3GPP TSG-RAN WG2 #116-e Tdoc draftR2-2111543

Electronic meeting, 1st – 12th November 2021

Agenda Item: 8.12.2.2

Source: Ericsson (Rapporteur)

Title: Report - Using NCD-SSB instead of CD-SSB for RedCap UEs (PH3)

Document for: Discussion, Decision

# 1 Introduction

RAN1 sent an LS to RAN2 and RAN4 on use of NCD-SSB instead of CD-SSB in [R2-2110727](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_116-e/Docs//R2-2110727.zip). RAN1 discussed the following options related to configuration and use of DL BWPs for RedCap:

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| * **For FR1, following options:**   + **Option 1:**     - **For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0),**       * **RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**     - **For an RRC-configured active DL BWP (if it does not include CD-SSB and the entire CORESET#0),**       * **RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**   + **Option 2:**     - **For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0),**       * **If it is configured for random access while not for paging in idle/inactive mode, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**         + **FFS: For BWP#0 configuration option 1, whether the UE can expect SSB transmission in the separate initial DL BWP when it is used in connected mode.**       * **If it is configured for paging, RedCap UE expects it to contain NCD-SSB for serving cell but not CORESET#0/SIB.**     - **For an RRC-configured active DL BWP in connected mode (if it does not include CD-SSB and the entire CORESET#0),**       * **RedCap UE expects it to contain NCD-SSB for serving cell [FFS: or CSI-RS or measurement gap configuration] but not CORESET#0/SIB.**   + **Note: if a separate initial/RRC configured DL BWP is configured to contain the entire CORESET#0, CD-SSB is expected by RedCap UE.**   + **Note: The network may choose to configure SSB or MIB-configured CORESET#0 or SIB1 to be within the respective DL BWP.**   + **FFS: For Option 1 and Option 2, whether RedCap UE can/cannot expect SSB under certain other conditions, e.g., for SSB monitoring periodicity (i.e., SMTC configuration) and DRX cycle**   + **FFS: Whether additional mechanism for SI update or how SI update notifications and/or SI updates are signaled to RedCap UEs**   + **FFS: FR2 case** |

In the LS, RAN1 asks for feedback from RAN2 and RAN4 on the following questions:

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| RAN1 respectfully requests RAN2 and RAN4 to provide feedback about the use of NCD-SSB instead of CD-SSB in terms of functionality feasibility, performance/coexistence, and specification/implementation impacts (when applicable) for idle/inactive/connected mode procedures for serving and non-serving cells for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB. Specifically, RAN1 would like RAN2/RAN4 to respond to the following questions before the RAN1#107-e meeting:   1. [RAN2/4] whether it is feasible to use NCD-SSB for serving and non-serving cell measurements for idle, inactive, and/or connected mode for all or some of RRM, RLM, BFD, link recovery, RO selection, mobility, time/frequency tracking and AGC 2. [RAN2/4] whether it is feasible to use NCD-SSB as QCL source of other DL channels/signals and as spatial relation (for UL channels/signals) transmitted in idle, inactive, and/or connected mode in the initial/non-initial DL BWP of RedCap UE 3. [RAN2] whether/when the PCIs indicated by the NCD-SSB and CD-SSB can be the same/different, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE 4. [RAN2/4] whether/when periodicities and/or TX power and/or block indexes (provided by *ssb-PositionsInBurst* in SIB1 or in *ServingCellConfigCommon*) and/or QCL sources of NCD-SSB can be same/different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE 5. [RAN2/4] whether it is necessary to introduce configuration limitations for NCD-SSB (e.g., regarding frequency locations, periodicity), e.g., to ensure coexistence with legacy UEs 6. [RAN2/4] if CD-SSB is not transmitted in the non-initial DL BWP of RedCap UE, whether it is feasible to transmit periodic CSI-RS for UE to use as an alternative of SSB in the non-initial BWP of RedCap UE or rely on UE performing RF retuning as in measurement gap outside active BWP for BWP without SSB nor CORESET#0 operation 7. [RAN2/4] whether it is feasible for a RedCap UE to retune to a CD-SSB rather than use an NCD-SSB of larger periodicity 8. [RAN2/4] any other potential impacts identified by RAN2/4 on support NCD-SSB for measurement   In order for the RAN1 work within the Rel-17 RedCap WI to be finalized in December 2021 as expected, RAN1 would need responses from RAN2 and RAN4 already before RAN1#107-e, which starts 11th November 2021. |

In RAN2#116-e, an offline discussion took place to summarize the Tdocs listed below with an intention to come up with a list of proposals that are agreeable and a list of proposals that require further discussion during the online discussion that followed.

* [1] [R2-2109576](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109576.zip), Definition and reduced capabilities for RedCap UE, and NCD-SSB related LS, Huawei, HiSilicon
* [2] [R2-2109741](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109741.zip), Discussion on NCD SSB and UE type for RedCap UEs, vivo, Guangdong Genius
* [3] [R2-2109448](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109448.zip), Reply LS on use of NCD-SSB instead of CD-SSB for RedCap UE, Qualcomm Incorporated
* [4] [R2-2109451](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109451.zip), NCD-SSB and RedCap-specific BWPs, Qualcomm Incorporated
* [5] [R2-2110095](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2110095.zip), Making ND-SSB work for RedCap in Rel-17, Apple
* [6] [R2-2110773](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2110773.zip), Use of NCD-SSB instead of CD-SSB for RedCap UEs, Ericsson

The report from the offline discussion was provided in [R2-2111334](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111334.zip) and during the online discussion that followed, the following was agreed:

RAN2 confirmed understanding of the current situation:

(FFS if any of the following will be included in a reply LS to RAN1

1. For idle/inactive UEs, the concept of non-cell-defining SSB (NCD-SSB) and the corresponding procedures, i.e., measurements, cell (re-)selection, do not exist in the current RAN2 specifications.
2. For idle/inactive UEs, using NCD-SSB for measurements and cell (re-)selection would still require the UE to re-tune to the CORESET#0 for reading SIBs.
3. In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD- or NCD-) SSB, but it does not allow using an NCD-SSB for RLM, BFD, link recovery, RO selection, mobility (mobility here refers to the frequency indicated in FreqDLInfo in HO command), in TCI-states or for any other functionality (other than RRM measurements).
4. It would be feasible to inform IDLE, INACTIVE and CONNECTED UEs about a NCD-SSB, however it is up to RAN1 and RAN4 to decide whether it is possible to use a NCD-SSB as QCL source.
5. According to the current RRC specification, PCIs indicated by other SSB and CD-SSB may be either the same or different if both other SSB and CD-SSB are transmitted on the serving cell.
6. PCIs indicated by the NCD-SSB and CD-SSB should be configured as same if both NCD-SSB and CD-SSB are transmitted on the serving cell.
7. According to the current RRC specification, periodicities and/or TX power and/or block indexes (provided by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon) and/or QCL sources of other SSB may be either the same or different from those of CD-SSB, if both other SSB and CD-SSB are transmitted on the serving cell.
8. Use of CSI-RS for cell and beam RLM and measurements is already supported from RAN2 signalling standpoint.

The report from the second phase of the offline discussion was provided in [R2-2111348](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111348.zip) and during the online discussion that followed, there was no progress. In this document, we continue the discussion based on the agreements above and the comments from the second phase of the discussion with the intention to finalize the replies to questions from RAN1 provided in the LS.

# 2 Discussion on draft replies to questions from RAN1

## 2.1 Question 1

**RAN1 Q1:** *[RAN2/4] whether it is feasible to use NCD-SSB for serving and non-serving cell measurements for idle, inactive, and/or connected mode for all or some of RRM, RLM, BFD, link recovery, RO selection, mobility, time/frequency tracking and AGC*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R1:** In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD or NCD) SSB. For RLM, BFD, link recovery, RO selection, mobility, i.e., assuming that here “mobility” refers to the frequency indicated in *FreqDLInfo* in HO command, in TCI-states or for any other functionality (other than RRM measurements), current RRC signalling does not use NCD-SSB, however from signalling standpoint it would be feasible to inform the UE about an NCD-SSB which it shall use instead of the CD-SSB.

In idle/inactive mode it would be feasible to inform UEs about an NCD-SSB from signalling standpoint. The concept of non-cell-defining SSB (NCD-SSB) and the corresponding procedures, i.e., measurements, cell (re-)selection, do not exist in the current RAN2 specifications and using NCD-SSB for measurements and cell (re-)selection would still require the UE to re-tune to the CORESET#0 for reading SIBs.

RAN2 could not conclude the discussion onwhether the impact on specifications due to using NCD-SSB instead of CD-SSB for serving and non-serving cell measurements for idle/inactive mode, would be substantial.

**Q1** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

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| **Company** | **Comments** |
| Apple | We already have the below response for Q8:  **RAN2 R8:** There may be more potential impact due to the use of NCD-SSB instead of CD-SSB. This reply LS captures what RAN2 has identified at this point in time, but more discussion is needed for further consideration.  **From this standpoint, we do not see the need to again say (in a way that can be incorrectly inferred in RAN1).**  **1st preference:**  **RAN2 R1:** In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD or NCD) SSB. For RLM, BFD, link recovery, RO selection, mobility, i.e., assuming that here “mobility” refers to the frequency indicated in *FreqDLInfo* in HO command, in TCI-states or for any other functionality (other than RRM measurements), current RRC signalling does not use NCD-SSB, however from signalling standpoint it would be feasible to inform the UE about an NCD-SSB which it shall use instead of the CD-SSB.  In idle/inactive mode it would be feasible to inform UEs about an NCD-SSB from signalling standpoint. The concept of non-cell-defining SSB (NCD-SSB) and the corresponding procedures, i.e., measurements, cell (re-)selection, do not exist in the current RAN2 specifications and using NCD-SSB for measurements and cell (re-)selection would still require the UE to re-tune to the CORESET#0 for reading SIBs.  **If companies insist on saying again for the idle/inactive in R1, when R8 already does the same, we want them to be in sync.**  **2nd preference:**  **RAN2 R1:** In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD or NCD) SSB. For RLM, BFD, link recovery, RO selection, mobility, i.e., assuming that here “mobility” refers to the frequency indicated in *FreqDLInfo* in HO command, in TCI-states or for any other functionality (other than RRM measurements), current RRC signalling does not use NCD-SSB, however from signalling standpoint it would be feasible to inform the UE about an NCD-SSB which it shall use instead of the CD-SSB.  In idle/inactive mode it would be feasible to inform UEs about an NCD-SSB from signalling standpoint. The concept of non-cell-defining SSB (NCD-SSB) and the corresponding procedures, i.e., measurements, cell (re-)selection, do not exist in the current RAN2 specifications and using NCD-SSB for measurements and cell (re-)selection would still require the UE to re-tune to the CORESET#0 for reading SIBs.  Other than the above impact on idle/inactive procedures using NCD-SSB, RAN2 did not have sufficient time to conclude on whether the impact on specifications due to using NCD-SSB instead of CD-SSB for serving and non-serving cell measurements for idle/inactive mode, would be substantial.  Apple notes (not as part of LS reply): We think that above is a fair reflection of the current situation. We do not think there actually was an active discussion online discussing the specification impact on NCD-SSB in idle/inactive and stating that there is no consensus incorrectly reflects that RAN2 had many discussions and that there was no convergence. |
| Qualcomm | We agree with Apple that the last paragraph is redundant with reply to Question 8. We think it is better to give a single answer on the potential impacts. So we’d propose not to include the last paragraph in the reply to Q1 and give an overall answer in Q8.  In addition, we also agree with Apple’s comment that “no consensus” does not correctly reflect the current situation in RAN2. We did not have sufficient online discussions on the potential impacts. We did not even get chance to review the summary of offline discussion (rapporteur’s proposals) before online. |
| CATT | We are ok on the modified reply text. But we suggest to deleting the last sentence “RAN2 will inform RAN1 if substantial impacts are identified later.” Because this seems like leaving RAN2 a homework, but we are not sure whether we have further discussion plan on this.  We don’t agree to remove the last paragraph, but ok to some modification to show the current RAN2 situation on this question. The last paragraph is about the RAN2 situation on question 1, but the Q8 and the corresponding reply are talking about whether there are any other impacts in addition to the questions the corresponding reply listed above. We don’t think there is any redundancy. |
| Huawei, HiSilicon | If people think RAN2 did not spend sufficient time to discuss the spec impact, why do we reply RAN1 on Q1 so rush? |
| Spreadtrum | We share the similar view as Apple and Qualcomm that the last paragraph is redundant. It has been included in reply of Question 8. |
| Samsung | We share the view with all the comments from Huawei:  - the term 'feasible' should be updated to 'possible', as it is from signalling perspective only (as ZTE also raised from the discussion).  - We are fine with the original wording for the second part (i.e. beginning with 'There is no consensus...' which reflects the RAN2 situation correctly. It should be noted that RAN1 only have one meeting left for Rel-17, so we cannot provide further input in our future meeting anyway... |
| Vivo | We prefer to remove the last paragraph, as it is not the fact in RAN2. “No consensus” doesn’t reflect the true situation in RAN2, as we didn’t have extensive discussion on the detailed design in RAN2.  But if companies have strong preference to add something, QC’s suggestion is preferred, and Apple’s wording is also acceptable.  Or alternatively, we could just need to mention that: *there are several companies indicate in RAN2 that the impact on specifications due to using NCD-SSB instead of CD-SSB for serving and non-serving cell measurements for idle/inactive mode, would be substantial.* |
| OPPO | We share the same view as Apple that the last paragraph is redundant. |
| Intel | Same view as QC and Apple. The last paragraph has been covered by the answer in Q8. Therefore it should be removed.  If companies really want to mention the situation here, we would prefer the version from Apple, but change “conclude” to “assess”, i.e..  Other than the above impact on idle/inactive procedures using NCD-SSB, RAN2 did not have sufficient time to assess whether the impact on specifications due to using NCD-SSB instead of CD-SSB for serving and non-serving cell measurements for idle/inactive mode, would be substantial. |
| DENSO | Agree with Qualcomm and Apple. It is premature to conclude “no consensus” given that potential impacts have yet to be discussed. Intel’s text proposal looks good to explain the current status. |
| LGE | We are generally fine with the draft.  We directly left two comments for the last graph.   * As we discussed in the meeting, we suggest to start with “RAN2 was not able to discuss ~ “.   No need to include “RAN2 will inform RAN1 if substantial impacts are identified later.“ Because we do not expect further discussion on this without any request. |
| MediaTek | Q1 only asks if it is feasible or not, and the first two paragraphs answer the question.  The final paragraph is unnecessary because it is:   1. not part of the question asked by RAN1 2. redundant as pointed out by others above in light of response to Q8 3. open to interpretation as ‘substantial’ is a subjective term |
| Ericsson | We prefer to indicate the status regarding the impact in idle/inactive mode and do not think that this is just a repetition of what is indicated in the reply to Q8. If “no consensus” is not acceptable to some companies, we are fine to indicate that RAN2 could not conclude whether the impact would be substantial due to limited time. We should not give the impression that RAN2 will provide further input though considering that this is the last RAN1 meeting and RAN2 does not intend to discuss this further. Please see the text above for the proposed updates.  [Huawei]: Based on the reply/clarification on “possible” and “feasible” from Ericsson in the comments, We understand “possible” = “already possible” but “feasible”= ‘can be possible”. **Therefore, we should change “~~possible~~” in our answer** **in Q7 to R1 into “already possible”.** |
| ZTE | For the operations in RRC\_Connected mode (except mobility), it is possible to use NCD-SSB instead of CD-SSB. But for idle/inactive activities, e.g. cell (re)selection, UE has to read the SIB1 of target cell, and this can only be done on CD-SSB.  During 1st round of offline discussion, companies (including us) have raised several open issues of using NCD-SSB in idle/inactive mode, but so far, no feedbacks or solutions have been provided.  Based on discussion we have during the 1st and 2nd rounds of offline, we think all companies agree that using NCD-SSB in idle/inactive mode is much more difficult than in connected mode.  So in the reply LS, we should avoid implying RAN1 that everything may easily be supported, but finally realize that it is hard to finish the study and specification work in RAN2 in Rel-17!  For compromise, we propose the following:  *RAN2 observes that using NCD-SSB instead of CD-SSB for idle/inactive modes is more difficult than for connected mode, and RAN2 did not have sufficient time to assess the impact on specifications due to using NCD-SSB instead of CD-SSB for serving and non-serving cell measurements for idle/inactive mode, would be substantial.* |

**Summary - Q1**

TBD

## 2.2 Question 2

**RAN1 Q2:** *[RAN2/4] whether it is feasible to use NCD-SSB as QCL source of other DL channels/signals and as spatial relation (for UL channels/signals) transmitted in idle, inactive, and/or connected mode in the initial/non-initial DL BWP of RedCap UE*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R2:** From signalling perspective, it is feasible to inform UEs in idle, inactive and/or connected mode about and NCD-SSB. However, it is up to RAN1 and RAN4 to decide whether it is possible to use an NCD-SSB as QCL source and spatial relation.

**Q2** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

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| **Company** | **Comments** |
| Apple | Agree. |
| Qualcomm | RAN1 also asked about the feasibility of using NCD-SSB for spatial relations but the current reply does not include answer on that. In our understanding, that is feasible too, the same as how NCD-SSB can be used as QCL source. |
| CATT | Agree. But we suggest the following modification:  From signalling perspective, it is feasible to configure NCD-SSB as QCL source and spatial relations for UEs in idle, inactive and/or connected mode.  We think what we can do “ From signalling perspective“ is “it is feasible/possible to configure“, we should leave all the evaluation of whether “it is feasible/possible to use“ to RAN1 and RAN4. |
| Huawei, HiSilicon | For the 1st sentence, we suggest the wording originally from rapporteur in phase2. “From signalling perspective, it is feasible to inform UEs in idle, inactive and/or connected mode about and NCD-SSB.”  The wording “it is feasible to use” is conflict with the 2nd sentence “it is up to R1/R4 to decide whether it is possible to use”.  Not prefer to add “spatial relation”. |
| Spreadtrum | Fine for the Qualcomm’s version. |
| vivo | Agree with Qualcomm’s text. |
| OPPO | Agree with QC’s suggestion. |
| Intel | We support the changes from QC. |
| DENSO | Agree with Qualcomm |
| MediaTek | Support Qualcomm’s addition as it is part of the question asked by RAN1. |
| Ericsson | The following (assuming that it includes the update from QC) is fine for us:  “From signalling perspective, it is feasible to inform UEs in idle, inactive and/or connected mode about an NCD-SSB. However, it is up to RAN1 and RAN4 to decide whether it is possible to use an NCD-SSB as QCL source and spatial relation.“ |
| ZTE | Agree with HW, from signalling point of view, it is possible to provide a NCD-SSB. But, whether it is feasible to use it as QCL source or spatial relation is out of RAN2 domain, and should be determined by RAN1/4. |

**Summary – Q2**

TBD

## 2.3 Question 3

**RAN1 Q3:** *[RAN2] whether/when the PCIs indicated by the NCD-SSB and CD-SSB can be the same/different, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE.*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R3:** According to the current RRC specification, PCIs indicated by NCD-SSB and CD-SSB may either be same or different if both NCD-SSB and CD-SSB are transmitted by the same serving cell. However, RAN2 thinks that PCIs indicated by NCD-SSB and CD-SSB should be configured as same if both NCD-SSB and CD-SSB are transmitted by the same serving cell.

**Q3** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

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| --- | --- |
| **Company** | **Comments** |
| Apple | Agree. |
| Qualcomm | Suggested minor editorial changes, e.g. “by the same serving cell” |
| CATT | We insist to add the following sentence at the last:  But this will impose some limitation on network deployment.  We RAN2 may have more clear concept on sysmtem impact, so we should feed back more information to help RAN1 and RAN4 form complete image on this issue. |
| Huawei, HiSilicon | The last half sentence “and NCD-SSB is used for serving and non-serving cell measurements for idle, inactive, and/or connected mode” is only proposed by one companies. We should remove it. Let’s stick to the RAN2 agreement.   1. According to the current RRC specification, PCIs indicated by other SSB and CD-SSB may be either the same or different if both other SSB and CD-SSB are transmitted on the serving cell.   We are open to the wording added by CATT. |
| Spreadtrum | Agree. |
| Samsung | We support the change from Huawei. |
| vivo | Agree. Besides, the suggestion from CATT is also fine for us. |
| OPPO | Agree |
| Intel | QC’s wording is fine to us. We can also accept moderator’s version. |
| DENSO | Agree with Huawei to remove the part of the last sentence. |
| MediaTek | We are ok with the moderator’s version |
| Ericsson | Agree with the suggestions from QC and Huawei. Regarding the comment from CATT; note that this recommendation for having the same PCI values if both NCD-SSB and CD-SSB are transmitted on the serving cell is to avoid impact on network functionality such as ANR: |
| ZTE | We are fine with the sentence added by CATT. And agree with HW that last sentence is not needed. |

**Summary – Q3**

TBD

## 2.4 Question 4

**RAN1 Q4:** *[RAN2/4] whether/when periodicities and/or TX power and/or block indexes (provided by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon) and/or QCL sources of NCD-SSB can be same/different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R4:** According to the current RRC specification, periodicities and/or TX power and/or block indexes (provided by *ssb-PositionsInBurst* in SIB1 or in *ServingCellConfigCommon*) and/or QCL sources of NCD-SSB may either be same or different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell. RAN2 thinks that those parameters should only be configured differently when needed, except periodicity, to avoid further consideration required to investigate the impact on signalling and procedures. The periodicities of NCD-SSB are up to network configuration and shall be not less than periodicity of CD-SSB.

**Q4** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

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| **Company** | **Comments** |
| Apple | Agree.  We do have a comment in that atleast the QCL reference should be the same when NCD-SSB is to provide the reference (in place of CD-SSB), and in using of beam indices, so that the UE can use beam info on one SSB to the other. So we propose the below to see if companies are ok. But if there is opposition, we are willing to accept this in the interest of sending the LS.  **RAN2 R4:** According to the current RRC specification, periodicities and/or TX power and/or block indexes (provided by *ssb-PositionsInBurst* in SIB1 or in *ServingCellConfigCommon*) and/or QCL sources of NCD-SSB may either be same or different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell. RAN2 thinks that those parameters should be configured differently only when it is really needed, e.g., periodicity and beam configuration, to avoid further consideration required to investigate the impact on signalling and additional UE procedures. |
| Qualcomm | Agree. |
| CATT | We suggest to the following modification:  RAN2 thinks that those parameters can be configured differently when it is really needed, e.g., periodicity, to avoid further consideration required to investigate the impact on signalling and procedures.  Otherwise, what is and who will define the criteria of “only when it is really needed“? we don’t think we need give additional reference or limitation on network implementation. |
| Huawei, HiSlicon | Same periodicity is not acceptable from NW side considering the resource consumption.  Please see the RAN4 agreement, who is in charge of the performance analyses. |
| Spreadtrum | Fine for Apple’s version. |
| Samsung | We can stick to the original wording, and we do not have to excerpt R4 agreements here which will be informed by R4 anyway. |
| vivo | Some suggestions below:  According to the current RRC specification, periodicities and/or TX power and/or block indexes (provided by *ssb-PositionsInBurst* in SIB1 or in *ServingCellConfigCommon*) and/or QCL sources of NCD-SSB may either be same or different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell. RAN2 thinks that those parameters could be configured differently only when it is needed, e.g., periodicity, to avoid further consideration required to investigate the impact on signalling and procedures. It could be up to NW configuration, which depends on particular deployment scenario. |
| OPPO | Agree |
| Intel | Agree the version from moderator. |
| DENSO | Agree with the original sentence. Not sure if the QCL reference of NCD-SSB is the realm of RAN2... Besides that, RAN4 agreements do not have to be repeated in the RAN2 LS. |
| MediaTek | We agree with the moderator’s version |
| Ericsson | Agree with the original text. Regarding the suggestion from Apple; it is probably correct but periodicity is only given as an example and it was captured as an example since it is in RAN2’s area of expertise, os it would good to keep it that way. We think there is no need to capture the agreement from RAN4 as it will captured in their reply Ls to RAN1.  Regarding the comments from CATT and Vivo; we do not think the proposed changes make the indication stronger in the direction CATT and Vivo wants. The intention is to say that this is up to network configuration however one must very careful since having different configurations may have impacts that may not be so straight forward to foresee and thus require further discussion. Please see the suggestion in the text above for an attempt to clarify the intention. |
| ZTE | We think the below modification from HW is reasonable even from RAN2 perspective.  RAN2 thinks that those parameters should be configured differently only when it is needed, except periodicity |

**Summary – Q4**

TBD

## 2.5 Question 5

**RAN1 Q5:** *[RAN2/4] whether it is necessary to introduce configuration limitations for NCD-SSB (e.g., regarding frequency locations, periodicity), e.g., to ensure coexistence with legacy UEs*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R5:** RAN2 could not reach consensus on whether it is necessary to introduce configuration limitations for NCD-SSB. Some companies think that NCD-SSB should not be on the sync raster and/or periodicity of NCD-SSB should be equal to or larger than that of CD-SSB whereas others think that there seems to be no need to have any limitations for configuration, other than PCI as mentioned above, or even if it is so this should be up to RAN1/4 to decide.

**Q5** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We are willing to compromise on this in the interest of progress. |
| Qualcomm | We have the same comment as Apple |
| CATT | Agree |
| Huawei, HiSilicon | We also have the same comment as Apple.  Minor wording polish can be based on the updated answer in Q4. |
| Spreadtrum | For on-sync-raster or off-sync-raster, we think both are workable for NCD-SSB. For on-sync-raster NCD-SSB, RAN1 spec has supported that NCD-SSB assists UE to find CD-SSB in cell search, so it is workable. From RAN2 perspective, on or off the sync raster does not impact measurement of NCD-SSB.  For the sake of progress, we can live with the current reply. |
| Samsung | Agree |
| vivo | Agree |
| OPPO | Agree |
| Intel | Agree the version from moderator. |
| DENSO | Agree |
| MediaTek | We agree with the moderator’s version |
| Ericsson | Agree |
| ZTE | Agree |

**Summary – Q5**

TBD

## 2.6 Question 6

**RAN1 Q6:** *[RAN2/4] if CD-SSB is not transmitted in the non-initial DL BWP of RedCap UE, whether it is feasible to transmit periodic CSI-RS for UE to use as an alternative of SSB in the non-initial BWP of RedCap UE or rely on UE performing RF retuning as in measurement gap outside active BWP for BWP without SSB nor CORESET#0 operation.*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R6:** Use of CSI-RS for cell and beam RLM and measurements is already supported from RAN2 signalling standpoint.. Regarding UE re-tuning to CD-SSB and CORESET#0; it is possible for the network to allow the UE to use gaps for intra-frequency measurements however whether those gaps are needed or feasible is up to RAN4 to decide

**Q6** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We are willing to compromise on this in the interest of progress. |
| Qualcomm | We think it is necessary to mention that CSI-RS is an optional UE capability and very likely not supported by RedCap UEs, due to its complexity. |
| CATT | Agree |
| Huawei, HiSilicon | The original wording is RAN2 agreement. Let’s stick to the RAN2 agreement without any change. |
| Spreadtrum | We share the similar view as Qualcomm. It is important to state that CSI-RS is an optional UE capability. |
| Samsung | We also prefer the original wording, but if majority wants to add QC's text, the second part of the sentence should be removed as it is not the fact but company's view. |
| vivo | Agree with Qualcomm’s text.  Besides, we assume the question is whether CSI-RS could be used alone for cell and beam RLM and measurement. When only CSI-RS is transmitted for UE in the non-initial BWP, **CSI-RS based functionalities (e.g. RRM measurement) cannot work alone**, as SSB is still required for the UE to meet the timing requirements. That is to say, an SSB should be anyway associated with this CSI-RS transmitter in the non-initial BWP. But there is no SSB on this non-initial BWP, then, it could be defined to associate with the SSB on initial BWP.  In this way, many un-expected retuning between initial BWP and non-initial BWP will be introduced for CSI-RS on non-initial BWP in order to maintain the timing, which will have impact on UE performance (e.g. latency or interruption) and power consumption.  Thus, we would like to suggest to add:  “Besides, an SSB is still required to be associated with CSI-RS for UE to meet the timing requirements” |
| OPPO | Agree |
| Intel | We prefer the wording from QC. |
| DENSO | Agree with Samsung. If the optional functionality is mentioned, “due to its complexity” should be removed. |
| MediaTek | The question from RAN1 is whether it is feasible to use CSI-RS as an alternative for SSB. It is obviously **not feasible** for UEs that do not support CSI-RS based RRM. This should be made clear in the response, and therefore we support QC’s addition. |
| Ericsson | Agree with the original text considering that the question asks whether it is feasible. We do not understand why it is important to indicate whether this is an optional considering that any mechanism that may be introduced by RAN1 would anyway need to implemented and it is not clear at this point in time whether 3GPP ends up necessarily with a simpler solution. |
| ZTE | No need to mention UE capability, RAN1 knows that capability because it is introduced by them. Stick to the RAN2 agreement. |

**Summary - Q6**

TBD

## 2.7 Question 7

**RAN1 Q7:** *[RAN2/4] whether it is feasible for a RedCap UE to retune to a CD-SSB rather than use an NCD-SSB of larger periodicity*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R7:** From RAN2 standpoint, it is already possible for a RedCap UE to retune to a CD-SSB rather than using an NCD-SSB of larger periodicity.

**Q7** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Agree |
| Qualcomm | Agree |
| CATT | Agree |
| Huawei, HiSilicon | The last sentence is not even asked by R1, especially on “sensible/efficient”.  Note, current specification always allow UE to do that, but whether it is mandatory is up to R1. |
| Spreadtrum | We believe RF retuning for processing CD-SSB will lead to measurement gap and have spec impact on 38.133.  In the legacy, periodicity of CD-SSB is guaranteed by gNB implementation which is not restricted by spec. We don’t know whether restricting the periodicity of NCD-SSB by spec is a correct standardization work.  From the discussion, it seems most companies suppose NCD-SSB is transmitted for connected-mode RedCap UEs, so there may be no overhead or NW power consumption issue for NCD-SSB.  The overhead of NCD-SSB is acceptable, since NCD-SSB can be the RS for AGC/synchronization/measurement to save the overhead of TRS/CSI-RS. If NCD-SSB is not there, TRS/CSI-RS with wideband and multiple slots are necessary in most cases.  For NW power consumption of NCD-SSB, it will transmitted simultaneously with CD-SSB, which has marginal addition for power consumption.  Anyway, for the sake of progress, we can live with the current version. |
| Samsung | We are fine with the original wording. |
| vivo | Actually, we prefer the original version. |
| OPPO | Agree |
| Intel | Agree the version from Moderator. |
| DENSO | Agree with the original wording. The final decision should be left to RAN1/4. |
| MediaTek | We agree with the moderator’s version, which leaves the final decision to R1/R4. |
| Ericsson | We agree that it is up to RAN1/4 to decide and suggest the following to resolve the conflict: “However, it is up to RAN1/4 to judge whether it is preferable to retune to a CD-SSB or to configure an NCD-SSB with a periodicity comparable to that of CD-SSB.” |
| ZTE | We are fine with the original wording. |

**Summary – Q7**

TBD

## 2.8 Question 8

**RAN1 Q8:** *[RAN2/4] any other potential impacts identified by RAN2/4* *on support NCD-SSB for measurement*

Based on the outcome of the second phase of the offline discussion and the online discussion after, the rapporteur proposes the reply below for this question:

**RAN2 R8:** There may be more potential impact due to the use of NCD-SSB instead of CD-SSB. This reply LS captures what RAN2 has identified at this point in time, but more discussion is needed for further consideration. RAN2 does not intend to continue the discussion in this release

**Q8** Please update the text directly in the draft reply above using the change marks. You can use the “Comments” column in the table below to justify/motivate the changes you have proposed or provide comments to the feedback/text proposals provided by other companies.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Agree. |
| Qualcomm | Agree |
| CATT | Agree |
| Huawei, HiSilicon | Fine to compromise.  It will be also good to add some kind warning to RAN1: “RAN2 may not be able to complete the standard efforts of this feature on time, if the decision in RAN1 causes significant RAN2 impact or requires more RAN1 involvement in in 2022.” |
| Spreadtrum | Agree |
| Samsung | Agree |
| vivo | Agree |
| OPPO | Agree |
| Intel | Agree the version from Moderator. |
| DENSO | Agree on the original answer proposed by the moderator |
| MediaTek | Agree with the moderator’s version |
| Ericsson | This is acceptable to us if it is clear to everyone that RAN2 does not intend to follow up with another LS reply to RAN1. We suggest to add the following: “RAN2 does not intend to continue the discussion in this release“ |
| ZTE | Agree. |

**Summary – Q8**

TBD

# 3 Conclusion

Based on the discussion above rapporteur suggests the following:

[Proposal 1 ???](#_Toc87397433)

# References

1. [R2-2109576](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109576.zip), Definition and reduced capabilities for RedCap UE, and NCD-SSB related LS, Huawei, HiSilicon, RAN2#116e, November 2021

1. [R2-2109741](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109741.zip), Discussion on NCD SSB and UE type for RedCap UEs, vivo, Guangdong Genius, RAN2#116e, November 2021

1. [R2-2109448](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109448.zip), Reply LS on use of NCD-SSB instead of CD-SSB for RedCap UE, Qualcomm Incorporated, RAN2#116e, November 2021

1. [R2-2109451](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2109451.zip), NCD-SSB and RedCap-specific BWPs, Qualcomm Incorporated, RAN2#116e, November 2021

1. [R2-2110095](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2110095.zip), Making ND-SSB work for RedCap in Rel-17, Apple, RAN2#116e, November 2021

1. [R2-2110773](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs//R2-2110773.zip), Use of NCD-SSB instead of CD-SSB for RedCap UEs, Ericsson, RAN2#116e, November 2021.