DC BCS4 band combination configurations requesting, respectively.
  + Proposal 2. For the same band combination, in case of both BCS0/1/2/3 and BCS4 are existed 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 3. It is needed to include BCS4 configurations in configurations tables in the 38.101-1 (clause 5.5A.3.1) and TS38.101-3(clause 5.5A.1). The templates in Table 1-4 and Table 1-6 without SCS column can be applied
* Recommended WF
  + Agreement on proposal 1, 2 and 3 above

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| **Company** | **Comments** |
| Xiaomi | Sub-topic 1-1: BSC4 should be introduced for all combinations |
| Huawei | Sub-topic 1-1:  Since other BCSs are also allowed, I think BCS4 can be requested for both the existing CA combos and new CA combos. Not sure when operators are allowed to request BCS4 if requested BCS4 is agreed.  Sub-topic 1-2:  For proposal 2, if other BCSs are also allowed, there is no need to restrict BCS4 for TP and CRs. Perhaps, some of combos have some technical issues which BCS4 can’t be used even if BCS4 exist in the WID.  For proposal 3, we also have a similar proposal in R4-2101817. The general format can be agreed. However, the specific wording can be further improved. For bandwidth class B, C, the sentence is not same as current spec. |
| Qualcomm | Sub-topic 1-1: BCS4 for all combinations or only requested combinations  It should depend on the request. Proponents could request the BCS (BCS4 or other BCS) based on their specific request.  Sub-topic 1-2: Configuration tables  For P2, it is a little confusing. What does BCS0/1/2/3 are completed by default mean? Who is responsible for submit the CR and TP for BCS0/1/2/3 after BCS4 is agreed?  Could P3 only apply for inter-band CA table? |

## 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** |
| R4-2103271 | *Way forward on BCS4 for NR* |

# Topic #2: MSD

## Companies’ contributions summary

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| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2102928](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102928.zip) | Cross-band MSD for ENDC and NR-CA BCS4 | Skyworks Solutions Inc. | Proposal 1: Adopt the following general guidelines for Xband isolation MSD and UL configuration specifications   |  |  |  | | --- | --- | --- | |  | Uplink Aggressor Band | Downlink Victim Band | | Channel Bandwidth | EN-DC and NR-CA BCS4:  Highest CBW specified for the aggressor band  NR-CA BCS<4:  Highest CBW specified for the aggressor band in the CA BCS table. | EN-DC and NR-CA BCS4:  MSD and UL configuration to be specified for all victim’s band specified CBW.  NR-CA BCS<4:  MSD and UL configuration to be specified for all victim’s band CBW specified in CA BCS table. | | 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. | Fully allocated DL configuration | | SCS | SCS should be the smallest SCS that is compatible with the highest UL CBW | | | Carrier Frequency | The UL and DL carrier frequencies should be configured to minimize the gap separating the DL victim carrier to the UL carrier frequency. | |   Proposal 2: Xband isolation MSD specifications shall be revisited systematically whenever a new CBW is agreed in any band for the case of EN-DC combinations. For the case of NR-CA, these specifications should be reviewed systematically a new CBW is introduced in the combination BCS table, be it from BCS 0,1 range or for the new BCS4 concept.  Proposal 3: Remove ambiguity on NR-CA UL aggressor band UL CBW and DL victim band SCS by correcting/adding footnotes in a similar fashion similar as was agreed for EN-DC [3].  If proposal 3 is agreed, we propose to file corresponding CR either during this meeting or at the next meeting.  Proposal 4: In case new CBW are introduced in a given NR band, or new BCS 4 concept is agreed, review systematically all other MSD cases that might be impacted, for example MSD due to harmonic relation.  Proposal 5: Further study if Proposal 1 is sufficient to prevent the introduction of additional MSD TP as suggested in WF [2].  Proposal 6: Adoption of BCS4 for NR-CA should be carefully evaluated on a combination per combination basis in order to prevent triggering excessive workload on evaluating requirements that may no longer reflect the reality of commercial network deployments/cell configurations. |
| [R4-2101816](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101816.zip) | Discussion on how to simplify MSD definition 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.  Observation 3: Currently, there is a strong demand to use unified derivation method to fill up the missing MSD requirements.  Proposal 1: The equation-based representation without explicitly writing down the number for each channel bandwidth can be used for the MSD exception tables due to harmonic interference and cross band isolation.  Proposal 2: It’s proposed to use equation (4) to derive the MSD values of other channel bandwidths.  Proposal 3: It’s proposed to reconstruct the MSD requirements based on the table 1, table 2 and table 3 for the exceptions due to UL harmonic, harmonic mixing and cross band isolation.  Proposal 4: It’s proposed to reconstruct the MSD requirements based on the table 4 and table 5 for the SUL exceptions due to UL harmonic and cross band isolation. |
| [R4-2102150](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102150.zip) | Discussion on BCS4 | T-Mobile USA | Proposal 1: The RAN4 CR(s) for adding BCS4 can be independent of any signalling changes that we decide on for additional BCS4 parameters.  Proposal 2: Instead of infinite channel BW as a placeholder for MSD, RAN4 can use the MSD of the next smaller channel BW.  Proposal 3: Endorse the Draft CR in R4-2102151.  Proposal 4: RAN4 to discuss how to handle potential new MSD for combinations that have not previously been identified as having MSD. |
| [R4-2102151](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102151.zip) | Draft CR for 38.101-1: Introduction of BCS4 | T-Mobile USA, MediaTek | Draft CR for the introduction of BCS4 |
| [R4-2100088](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100088.zip) | Required changes to the original BCS4 idea | Nokia, Nokia Shanghai Bell | Observation 5: Once Method 3(Feature Set with BCS4 + Max and Min CBWs) is introduced, MSD issues due to the introduction of new CBWs will not become a BCS4 specific issue. |

## Open issues summary

### Sub-topic 2.1: MSD requirements

* Proposals
  + Endorse the draft CR R4-2102151 from T-Mobile that fills in MSD gaps
  + Implement the equation-based MSD calculation method proposed in R4-2101816 from Huawei
  + Adopt the general guidelines in R4-2102928 from Skyworks
* Recommended WF
  + Discuss if to change MSD method and representation or whether to use existing MSD tables and fill in the gaps
  + Adopt the general guidelines proposed
  + Agree on scope of CR
  + Based on outcome of discussions, possibly endorse CR filling in MSD gaps

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| **Company** | **Comments** |
| ZTE | Different companies have different proposals, how to converge?  We prefer to use a simple way to define/derive the MSD value:  1; For R4-2102151, it looks simple, but we would like to understand the principle to derive the values. For example, why 1.5dB for 40MHz for n1-n3 which is same with 30MHz. It seems the values should be scaled by the BW.   1. For R4-2101816, actually the equation (1) is not always for all bands, for FDD bands, duplexer gap needs to be considered to derive the REFSEN requirements(also for some band, the equation may not applicable considering CIM3/5 problem), and also for some new addition CBWs for a certain band, the REFSEN cannot be derived by a equation. And for equation (2), How to derive or define PI? does it total interference after MRC? We think it is no need to define PI in the spec, it is not the minimum RF requirement.   Last, we would like to remind that there are already some draft CR to add BCS1/2 configuration in basket WID agenda, where the cross band isolation MSD values are not included just waiting for the consensus in this thread. If the MSD values are not approved in this meeting, how to treat these draft CR? |
| Huawei | Generally, RAN4 just derive the MSD values for other channel bandwidth using the general principle. If RAN4 has a common understanding on the principle, the equation-based representation can be used for the MSD exception table, just like ACS, maximum input level and so on.  If RAN4 doesn’t have a common understanding on the principle, I’m not how we can derive MSD requirements for different channel bandwidth even if we just fill the table.  1) For MSD due to CIM3/CIM5, we can specify a new kind of MSD as suggested in R4-2016839. I suppose the MSD due to CIM3/CIM5 is related to the frequency relation just like harmonic. The general MSD due to cross band isolation is related to the PA spurious emission level and others.  2) PI is not a RF minimum requirements just like MSD. They are all the parameters. The RF requirements are the REFSENS considering exception. PI can be defined based on the general MSD analysis, |
| T-Mobile USA | To ZTE #1: MediaTek calculated 1.5 dB for n1->n3. For other rows we either copied existing rows for similar combinations that had the same values above and below the missing MSD, or we calculated values based on the interferer power, or MediTek commented about some of the values they added based on interpolation, and for others we used the next lower MSD value as a placeholder, instead of using infinity.  ZTE: Seems no general approaches to derive the values. It should be re-calculated case by case using the different approaches, also sometimes the values were averaged from different inputs, how can we reappear the interference? For n1->n3, could we agree 1.4dB for 40MHz by scaling with CBW? |
| Qualcomm | For R4-2102151, it seems the interpolation is used to derive the missing bandwidth. We need more time to check if the MSD is correct. For the MSD with NOTE x or square brackets, what’s the status for these band combos? Shall we market them as uncompleted?  For R4-2101816, RAN4 need to confirm if the general equation approach is valid for all the channel bandwidth of band combinations. What’s shall we do if the MSD derived by equation is not consistent with specification? Furthermore, the equation doesn’t show the dependence with Rx antenna number.  For R4-2102928, it looks like a general issue for all the band combinations regardless of BCS configurations. We agree e with P6 that we should check the MSD case by case. |
| CHTTL | For R4-2101816, it is a huge change to the specification, and usually MSD comes from the average from different inputs, we think it’s better to stick to existing approach, we just need to fill in the missing value due to the introduction of BCS4.  For R4-2102928, agree with P6 that we should check the MSD case by case. But regarding P1, highest CBW is specified for the aggressor band, but what if even larger CBW is introduced in the future, do we need to change the requirment? And another clarification, with the table, we will have two set of cross band isolation requirement if the Highest CBW of the aggressor band in BCS4 is larger than BCS <4? |
| Ericsson | For R4-2102151. We would like to endorse the CR.  For R4-2101816, we welcome the thinking of equation-based MSD and think this might be a very good way forward. But possibly some more time is needed to investigate this further and agree on a common view on how to apply this. |
| Skyworks | R4-2102151 is imcomplete on one side and implement BCS4 for all combinations which is not agreed. Furthermore some cross band isolations needs to be reviewed totally because the UL BW has also changed (on top of DL BW or not). We prefer to have a clear agreement on how and when BCS4 applies  We do not think eqution based approach works for all cases (for example IMD orders.. which have steps that are captured or not with BW) . We are Ok to study which cases could be based on equations  For R4-2102928 our guidelines are valid for any BCS that would introduce a new largest BW. It is important to recognize that there are even cases where a new largest BW could create an cross-band isolation MSD where it did not exist before. Recently there are combinations where the UL configuration contains intra-band UL CA and cross band isolation is even more of an issue then.  Regardless of the other aspects we need agree the guidelines which and how MSD must be updated we suggest we have a way forward on these guidelines and discuss our proposals in that context. |

## Companies views’ collection for 1st round

### Open issues

### 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** |
| R4-2102151 | Draft CR for 38.101-1: Introduction of BCS4 | T-Mobile USA, MediaTek | ZTE: It seems the description is only for A-A type configurations, how about high order configuration such as A-C type?  What does it mean "BCS4 is an available for every CA combinations"? Does it means it is no need to submit any Tdoc for the exising band combinations although there are many running TPs in this meeting? |
| Huawei: Comments from other company in this CR can be removed. 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. Currently, companies are still asking report BCS for intra-band EN-DC. Same situation is also applicable for NR CA. The general part in in 5.5A.0 can reflect the scope of BCS4. |
| Qualcomm: It seems the interpolation is used to derive the missing bandwidth. We need more time to check if the MSD is correct. For the MSD with NOTE x or square brackets, what’s the status for these band combos? Shall we market them as uncompleted? |
|  |  |  | Skyworks: agreements on BCS4 scope are needed first. We are OK that we have some place holder for issues to be solved but do not agree that all cases must be specified if there is no request. |
|  |  |  | Company A |
| Company B |
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## 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:None*  *Candidate options:Same as before*  *Recommendations for 2nd round:Continue the discussion* |

*Recommendations on WF/LS assignment*

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

### Sub-topic 2.1: MSD requirements

* Proposals
  + Revise and then possibly endorse the draft CR R4-2102151 from T-Mobile that fills in the MSD gaps
  + Start investigating the equation-based MSD calculation method proposed in R4-2101816 from Huawei
  + Adopt the general guidelines in R4-2102928 from Skyworks
* Recommended WF
  + Discuss if to change MSD method and representation or whether to use existing MSD tables and fill in the gaps
  + Adopt the general guidelines proposed
  + Agree on scope of CR
  + Based on outcome of discussions, possibly endorse CR filling in MSD gaps

The following Huawei documents have been moved to this email thread and are to be treated together with the discussion on R4-2102928 from Skyworks:

* + R4-2101602 DraftCR for 38.101-1 to add BCS1 for CA\_n1A-n3A (to be revised in R4-2103045).

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| **Company** | **Comments** |
| Huawei | For R4-2101816, I think we just derive the MSD requirements for different DL channel BW in one band combination. In fact, we didn’t specify them one by one for different DL channel BW. However, seems that the general deriving method for one band combination is lost, so that it’s very hard to fills these MSD gaps. For one band combination and one kind of MSD, the equation based approach can be applicable for all the channel bandwidths. (We have no intention to introduce this approach for IMD.)  For R4-2102928, it may be a good principle to derive the MSD due to the reason which is not CIM3/CIM5. For CIM3 and CIM5, the determined frequency relationship is similar with harmonic interference. And larger channel bandwidth may lower the PSD. For MSD due to CIM3 and CIM5, it’s very important to make sure all of the CIM interference fall into the DL channel bandwidth, which is the worst case. Similar to the harmonic interference, the minimum DL channel bandwidth and UL RB configuration is the worst case. Fully allocated UL configuration is not applicable for all the band combinations, considering the UL RB restriction for some of band combinations.  If there is no technical comments on R4-2103045, technical endorsed can be used at least. |
| Qualcomm | We are still checking the proposed values for the missing MSD. Need more time to check if the proposed MSD or general equation to calculate MSD is accurate or not.  Can companies help to clarify why this draft CR of R4-2101602 is treated in this email thread? Is it related with BCS4 discussion? It seems this draft CR should be treated in NR CA basket? |

## 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** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Signalling

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [R4-2102150](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102150.zip) | Discussion on BCS4 | T-Mobile USA | Proposal 1: The RAN4 CR(s) for adding BCS4 can be independent of any signalling changes that we decide on for additional BCS4 parameters. |
| [R4-2101371](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101371.zip) | The signalling for BCS4 | Xiaomi | Proposal 1: introduce a new UE signalling with BCS4 in IE *FeatureSetDownlinkPerCC, i.e., channelBWs-UL-ca/channelBWs-DL-ca.* The signalling allows UE report the channel bandwidths it supports by bitmap on one carrier of a band of a band combination, and absence of the signalling for a CC means that the UE supports all channel bandwidths in this CC as singe carrier operation.  Proposal 2: sent LS to RAN2 to ask introduce the new signalling as the annex. |
| [R4-2102188](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102188.zip) | Discussion on UE capabilities signalling to enable BCS4 | ZTE Corporation | Observation 1. The UE supported channel bandwidths for each band are limited by the signalling of channelBWs-DL and channelBWs-UL  Proposal. Signalling of BCS4 support per band combination. |
| [R4-2102502](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102502.zip) | Discussion on candidate methods for BCS4 | Qualcomm Incorporated | Observation 1: Except for original BCSs, there is no specific signalling to indicate the supported CBW for the bands in a band combination.  Observation 5: Method 3, i.e., BCS4 signalling with additional minimum channel bandwidth supporting on each carrier via multiple feature sets reporting is the best approach.  Proposal 1: RAN4 to agree to use the method of BCS4 signalling with additional minimum channel bandwidth supporting on each CC for the band combination reporting via multiple feature sets.  Proposal 2: Send an LS to RAN2 to inform above RAN4 agreement. RAN2 to introduce the signalling for minimum channel bandwidth supporting on each CC for the band combination and to allow UE signalling maximum and minimum channel bandwidth supporting on each CC for the same band combination via multiple feature sets |
| [R4-2100088](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100088.zip) | Required changes to the original BCS4 idea | Nokia, Nokia Shanghai Bell | Proposal: Introduce a new capability for a UE to indicate the supported minimum CBW per SCS per CC per NR band within a band configuration and allow the UE to indicate supported CBW combinations for a CA configuration via Feature Sets.  Proposal 2: Send an LS to inform RAN2 of a necessity of the new capability mentioned in Proposal 1 and a relevant feature set(s) to have an equivalent functionality that the traditional BCS has. |

## Open issues summary

### Sub-topic 3.1: Signalling

* Proposals

**Option 1**

* + R4-2101371 by Xiaomi, introduce a new UE signalling with BCS4 in IE FeatureSetDownlinkPerCC, i.e., channelBWs-UL-ca/channelBWs-DL-ca. The signalling allows UE report the channel bandwidths it supports by bitmap on one carrier of a band of a band combination, and absence of the signalling for a CC means that the UE supports all channel bandwidths in this CC as single carrier operation. Send LS to RAN2 to ask for introduction of such signalling.

**Option 2**

* + R4-2102188 by ZTE, Signalling of BCS4 support per band combination

**Option 3**

* + R4-2102502 by Qualcomm, RAN4 to agree to use the method of BCS4 signalling with additional minimum channel bandwidth supporting on each CC for the band combination reporting via multiple feature sets. Send an LS to RAN2 to inform above RAN4 agreement. RAN2 to introduce the signalling for minimum channel bandwidth supporting on each CC for the band combination and to allow UE signalling maximum and minimum channel bandwidth supporting on each CC for the same band combination via multiple feature sets

**Option 4**

* + R4-2100088 by Nokia, introduce a new capability for a UE to indicate the supported minimum CBW per SCS per CC per NR band within a band configuration and allow the UE to indicate supported CBW combinations for a CA configuration via Feature Sets. Send an LS to inform RAN2 of a necessity of the new capability mentioned in Proposal 1 and a relevant feature set(s) to have an equivalent functionality that the traditional BCS has

**Option 5**

* + R4-2101817 by Huawei, The first candidate method (original BCS4 method) without “minimum channel bandwidth” capability can be chosen by RAN4.
* Recommended WF
  + Converge on type of capability signalling to be used.
  + Discuss the content of LS to RAN2 asking about possibility for such signalling.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | For clarification, our proposal (i.e. Option 2) is also adopt the original BCS4 method, i.e. no minimum channel bandwidth capability should be selected. So actually option 2 is similar with Option 5.  In our understanding, before RAN4 introduce a 'BCS4' concept, there are no any difference for BCS01/2/3/4 from RAN2 perspective. Also the IoDT issue have already been considered when RAN2 introduced the channelBWs-DL and channelBWs-UL(i.e. IoDT bit capabilities) according to RP-181443 and R2-1810907. Therefore, we think the current RAN2 signalling can work, i.e. no need to introduce new signalling. |
| Huawei | We share the same view with ZTE. The first candidate method (original BCS4 method) without “minimum channel bandwidth” capability can be chosen by RAN4.  In R4-2101371, one kind of ambiguity was identified for intra-band CA case. However, there is no such ambiguity for inter-band CA, so the proposed UE signalling is unnecessary.  In R4-2100088 and R4-2102502, some special cases are provided as below.  C:\Users\z00471447\AppData\Roaming\eSpace_Desktop\UserData\z00471447\imagefiles\D1EACCEB-2090-48B1-8BC6-FD0CBD6ABF0D.png  C:\Users\z00471447\AppData\Roaming\eSpace_Desktop\UserData\z00471447\imagefiles\F5724085-13F5-4F67-8E03-8779461F974A.png  However, they are not the real demand from operators if you check all the spec and basket WI.  I wonder why RAN4 need to discuss a conceive scenario. |
| T-Mobile USA | We disagree with the Option 1 proposal from Xiaomi. There already is a bitmap in RAN2 signalling. One of the key aspects of BCS4 is it uses existing signalling.  We support Option 2. As with existing, BCSs, BCS4 should be signalled per band combination.  We’re not sure if Option 3 Multiple feature sets is worth the complexity. What if the operator only wanted multiples of 20 MHz? Seems like a tradition BCS will be simpler and cover all cases.  We support Option 4, to include a minimum channel BW parameter. This seems like it will be useful.  We would be OK with Option 5, but think that Option 4 would be better. |
| Nokia | To ZTE/Huawei: In our understanding, using channelBWs-DL and channelBWs-UL to reduce the number of channelBW combinations means UEs will lose to use availability of some channelBWs as single band operation. This would violate mandatory conditions in some cases. We understand that not all the UEs use all possible channelBW combinations during CA mode, but these UEs still want to use these lost channelBWs as single band operation.  We technically compare each method and multiple feature sets usage can provide the best flexibility among them at the cost of complexity. But in order to address the raised IoDT cost issue and to proceed with this BCS4 discussion, we believe at least the introduction of minimum channel bandwidth is necessary. This can address most of the existing channelBW combinations cases. |
| Xiaomi | Firstly, I would like to correct our proposal as introduce a new UE signalling with BCS4 in IE FeatureSetUplinkPerCC/FeatureSetDownlinkPerCC, i.e., channelBWs-UL-ca/channelBWs-DL-ca, I missed FeatureSetUplinkPerCC in my contribution.  Secondly, ZTE said IoDT issue have already been considered when RAN2 introduced the channelBWs-DL and channelBWs-UL, yes, but it is for single carrier operations. Current issue is how to guarantee the IoDT issue for the band combs when the UE supporting channel bandwidths are different for the band between single carrier operation and the band combs, if we just introduce BCS 4 simply like Option2. Before, we guarantee the difference using BCS1/2/3, now BCS4 contains all possible defined channel bandwidths for each band in the combination.  Thirdly, multiple feature sets need UE multiply report the min and max channel bandwidth that it supports, Compared with Option 1, all need add a new signalling, why don’t we use the similar way with the single carrier operation to resolve the IoDT issue? |
| ZTE | Disagree with Option 1 proposed by Xiaomi, reasons are the same with T-Mobile USA.  To Nokia, it seems same situations for introducing minimum channel bandwidth signalling that lose to use availability of some channelBWs as single band operation, also violate mandatory conditions in some cases...  [Qualcomm]: Per our understanding, min, channel bandwidth signalling is only used for band combination. It has nothing to do with supporting BW in single band operations. channelBWs-DL/UL are still valid for signal band operation.  Since the IoDT issues were also raised when RAN2 defined the signalling 2.5 years ago, so we think we can sent a LS to ask RAN2’s understanding to see whether or not the current RAN2 signalling are enough to solve IoDT issues for BCS4.  [Qualcomm]: In our paper [R4-2102502](ftp://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102502.zip), we analyse the current signlling in RAN2 and seems option 3&4 is the best way to solve this IoDT issue. |
| Qualcomm | To ZTE/Huawei, we have the similar view as Nokia and Xiaomi that the current channelBWs-DL and channelBWs-UL are ONLY used to signal the supporting CBW for single band operation. It could not be used to signal the supporting CBW for band combination. Otherwise, why we defined BCSs for band combinations? UE can support all the CBW for single band operation. Meanwhile, UE can support some of CBW configurations for the band combination via BCSs reporting.  To Huawei’s comments on “special cases”, yes, it is the not the case in the spec, but it is might be the real request from operators in IoDT. In addition, we couldn’t prevent operators from requesting the band combinations with certain CBW configurations in future.  To Xiaomi, introducing new singling for channelBWs-UL-ca/channelBWs-DL-ca can solve the IoDT issues, the problem is it will increase signalling overhead very much since UE will have to report bitmap signalling for all the supported band combinations. Multiple set has been supported from RAN2, anyway, UE will report the signalling via multiple feature sets.  [Xiaomi]:Yes, signalling overhead is a problem, compared with flexible, maybe the signalling overhead can be ignored, maybe we can ask RAN2’s opinion.  To T-Mobile, in your example, if the operator only wanted multiples of 20 MHz, UE can report one feature set with 20Mhz for both max and min CBW. Option 3 can flexibly indicate any CBW supporting in a band combination.  From my reading, Option 3 and Option 4 are equivalent. Both Nokia and QC are proposing to introduce minimum CBW per CC via existing multiple feature sets singling.  In general, we think the intention of introducing BCS4 is to reduce the RAN4 work rather than limiting UE/network implementation. The option 3&4 are equivalent to the traditional BCSs approach meanwhile it can reducing the workload in RAN4. Therefore, we support option 3&4. |
| Ericsson | We share the same view as ZTE and Huawei. The first candidate method (original BCS4 method) without “minimum channel bandwidth” capability is preferred. We don’t want additional signalling to be added. |

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

Moderator: No CRs/TPs in this AI

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:None*  *Candidate options:Same as before with the exception of option 2 and 5 which are now merged*  *Recommendations for 2nd round:Continue the discussion* |

*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*

|  |  |
| --- | --- |
| **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)

### Sub-topic 3.1: Signalling

* Proposals

**Option 1**

* + R4-2101371 by Xiaomi, introduce a new UE signalling with BCS4 in IE FeatureSetDownlinkPerCC, i.e., channelBWs-UL-ca/channelBWs-DL-ca. The signalling allows UE report the channel bandwidths it supports by bitmap on one carrier of a band of a band combination, and absence of the signalling for a CC means that the UE supports all channel bandwidths in this CC as single carrier operation. Send LS to RAN2 to ask for introduction of such signalling.

**Option 2**

* + R4-2102188 by ZTE and R4-2101817 by Huawei, Signalling of BCS4 support per band combination

**Option 3**

* + R4-2102502 by Qualcomm, RAN4 to agree to use the method of BCS4 signalling with additional minimum channel bandwidth supporting on each CC for the band combination reporting via multiple feature sets. Send an LS to RAN2 to inform above RAN4 agreement. RAN2 to introduce the signalling for minimum channel bandwidth supporting on each CC for the band combination and to allow UE signalling maximum and minimum channel bandwidth supporting on each CC for the same band combination via multiple feature sets

**Option 4**

* + R4-2100088 by Nokia, introduce a new capability for a UE to indicate the supported minimum CBW per SCS per CC per NR band within a band configuration and allow the UE to indicate supported CBW combinations for a CA configuration via Feature Sets. Send an LS to inform RAN2 of a necessity of the new capability mentioned in Proposal 1 and a relevant feature set(s) to have an equivalent functionality that the traditional BCS has
* Recommended WF
  + Converge on type of capability signalling to be used.
  + Discuss the content of LS to RAN2 asking about possibility for such signalling.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | We still believe option 3 or 4 is the way we should take.  For option 1, we would understand the motivation that Xiaomi proposed the option 1. If we had started the discussion on BCS4 at the beginning of NR introduction, the Option could have been one of the candidates. For Option 2, this is not realistic. Again, there are UEs which do not like to support some bandwidth combinations for CA configurations but these UEs still want to support channel bandwidths for some bands as single band operation. The option 2 does not allow to do such situations. This would be quite a bigger restriction compared to the conventional BCS. |
| Xiaomi | For Option 2, we agree Nokia, there are the UE indeed which do not like to support some bandwidth combinations for CA configurations but these UEs still want to support channel bandwidths for some bands as single band operation. RAN4 should keep this restriction like the conventional BCS to allow UE avoid unnecessary configure and test.  Compared Option1 with Option 3 or 4, Qualcomm commented that Option 1 will increase signalling overhead very much, so I reconsidered the signalling overhead issue, currently FR1 has 13 CBW and it will be 15 CBWs considering brand channel bandwidth. Therefore, Option 1 need 16 bit. And Max CBW and min CBW need 5bit separately. For multiple feature set, it needs 10bit when report once, it will need 20bit when report twice. Obviously, when multiple feature set reports twice, the signalling overhead will be large than Option1, and has less flexible than Option 1.  I think it is unnecessary to talk about the pros and cons compared Option1 and Option3 or 4, we should agree the signalling to restrict the configuration for CBW is need at first, then we can send LS to RAN2 including current candidates signalling solutions, let RAN2 evaluate which method will be chose, maybe RAN2 has better solution than Option1/3/4. |
| Huawei | Generally, BCS is based on the operators’ request instead of UE’s like or dislike. If UE don’t like this BCS, it’s unnecessary to report it. Again, there is no need to spend time discussing the imaginary scenario. If companies dislike some of channel bandwidths in Table 5.3.5-1 from TS 38.101-1, you should remove them firstly. If not, it means there is clear market demand for some operators in the world and we can’t agree UE to do it by reporting minimum CBW capability. |
| Qualcomm | We share the same view as Nokia.  In addition to Nokia’s comments, option 2 will introduce additional design and IoDT burden to UE which is not acceptable for us. The intention of introducing BCS4 is to reduce the RAN4 workload so it should not bring any other issues for UE. RAN4 could reach the consensus firstly that channelBWs-UL/DL is the signalling for single carrier operation. The new signlling of min. CBW proposed in option 3 or option 4 is the signalling for CA operation. They are different UE capability. Furthermore, for intra-band CA, it is not possible to use original BCS4 (i.e., option 2) since UE could not support all the possible combinations of CBW in single carrier operation. Therefore, additional signalling is necessary.  Response to Xiaomi:  Can you elaborate why 16bits for option 1. For example, 15bits for each band, if we consider 2 bands combination, would we need 30bits to indicate the possible CBW configurations rather than 16bis?  Response to Huawei:  As Nokia, Xiaomi commented, channel bandwidths in Table 5.3.5-1 from TS 38.101-1 is for single carrier operation rather than CA operation. UE could support all the CBW for single carrier operation but only support some of CBWs in CA operation. Otherwise, can you explain why we specified SupportedBandwidth and BCS? |

## 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** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |