3GPP TSG-RAN WG2 #116-e Tdoc draft R2-2111348

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 (PH2)

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:

|  |
| --- |
| * **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:

|  |
| --- |
| 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.

In this document, we continue the discussion based on the agreements above with the intention to draft 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 discussion so far, 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, which 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 using NCD-SSB, however 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.

**Q1** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung |  | The proposal can be revised to highlight the fact and to avoid misunderstanding of RAN2 response by RAN1:*RAN2 R1: In connected mode, current RRC signalling allows configuring SSB-based RRM measurements on any (CD or NCD) SSB. However, for RLM, BFD, link recovery, RO selection, mobility, which 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.* *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.* |
| DENSO | Yes | We prefer the original sentence, as it reflects what is supported in the current spec and what would be feasible from signaling standpoint. |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicion | Yes in principle, with existing wording,Additional wording is needed. | Agree with the comments from Samsung. Or, “from signalling standpoint” should also be added in the end of 1st paragraph.Also, as request by R1 ( *“in terms of functionality feasibility, performance/coexistence, and specification/implementation impacts (when applicable)”*), we should also add more information in this Question. We suggest to add “Using NCD-SSB for serving and non-serving cell measurements will cause new design in RAN2 with significant standard efforts and spec impact, e.g. on the RRM, RLM, BFD, link recovery, RO selection, mobility”. The list potential changes on RAN2 should be known by other WGs to understand better on RAN2 impacts. |
| CMCC | Yes |  |
| MediaTek | Yes in principle (editorial update) | We disagree with the change from Samsung as this information is not provided in the previous sentence as indicated in the comment. The previous sentence relates to RRM, and not the other listed procedures. We also disagree with the additional wording from Huawei, as this is already made clear in the text (i.e. what is not supported today is listed).We only have the following editorial suggestions:***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, which 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 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.* |
| Sharp | Yes | Agree with the original text from rapporteur and the editorial suggestion from MediaTek. |
| CATT | Yes but | We agree with Huawei on lising potential changes on RAN2, to emphasize RAN2 significant standard effort. Otherwise, the “it would be feasible” can result in a misunderstanding of it is some function easy to support. |
| LGE | Yes |  |
| Intel | Yes in principle | We agree with MediaTek. The changes from Samsung and Huawei are not acceptable to us.Mediatek ‘s suggestions looks good to us. In addition, we may mention whether the reading SIBs will happen frequently or not. At least mention in which cases, the UE may read SIBs. We would suggest to change it as:

|  |
| --- |
| 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 upon cell change, modification of system information or receiving short message. |

 |
| Spreadtrum | Yes | We share the similar view as DENSO. |
| vivo | Yes in principle | We agree with MediaTek and Intel. The proposals from Samsung and Huawei are also not acceptable to us, as it is not the fact what have discussed.Besides, 1. we think we should mention in the LS that UE retuning for SIB reception is not a frequent behaviour:*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, where the re-tune is a frequent behaviour.* Otherwise, the Intel’s suggestion could be considered as an alternative. 2. For “mobility” in the first paragraph, we suggest to add more clarification as we agreed during online “mobility (mobility here refers to the frequency indicated in FreqDLInfo in HO command)” |

**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 discussion so far, the rapporteur proposes the reply below for this question:

**RAN2 R2:** It would be 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.

**Q2** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes in principle | *RAN2 R2: It would be feasible to inform UEs in idle, inactive and/or connected mode about an NCD-SSB from signalling perspective, however it is up to RAN1 and RAN4 to decide whether it is possible to use an NCD-SSB as QCL source.* |
| DENSO | Yes in principle | Agree on Samsung’s text proposal. |
| Qualcomm | Yes in principle | We would like to suggest the following rewording:“From signaling perspective, it is feasible to configure an NCD-SSB as QCL source for UEs in idle, inactive and/or connected mode . However, it is up to RAN1 and RAN4 to decide whether it is possible to use an NCD-SSB as QCL source.” |
| OPPO | Yes in principle | Agree on Qualcomm’s text proposal. |
| Huawei, HiSilicon | Yes | Samsung’s wording is an important clarification. For others, let’s stick to the R2 agreement. |
| CMCC | Yes in principle | Agree on Samsung’s text proposal. |
| MediaTek | Yes in principle | Agree with QC’s text  |
| Sharp | Yes in principle | Agree with QC’s text proposal. |
| CATT | Yes | Agree with the wording of Samsung. And we shoud keep original wording of RAN2 common understanding, to leave the determination to RAN1 and RAN4.  |
| LGE | Yes in principle | Both Samsung and Qualcom’s suggestion are fine for us. |
| Intel | Yes in principle | Agree with QC’s text  |
| Spreadtrum | Yes in principle | We support Qualcomm’s revision. |
| vivo | Yes in principle | Agree with QC’s text. |

**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 discussion so far, 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 on the serving cell. However, RAN2 thinks that 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.

**Q3** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes in principle | Prefer to add something like “…, in order to use NCD-SSB for serving and non-serving cell measurements for idle, inactive, and/or connected mode.” at the end of the last sentence. Otherwise, the answer sounds not so logical.Suggested 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 on the serving cell. However, RAN2 thinks that 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, in order to use NCD-SSB for serving and non-serving cell measurements for idle, inactive, and/or connected mode. |
| Huawei, HiSilicon | Yes | Not prefer to add the wording form OPPO, it seems “if” is better than “in order to” on the current RAN2 situation. |
| CMCC | Yes |  |
| MediaTek | Yes |  |
| Sharp | Yes |  |
| CATT | Yes | We agree with OPPO to give some explanation on the reason of “ RAN2 thinks“, but agree with huawei on using “if“ instead of “in order to“.And we have a concern on the “However, RAN2 thinks that 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.“Which will impose a limitation on network deployment.Generally a cell will provide service for not only Redcap UE but also non-redcap UE. And this can incease complexity on upgrade current network to support Redcap. So we suggest adding some clarification:“However, RAN2 thinks that 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(but this will impose some limitation on network deployment).“ |
| LGE | Yes |  |
| Intel | Yes | Same PCI is a reasonable design if NCD-SSB and CD-SSB are in the same serving cell.  |
| Spreadtrum | Yes |  |
| vivo | Yes | Agree with CATT’s suggestion on “but this will impose some limitation on network deployment” |

**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 discussion so far, 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 it would be the simplest to configure those parameters same, otherwise further consideration is required to investigate the impact on signalling and procedures.

**Q4** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes in principle | The intention looks O.K. For this question, is it up to RAN1/4 to make a final decision? |
| Qualcomm | Yes |  |
| OPPO | Yes in principle | Same view aw DENSO. |
| Huawei, HiSilicon | No | For periodicities, we have concern on the wording of “RAN2 thinks that it would be the simplest to configure those parameters same, otherwise further consideration is required to investigate the impact on signalling and procedures.“.For wording after “RAN2 thinks“, it is not something in the current spec, but just some RAN2 guidance on NCD-SSB designed in R1. So, we have two concerns, which should be also added.1st, those for NCD-SSB and CD-SSB should be two indenpendent configurations/Ies, which is based on NW implementation. Same periodicity of NCB-SSB as CD-SSB caues too much NW resoure comsumption and complexity, when transmitting both CD-SSB and NCD-SSB in the same slot.2nd, small periodicites requires more NW transmittion on NCD-SSB, which would cause considerable system overhead, which cannot be ignored. We should add “NW should configure larger periodicity of NCD-SSB than that of CD-SSB.“ |
| CMCC | No | Share similar view with Huawei, though it would be the simplest to configure those parameters same, it could cause extra system overhead if the peroidicity of NCD-SSB is small. Also, RAN2 could not reach consensus on whether it is necessary to introduce configuration limitations for NCD-SSB as mentioned in the reply of Q5. It’s better to remove the sentence of “RAN2 thinks that it would be the simplest to configure those parameters same, otherwise further consideration is required to investigate the impact on signalling and procedures.“  |
| MediaTek | Yes |  |
| Sharp | Yes in principle | Share view with DENSO. |
| CATT | No | Agree with Huawei and CMCC. |
| LGE | Yes |  |
| Intel | Yes | It can make specification simple if NCD-SSB has the same configuration as CD-SSB. The NCD-SSB periodicity is not necessarily the same with the CD-SSB; but all other parameters are better to be the same with CD-SSB;  |
| Spreadtrum | Yes |  |
| vivo | With comments | We agree we could leave the final decision to RAN1/RAN4. When both NCD-SSB and CD-SSB are transmitted on the serving cell, it has already been supported by the legacy system. In this way, the legacy design on the periodicities and/or TX power and/or block indexes and/or QCL sources for NCD-SSB can be re-used the basis. In addition, these parameters could be up to NW configuration, which depends on particular deployment scenario. From RAN2 point of view, actually, there is no restriction on this point. |

**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 discussion so far, 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 in the configurations, other than PCI as mentioned above or even if so this should be up to RAN1/4 to decide.

**Q5** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes |  |
| Qualcomm | - | Maybe we can have some online discussion to see if companies can converge before we agree or disagree on the above proposed reply? |
| OPPO | Yes |  |
| Huawei, HiSilicon |  | This depends on Q4 on the periodicity. We think it is worth mentioning that the performance impact to the NW side should be further evaluated. |
| CMCC | Yes |  |
| MediaTek | Yes, but | Agree with QC that it would be useful to have some discussion online to determine consensus or lack thereof |
| Sharp | Yes |  |
| CATT | Yes |  |
| LGE | Yes |  |
| Intel | Yes | We see the benefit to have limitation. We also agree with QC, MediaTek, it would be useful to check whether there is consensus or not.  |
| Spreadtrum | Yes | For frequency location, RAN1 spec supports the on-sync-raster NCD-SSB, in which the bits for CORESET0 can be re-interpreted, and RAN1 spec also supports the off-sync-raster NCD-SSB to assist UE easily find CORESET0 to complete the ANR/PCI functions. For periodicity, it can be further discussed.We are fine for the current proposal to reflect the current situation. |
| vivo | Yes | The particular issue for Q5 is whether the NCD-SSB could be located at the channel raster or not. From configuration point of view, it is possible for a NCD-SSB to be located at the channel raster. Depending on the number of NCD-SSB locate at the channel raster, it may have impacts on a UE to perform cell search/identification. Thus, some limitations on frequency location for NCD-SSB could be considered, but the detailed design should be evaluated and decided in RAN4. For the NCD-SSB periodicity, there is no motivation to introduce some restriction from RAN2 point of view. It could have the same value set as the CD-SSB to make it simpler or have different values from the CD-SSB to leave some flexibility.Thus, we are fine to mention the current RAN2 status to RAN1/RAN4 in the reply LS.  |

**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 discussion so far, 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** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes |  |
| Qualcomm | - | We’d like to suggest the following change:“Use of CSI-RS for cell and beam RLM and measurements is already supported from RAN2 signalling standpoint. However, its use is an optional UE capability and may not be supported by all UEs. 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.“ |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes | For the comments from QC, we see no big difference on the current specification. RAN1 colleagues also know the UE capability well. |
| CMCC | Yes |  |
| MediaTek | Yes in principle  | The clarification from QC is necessary, as CSI-RS based procedures are only feasible for a subset of UEs. It needs to be highlighted that CSI-RS based operation is not a feasible solution for all UEs. |
| Sharp | Yes |  |
| CATT | Yes |  |
| LGE | Yes in principle | Agree on Qualcomm’s text proposal. |
| Intel | Yes in principle | Agree the text proposal from Qualcomm.  |
| Spreadtrum | Yes in principle | We prefer the QC’s version. |
| Vivo | - | 1. We agree with Qualcomm’s text proposal.2. 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“Use of CSI-RS for cell and beam RLM and measurements is already supported from RAN2 signalling standpoint. However, its use is an optional UE capability and may not be supported by all UEs. Besides, an SSB is still required to be associated with CSI-RS for UE to meet the timing requirements” |

**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 discussion so far, the rapporteur proposes the reply below for this question:

**RAN2 R7:** It is feasible for a RedCap UE to retune to a CD-SSB rather than use an NCD-SSB of larger periodicity from RAN2 standpoint.

**Q7** Do you agree with the draft reply above? “Yes”, “Yes in principle” or “No”. If “Yes in principle” please provide suggestions on how to improve the text. If “No”, please explain why and provide a text proposal.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes |  |
| Qualcomm | - | We’d like to suggest the following changes:“From RAN2 standpoint, it is possible for network to configure measurement gaps for a RedCap UE to retune to a CD-SSB rather than use an NCD-SSB of larger periodicity. However, it is up to RAN1/4 to decide whether it is more sensible/efficient to retune to a CD-SSB or to configure an NCD-SSB with a periodicity comparable to that of CD-SSB.“ |
| OPPO |  | OK with Qualcomm’s text proposal. |
| Huawei, HiSilicon | Yes | “sensible/efficient” is not the question R1 asked, which should not be added.“network to configure measurement gaps for” is not needed, because that’s the R2 spec details.As compromise, we are fine to update as “It is feasible/possbile for a RedCap UE to retune to a CD-SSB rather than use an NCD-SSB of larger periodicity from RAN2 standpoint.” |
| CMCC | Yes |  |
| MediaTek | - | Ok with Qualcomm’s TP |
| Sharp | Yes in principle | Ok with Qualcomm’s text proposal. |
| CATT | Yes |  |
| LGE | - | Agree on Qualcomm’s text proposal. |
| Intel | - | Agree with Qualcomm’s TP.  |
| Spreadtrum | - | We support the QC’s version. The measurement gap is needed for RedCap UE to retune to CD-SSB. Furthermore, the current description in 38.133 needs to be updated. For example, the condition of initial DL BWP is not feasible any more.The UE can perform intra-frequency SSB based measurements without measurement gaps if-    the UE indicates ‘no-gap’ via *intraFreq-needForGap* for intra-frequency measurement, or-    the SSB is completely contained in the active BWP of the UE, or-    the active downlink BWP is initial BWP[3].On the other hand, we are not sure the “measurement gap” is needed or has some spec impact for RF retuning to CD-SSB for RedCap UEs in idle/inactive mode. |
| vivo | - | It is feasible, but we think when NCD-SSB is configured for RedCap Ues, it could be used when it is **enough for the requirements of the related functionalities defined for NCD-SSB**.If a NCD-SSB with larger periodicity is configured, it may be too large for the UE to perform corresponding functionalities, e.g. RRM, RLM, BFD, etc. Then, a UE still needs CD-SSB to fulfil the corresponding requirements. Then, un-expected RF retuning will be introduced here, which will increase the UE power consumption significantly and impact the performance.Thus, we think once the NCD-SSB is configured for UE, it should be at least enough for the requirements of related functionalities define for NCD-SSB. Otherwise, there is no motivation to offload some Ues to NCD-SSB.We are fine with Qualcomm’s text proposal to leave it to RAN1/RAN4 for final decision.  |

**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 discussion so far, the rapporteur proposes the reply below for this question:

**RAN2 R8:** None

**Q8** Do you agree with the draft reply above? If “No”, please provide a text proposal for further discussion.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | - |
| DENSO | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSIlicon | No | “None” means consensus in R2 that there is no more impact, which is not the case. It is just no further time to discuss and conclude on this.We suggest below to describe the current situation: *“More potential impacts from RAN2 on support NCD-SSB for measurement still requires more discussion“.*We should list the RAN2 potential impacts as listed by rapporteur in the phase 1 discussion for Q8.In addition, we suggest to add RNA2 concern on completing the feature by the end of WI.“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.” |
| CMCC | - | Agree with Huawei’s text proposal. |
| MediaTek | Yes |  |
| Sharp | Yes |  |
| CATT |  | Agree with Huawei |
| LGE | Yes |  |
| Intel | Yes |  |
| Spreadtrum | Yes |  |
| Vivo | Yes |  |

**Summary – Q8**

TBD

# 3 Conclusion

Based on the discussion above rapporteur suggests the following:

TBD

# 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