3GPP TSG-RAN WG2 #116bis-e draftTdoc R2-2201738

Electronic meeting, Jan 17th – 25th January 2022

Agenda Item: 8.12.2.2

Source: Ericsson (Rapporteur)

Title: NCD-SSB and Initial BWP aspects

Document for: Discussion, Decision

# 1 Introduction

RAN1 sent an LS to RAN2 and RAN4 on use of NCD-SSB instead of CD-SSB in [R1-2112802](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112802.zip) and asked for feedback from RAN2 and RAN4 on whether the working assumptions are acceptable from RAN2 and RAN4 perspectives, respectively.

In RAN2#116bis-e, a report is prepared to summarize the Tdocs listed below:

* [R2-2200190](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200190.zip) Discussions on RedCap-specific BWPs Qualcomm Incorporated
* [R2-2200287](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200287.zip) Open issues on Early identification, camping restrictions and NCD-SSB Intel Corporation
* [R2-2200401](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200401.zip) BWP configuration for RedCap UE DENSO CORPORATION
* [R2-2200554](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200554.zip) Identification and access restriction of RedCap UE, and NCD-SSB related issuesHuawei, HiSilicon
* [R2-2200597](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200597.zip) Issues on NCD SSB, identification and access for RedCap vivo, Guangdong Genius
* [R2-2200608](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200608.zip) Discussion on separate initial BWP and NCD-SSB for RedCap UE ZTE Corporation, Sanechips
* [R2-2200830](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200830.zip) Using NCD-SSB or CSI-RS in DL BWPs for RedCap UEs Ericsson
* [R2-2200831](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200831.zip) [DRAFT] Reply LS on the use of NCD-SSB or CSI-RS in DL BWPs for RedCap UEs Ericsson
* [R2-2200862](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200862.zip) Discussion on use of NCD-SSB or CSI-RS in DL BWPs for RedCap UE CMCC
* [R2-2201113](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201113.zip) RedCap UE power-saving aspects at cell re-selection Apple
* [R2-2201461](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201461.zip) Aspects related to use of NCD-SSB MediaTek Inc.

The summary was provided in [R2-2201732](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201732.zip) and during the online discussion, the following agreements were made:

Agreements:

1. A RedCap UE in idle/inactive mode monitors paging only in an initial BWP (default or RedCap specific) associated with CD-SSB and performs cell (re-)selection and measurements on the CD-SSB

2. If a RedCap-specific initial UL BWP is configured for RACH, RedCap UEs shall use only the RedCap-specific initial UL BWP to perform RACH.

In this document, we continue the discussion based on the agreements above and the list of Tdocs provided above with the intention to formulate a list of proposals that are agreeable and a list of proposals that require further discussion during the related online session.

# 2 Discussion

## 2.1 RRC Idle/Inactive mode

**Q 2.1.1** If a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, do you think that measurements should be based on CD-SSB for RACH resource selection? Please elaborate your reply. If you agree comment on whether field description of *rach-ConfigCommon* should be updated accordingly.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | The field description update can be discussed in the running CR. |
| Qualcomm | Yes | If RedCap-specific initial DL BWP does not include any SSB, then RedCap UEs have to use the CD-SSB included in the default initial DL BWP as QCL source for RO selection, unless there are other options (Is there any?) |
| ZTE | Yes with comments | If the question only covers “initial” RACH resource selection, we agree the measurements can be based on CD-SSB;If the question also covers RACH resource selection upon Msg1/MsgA retransmission, please see our response to Q2.1.3. |
| Intel | Yes | RANP already agreed that CD-SSB is used for measurements. It should be also applied for RO selection. =  |
| Sharp | Yes | For the separate initial BWP not containing an SSB, field description of *rach-ConfigCommon* should be updated correspondingly to remove the limitation of containing an SSB. |
| Vivo | Yes | RAN1 has agreed “*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.”*. In this way, if UEs perform random access in the separate initial BWP, the measurement on CD-SSB should be used for RACH resource selection.Our initial thinking is there is not any particular clarification is needed in the field description of *rach-ConfigCommon*, but we are fine to discuss it during running CR phase. |
| Spreadtrum | Yes | Redcap UE has to use the CD-SSB for RO selection if Redcap-specific initial BWP does not include any SSB. |
| Xiaomi | See comments | Agree with ZTE that, if it is for the first transition of Msg1/MsgA, it is ok to use CD-SSB for measurement. If it is for retransmission, we need to discuss Q.2.1.3.  |
| Fujitsu | Yes | We think the RACH resource selection should be based on the measurement on CD-SSB. Unless RAN4 confirms that a RedCap UE cannot use the RA resource in a UL BWP with the linked DL BWP having non associated SSB. |
| Samsung | Yes | UE should use the CD-SSB for the operation, even for the retransmission. |
| Nokia, Nokia Shanghai Bell | Yes | This is already agreed in RAN. |
| DENSO | Yes | There is no other choice to use CD-SSB within the default initial DL BWP. On the other hand, apart from the RAN1 agreement spottd by vivo, there is also the following note in the corresponding set of RAN1 agreements.*Note: The network may choose to configure SSB or MIB-configured CORESET#0 or SIB1 to be within the respective DL BWP.*Not sure what the NW intend to do so, but anyway this note does not have to be taken into account so far and the UE should use CD-SSB. It is also better to be clarified the this UE behaviour in the field description. |

**Summary – Q 2.1.1**

TBD

1. …

**Q 2.1.2** If a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, do you think that *PDCCH-ConfigCommon* of the separate initial DL BWP should include common search space configuration for RAR but not for paging, SIB1 and other SIBs? Please elaborate your reply.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes  |  |
| Qualcomm | Yes | If network configures RedCap-specific initial UL BWP for RACH, then it is desirable to have RA search space configured in the RedCap-specific initial DL BWP, to avoid BWP switching in RACH procedures. In RAN plenary #94e it was agreed that if RedCap-specific DL BWP does not include CD-SSB, then it should not include CSS for paging or SIBs.  |
| ZTE | Yes | The UE is required to monitor Paging/SIB1/OSI based on configuration of default initial DL BWP which is associated with CD-SSB. So there is no need to signal the common search space configuration for Paging/SIB1/OSI in RedCap specific initial DL BWP. This also implies that when UE enters RRC\_CONNECTED mode, the RedCap is not required to monitor Paging/SIB1/OSI when RedCap specific initial DL BWP is activated. |
| Intel | Yes | RAN1 is discussing whether the center frequencies should be always aligned between iDL and iUL BWPs. We believe it would be good if the UE can receive the RAR via separate initial BWP to enable offloading of DL messages and PDCCH for random access and to avoid having to perform freq retuning, i.e. *PDCCH-ConfigCommon* of the separate initial DL BWP should include common search space configuration for RAR. This is also consistent with the following agreements from RAN1 #107-e meeting:Agreement:* For FR1,
	+ For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0) from RAN1 perspective,
		- 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.
		- Note: RAN1 assumes REDCAP UE performing Random access in the separate DL BWP does not need to monitor paging in a BWP containing CORESET#0

Agreement:* For FR2,
	+ For a separate initial DL BWP (if it does not include CD-SSB ~~and the entire CORESET#0~~) from RAN1 perspective,
		- 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.
		- Note: RAN1 assumes REDCAP UE performing Random access in the separate DL BWP does not need to monitor paging in a BWP containing CORESET#0
 |
| Sharp | Yes | One thing should be clarified that RedCap UEs would receive paging, SIB1 and other SIBs according to common search space configuration configured in legacy initial DL BWP. |
| vivo | Yes | We think network should configure CSS for RAR if separate initial BWP is used for RACH. Otherwise, frequent BWP switching is needed during RACH procedure. |
| Spreadtrum | Yes |  |
| Xiaomi | YEs | RAN1 has discussed this and considered that if if there is no SSB in the separate initial DL BWP, the UE needs to retune to MIB-configured initial DL BWP to receive SSB for synchronization every paging DRX cycle. It will complicate UE’s implementation and increase UE’s power consumption.So they agreed that:* + For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0) from RAN1 perspective,
		- 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.
 |
| Fujitsu | Yes |  |
| Samsung | Yes | We understand that the agreements from RAN#94-e imply this. |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | It is in-line with the RAN1 agreement and the plenary decision. To make sure, according to the RAN1 agreement, it is for the case: 1) if the separate initial DL BWP does not include CD-SSB and the entire CORESET #0 for FR1 2) if the separate initial DL BWP does not include CD-SSB for FR2If the separate initial DL BWP includes CD-SSB and the entire CORESET #0, search space configurations for SIB1/OSI/paging are also present in PDCCH-ConfigCommon, as well as the one for RACH. |

**Summary – Q 2.1.2**

TBD

**Q 2.1.3** If a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, do you think

* (**Option 1**) it should be up to UE implementation to perform new RSRP measurement in a DL BWP associated with CD-SSB before a Msg1/A retransmission, or
* (**Option 2**) UE should always perform new RSRP measurement in a DL BWP associated with CD-SSB?
* (Option 3) To allow network to indicate NCD-SSB (which associated with separate initial BWP) in system information, and UE performs new RSRP measurement based on the NCD-SSB before a Msg1/A retransmission.

Please elaborate your reply.

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| --- | --- | --- |
| **Company** | **Option (1/2/Other)** | **Comments** |
| Huawei, HiSilicon | Option1 | If there is no clear RAN2 majority, maybe we can consult/wait for R4 on this issue. |
| Qualcomm | Option 1 | The rationale behind this proposal is the following. In legacy procedure, if UE needs to perform Msg1/A reTx, it restarts the RACH procedure from RO selection. And RAN4 spec has a tight timing requirement on how soon UE shall start the reTx procedure. This is not a problem in legacy because UE may take new RSRP measurement during RAR window. If RedCap-specific initial DL BWP is not configured with any SSB, UE then has to measure CD-SSB in the default initial DL BWP before performing Msg1/A reTx. Therefore, there are two options:1. Leave it to UE implementation whether to take new RSRP measurement before Msg1/A reTx;

Or relax the timing requirement for Msg1/A reTx (RAN4 have to be involved). |
| ZTE | Option 3 or 2 | We have added Option 3.In our view, it is unclear what RAN4 will conclude for Option 1. Leave it to UE implementation is a bit risky like some UE may use the same RSRP results for RACH resource selection during the entire RACH procedure. Option 2 is not optimal but at least it mandates UE to obtain new results before each Msg1/A retransmission. In our view, when network configures a separate initial BWP which does not contain CD-SSB, anyway, the network needs to deploy a NCD-SSB within the separate initial DL BWP so that RRC\_CONNECTED UEs can perform RLM/BFD… based on the NCD-SSB. So if the NCD-SSB can be visible to idle/inactive UEs, then it can be helpful for UE to obtain new RSRP for RACH resource reselection upon Msg1/A retransmission. We understand RAN1 has made the following agreement, but after checking with our RAN1, seems RAN1 hasn’t considered the case that SSB measurement may be needed during RACH procedure. * + For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0) from RAN1 perspective,
		- 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.

So we are proposing Option 3 which can address this problem completely. In addition, the NCD-SSB can only be used for RACH resource selection, so it does not impact other UE behaviors. Of course, we can double check with RAN1 whether there is concern on Option 3 (if majority companies in RAN2 support Option 3). |
| Intel | Option 2 | We consider this aligned with RANP conclusion.  |
| Sharp | Option1  | For msg1/A retransmission, beams switching is also up to UE implementation and UE may not always change its Tx beams. Therefore, whether perform RSRP measurement can be also up to UE implementation. |
| vivo | Option 1 | From RAN2 point of view, Option 1 is enough. Whether need to define new requirement is up to RAN4. In this way, we think we could conclude option 1 first in RAN2, and then inform RAN4.  |
| Spreadtrum | Option 1 | It may have impact on RAN4. RAN4 will decide it if needed. |
| Xiaomi | - | We should consult RAN4 first for the retuning requirement for Msg1/A reTx |
| Fujitsu | Option 3 or 1 | The precondition of the question is pending. It’s not clear whether RedCap UEs can perform RA using the resource on the separate RedCap initial UL BWP while the linked separate initial DL BWP has no associated SSB. That should depend on RAN4.We agree with ZTE about allowing NW to indicate NCD-SSB in system information, since that can facilitate RedCap UEs using RedCap specific BWP in both connected and idle states.  |
| Samsung | Option 1 | We are fine to go with Option 1, even though Option 2 would be the practical option what UE would do. |
| Nokia, Nokia Shanghai Bell | Option 2 | This seems aligned with RAN agreement. |
| DENSO | Option 1 (3 is also acceptable) | Agree with Qualcomm that it is challenging to always obtain new RSRP for every retransmisssion. O.K to consult RAN4 about relaxing the timing requirement.On the other hand, Option 3 proposed by ZTE is also fine, which can avoid the switching between BWPs. |

**Summary – Q 2.1.3**

TBD

**Q 2.1.4** Do you think RedCap-specific two-step RACH (if configured) and four-step RACH should always configured in the same BWP? Please elaborate your reply.

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | It seems quite clear from the agreement we made:” *2. If a RedCap-specific initial UL BWP is configured for RACH, RedCap UEs shall use only the RedCap-specific initial UL BWP to perform RACH.*” |
| Qualcomm | Yes | This proposal intends to avoid the following scenarios:1. Network configures a 2-step RACH configuration in RedCap-specific initial UL BWP but no 4-step RACH configuration in that UL BWP. In this case, UE does not have a RedCap-specific 4-step RACH configuration to perform fallback;

If network configures only a 4-step RACH in RedCap-specific initial UL BWP, then RedCap UE should not use 2-step RACH configuration (if configured) in the non-RedCap initial UL BWP.  |
| ZTE | Yes |  |
| Intel | yes | The simple and clean way is to configure them in the same initial BWP. |
| Sharp | Yes | We assume RA type switching cannot happen among different initial BWPs for RedCap UEs. |
| vivo |  | Agree if the intention is to avoid scenarios mentioned by Qualcomm. |
| Spreadtrum | Yes | It is a simple way. |
| Xiaomi | Yes |  |
| Fujitsu | YEs |  |
| Samsung | Yes | - |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | Agree with Qualcomm that both RACH procedures should be performed within the same BWP. |

**Summary – Q 2.1.4**

TBD

**Q 2.1.5** Please provide your comments here if you think there are any other issues that should be discussed for RedCap UEs in idle/inactive mode.

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| **Company** | **Comments** |
| Huawei, HiSilicon | **To save SIB1 size, the RedCap-specific initial BWP configurations (introduced by RAN1) should be only configured with the delta parameters compared to the legacy one.( i.e. use the same value as legacy if absent).** |
| ZTE | Regarding the issue raised by Huawei, we think the intention is good, but we are not sure whether it can be feasible for most parameters, because:1. Currently, all parameters in system information are considered as “Need R” by default, so it is not easy to support “delta”, as we need to define new rules that the absent of which parameters means “release”, and the absence of which parameters means “using the one from legacy initial BWP”2. Several physical configurations are configured according to the frequency domain boundary of BWP, and most likely the boundary of RedCap specific BWP will be different from legacy BWP. |
| Xiaomi | According to the( [R2-2200095](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2200095_R1-2112977.docx) LS on updated Rel-17 LTE and NR higher-layers parameter list), if the initial UL BWP for non-RedCap UEs exceeds the RedCap UE maximum bandwidth, a separate initial UL BWP for RedCap UEs can be configured. If the separate initial UL BWP is configured but wider than the maximum RedCap UE bandwidth, then is this cell be treated as *cellbarred* by RedCap UE?For the downlink, if the separate initial DL BWP is configured but wider than the maximum RedCap UE bandwidth, then is this cell be treated as *cellbarred* by RedCap UE or the UE can fall back to the MIB-configured initial DL BWP and consider the cell as not barred?We proposed this quesion on access restrictions agenda(R2-2200468). |
| DENSO | On the point raised by Huawei, we are also not sure if all of the DL/UL configuration should be different between RedCap UEs and legacy UEs, and so should be configured separately. According to the RAN1 CR (e.g. R1-2112935), RedCap specific DownlinkConfigCommonSIB and UplinkConfigCommonSIB are assumed to be defined. If so, frequeny band, point A, SCS, etc. can be different from the legacy UEs. Whilst this approach is flexible and RedCap only cell can be supported, it also increases the size of SIB1. It would be worth to check which L1 configuration are common or different, albeit it is a sort of ASN.1 review like discussion. |
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**Summary – Q 2.1.5**

TBD

## 2.2 RRC Connected mode

**Q 2.2.1** In RRC connected mode, do you think it should be possible to configure NCD-SSB for a RedCap UE in dedicated DL BWP? Please elaborate your reply.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | But, it can be further discussed whether the new IE is added in *BWP-DownlinkDedicated* or *BWP-DownlinkCommon.* |
| Qualcomm | Yes | As agreed by RAN1 |
| ZTE | Yes |  |
| Intel | Yes | Based on RAN2/RAN4 LS, from both performance and signalling perspective, 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. |
| Sharp | Yes |  |
| vivo | Yes | This has been concluded in RAN1.  |
| Spreadtrum | Yes |  |
| Xiaomi | Yes |  |
| Fujitsu | Yes |  |
| Samsung | Yes | - |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | In accordance with the RAN1 agreement. |

**Summary – Q 2.2.1**

TBD

**Q 2.2.2** For connected mode operation do you think NCD-SSB should have the same properties (e.g., *ssb-PositionsInBurst*, *PCI*, *ssb-periodicity*, *ssb-PBCH-BlockPower*) as the corresponding CD-SSB? Please elaborate your reply. Note that the question is about “properties”, not “configuration” (please see the next question regarding the discussion on configuration).

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes, but | But see our comments in below question. |
| Qualcomm | Yes | Regarding ssb-periodicity:It is fine with us if RAN2 agree to mandate the same periodicity between CD-SSB and NCD-SSB. But RAN1 and RAN2 did agree last meeting that the periodicity of NCD-SSB can be different from that of CD-SSB.  |
| ZTE | Yes |  |
| Intel | Yes | it can make specification simple if NCD-SSB has the same configuration as CD-SSB.  |
| Sharp | Yes |  |
| Vivo | Yes |  |
| Spreadtrum | Yes |  |
| Xiaomi | YEs | RAN2 in last meeting has agreed that “periodicities and/or TX power and/or block indexes 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.”We are fine that the NCD-SSB has the same parameters as CD-SSB.But for TX power, we are not sure as RAN4 has stated in the LS that : it is RAN4 understanding that if power boosting is used for CD-SSB then it may not be always possible to use the same TX power for NCD-SSB |
| Fujitsu | Yes, but | We believe the periodicity of NCD-SSB can be flexible different from CD-SSB. |
| Samsung | Yes | Same view as Intel, and this would avoid any additional potential impact. |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | But O.K to support different SSB periodicy. |

**Summary – Q 2.2.2**

TBD

**Q 2.2.3** For connected mode operation do you think it should be possible for the network to provide *absoluteFrequencySSB*, *ssb-PositionsInBurst*, and *ssb-periodicity* explicitly for NCD-SSB, i.e., other properties such as *PCI*, *ssb-PBCH-BlockPower* are configured with the same values from serving cell's CD-SSB? Please elaborate your reply.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Not all | 1. *ssb-PositionsInBurst* should be same.
2. *ssb-PBCH-BlockPower* should be decided by R1/R4.
3. *ssb-periodicity*: In addition to the periodicty, the time offset of NCD-SSB should also be able to configure different values. If multile NCD-SSBs always have the same time offset with CD-SSB (even with different periodicty), it means the transmisison of NDC-SSBs may occur in the same time slot as CD-SSB. From gNB side, transmitting many SSBs at the same time will cause unaffordable power, which could be one blocking issue. We can use the similar IE like *periodicityAndOffset* in SSB-MTC
 |
|  |  |  |
| Qualcomm | See comment | NCD-SSB and CD-SSB should have the same *ssb-PositionsInBurst* |
| ZTE | See comment | 1. ssb-periodicity can be the same or different, as already agreed in RAN4;2.ssb-PBCH-BlockPower can be the same or different, as already in RAN4; 3. ssb-PositionsInBurst: We actually see no problem if network configures different ssb-PositionsInBurst for CD-SSB and NCD-SSB. But no strong view either. |
| Intel | No for ssb-PositionInBurst and ssb-periodicity  | it can make specification simple if NCD-SSB has the same configuration as CD-SSB. To ensure coexistence with legacy UEs, NCD-SSB should be configured off sync raster and with the same subcarrier spacing, same PCI and same ssb-PositionsInBurst as the CD-SSB. Therefore ssb-PositionInBurst, ssb-periodicity should also be configured with the same values from serving cell’ CD-SSB.  |
| Sharp | See comments | *ssb-periodicity can be explicitly provided considering s*sb-periodicity would be larger than that for CD-SSB.*Ssb-PositionInBurst* should be configured with the same values as that for CD-SSB |
| vivo | See comment | We think *ssb-periodicity* could be configured differently. For other properties, we prefer same configuration with CD-SSB, which would be simpler and lead similar performance with CD-SSB.  |
| Spreadtrum | See comment | *ssb-PositionsInBurst* shall be the same*. ssb-periodicity* can be the same or different. |
| Xiaomi | See comment | *ssb-PBCH-BlockPower* may not be configured with the same values as RAN4 agreed that „It is RAN4 understanding that if power boosting is used for CD-SSB then it may not be always possible to use the same TX power for NCD-SSB“.We are fine that PCI, ssb-PositionsInBurst, ssb-periodicity are configured as the same. |
| Fujitsu | Yes | We think *ssb-PositionsInBurst* of NCD-SSB should also use the value configured for CD-SSB.Agree with HW on supporting the explicit configuration of time window (SSB-MTC) for NCD-SSB. |
| Samsung | No for ssb-PositionInBurst and ssb-periodicity  | This would avoid any additional potential impact, as indicated above. |
| DENSO | Yes except for ssb-PositionInBurst | SSB frequency and periodicity should be configured explicitly. On the other hand, the other properties do not have to be configured explicitly, since it should be the same as for CD-SSB. |

**Summary – Q 2.2.3**

TBD

**Q 2.2.4** For connected mode operation do you think periodicity of NCD-SSB shall be not less than the periodicity of serving cell’s CD-SSB? Please elaborate your reply.

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| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes |  |
| Qualcomm | Yes | It is unnecessary to have more frequent transmissions of NCD-SSB than CD-SSB.  |
| ZTE | Yes |  |
| Intel |  | It can make specification simple if NCD-SSB has the same configuration as CD-SSB.  |
| Sharp | Yes |  |
| vivo | Yes |  |
| Spreadtrum | Yes |  |
| Xiaomi | Yes |  |
| Fujitsu | Yes |  |
| Samsung | - | We also think that the configuration should be same as CD-SSB. |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes |  |

**Summary – Q 2.2.4**

TBD

**Q 2.2.5** For connected mode operation if NCD-SSB is configured in a dedicated DL BWP, do you think RedCap UE should assume that the “*SSB*” in *QCL-Info* IE and “*ssb-Index*” in *RadioLinkMonitoringRS* IE refer to the beam with the same index in the NCD-SSB configured in that BWP? Please elaborate your reply.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon  | Yes |  |
| Qualcomm | Yes | This helps ensure beam with the same index in NCD-SSB and CD-SSB are quasi-colocated and hence minimize the impact on the current spec. |
| ZTE | Yes |  |
| Intel | Yes | It should be a simple approach that network can configure a NCD-SSB fully QCL’ed with the CD-SSB (i.e. if two beams have the same beam index, then they are QCL’ed).; |
| Sharp | Yes |  |
| vivo | Yes |  |
| Spreadtrum | Yes |  |
| Xiaomi | Yes |  |
| Fujitsu | Yes |  |
| Samsung | Yes | - |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | Another question is if RedCap UE supports up to 2/4 BWPs and RedCap UE is configured with multiple BWPs, how to configure NCD-SSB? Should NCD-SSB be configured for each dedicated DL BWP, explicitly? Or is it configured one of the dedicated DL BWPs and refer to that BWP? |

**Summary – Q 2.2.5**

TBD

**Q 2.2.6** For connected mode operation if NCD-SSB is configured in a dedicated DL BWP whose paired UL BWP is configured with *RACH-ConfigDedicated*, *RACH-ConfigCommon* or *BeamFailureRecovery Config*, do you think the SSB in that RACH configuration (e.g., in *CFRA-SSB-Resource* IE or in *PRACH-ResourceDedicatedBFR* IE) should refer to the NCD-SSB configured in that DL BWP? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | NCD-SSB can be used for RO selection. |
| Qualcomm | Yes | Otherwise UE has to use SSB configured in other DL BWP as QCL source for RO selection and RA search space. That may require UE to switch BWPs between steps in a RACH procedure. |
| ZTE | Yes |  |
| Intel | Yes | Would be good to let the RRC\_CONNECTED UE only check same DL BWP. |
| Sharp | Yes |  |
| Vivo | Yes | This is one of the intention for separate initial BWP with NCD-SSB. RACH resource selection should be based NCD-SSB to avoid frequent BWP switching during RACH procedure. |
| Spreadtrum | Yes |  |
| Xiaomi | Yes |  |
| Fujitsu | Yes |  |
| Samsung | Yes | Agree with Intel. |
| Nokia, Nokia Shanghai Bell | Yes |  |
| DENSO | Yes | To avoid BWP switching. |

**Summary – Q 2.2.6**

TBD

**Q 2.2.7** For connected mode operation do you think neighbour cell measurements based on NCD-SSB should be supported for RedCap UEs? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No | 1st, there is no guarantee that all the neighbor cells have NCD-SSB and all the NCD-SSB of neighbor cells will be in the same *absoluteFrequencySSB*. So, in normal cases, UE has to switch to CD-SSB for some measurement of neighbor cells. In that case, there is no benefit of power saving to support this NCD-SSB based measurement, if CD-SSB based measurement is anyway required. 2nd, it is not clear how the UE maintain the intra-frequency cells list, if the NCD-SSB is on the same frequency but the CD-SSB is on different frequency of one neigbor cell, especially when UE performs BWP switch. |
| Qualcomm | No | Although it is up to network configuration, we don’t see the need to do so. |
| ZTE | Yes | This has been supported since Rel-15, so don’t understand why restriction is needed. From UE’s perspective, the UE does not need to care whether the measured SSB is CD-SSB or NCD-SSB when performing neighbour cell measurements. Whether NCD-SSB can be configured for neighbour cell measurement can be up to network implementation (as in legacy). And it is up to network to decide whether handover to target cell can be triggered after receiving the measurement report. Please note that the current spec allows the network to configure RRM on one SSB frequency but trigger handover towards another SSB frequency (for wideband cc case). |
| Intel | Yes | We do not see the problem to support it for neighbour cell. |
| Sharp | Yes | Up to NW’s configuration |
| vivo | Yes | From signal structure point of view, the signal structure of the NCD-SSB is identical as that of CD-SSB. For all measurements depends on the detection of the signal strength, there should be no difference to obtain signal strength for different purpose (including RRM) and mobility by using either NCD-SSB or CD-SSB from UE perspective. Thus, there is no any problem to use NCD-SSB for serving and neighboring cell measurements for connected mode. |
| Spreadtrum | Yes | It can be configured by network. |
| Xiaomi | No | It is very difficult for the UE to maintain the intra-frequency cells. If intra-frequency neighbor cells are measured based on NCD-SSB or CD-SSB?  |
| Fujitsu | Yes | It’s up to NW configuration that NCD-SSB or CD-SSB is configured as the neighbor cell measurement object. We think there may be limited specification impact for supporting NCD-SSB based neighbor cell measurements. |
| Samsung | Yes | It is up to network, and would not bring additional UE complexity since the feature was supported from Rel-15. |
| DENSO | Yes | No problem is foreseen, since the RRM measurement over NCD-SSB is supported since Rel-15. Agree that it does not matter whether SSB is cell-definign or not from measurement viewpoint. |

**Summary – Q 2.2.7**

TBD

**Q 2.2.8** For serving cell measurement based on NCD-SSB in connected mode; do you think

* (**Option 1**) *MeasObjectId* should be configured for each NCD-SSB, or
* (**Option 2**) *MeasObjectNR* is extended to include *ssbFrequency* for each NCD-SSB?

Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Option**  | **Comments** |
| Huawei, HiSilicon | Option 1, but no strong view | The intention is to indicate the ssbFrequency for each NCD-SSB of BWP. In case of BWP switch, for serving cell measurement based on NCD-SSB, UE’s serving cell measurement object is the ssbFrequency associated with the NCD-SSB of its active BWP. Therefore, the RRC measurement configuration should provide the ssbFrequency of all possible NCD-SSB. |
| Qualcomm | Option 1 | Less impact on the current spec |
| ZTE | Postpone | In general, we can define implicit rules (similar to Q2.2.5 and Q2.2.6), such as: if RedCap is configured with NCD-SSB and the active BWP contains NCD-SSB, then UE should use NCD-SSB for serving cell measurements, otherwise, CD-SSB is used.Before discussing Q2.2.8, we think it is important to first discuss some high level issues to align company’s understandings, for instance:1) Whether UE can dynamically change the SSB used for serving cell measurement based on active BWP? 2) When serving cell measurement is performed on NCD-SSB, intra-frequency neighbor cells are measured based on NCD-SSB or CD-SSB? 3) Whether network can configure different cell derivation parameters (e.g. absThreshSS-BlocksConsolidation, nrofSS-BlocksToAverage) for NCD-SSB and CD-SSB?So we suggest to postpone this discussion, companies can bring contributions to next meeting. |
| Intel | Option 1 | Separate MeasObject for NCD-SSB is the clean way.  |
| Sharp | Option1 |  |
| vivo | Either is fine | Option 1 is clearer. While option 2 is simple, as long as the *ssbFrequency* for each NCD-SSB would be provided. |
| Spreadtrum | Option 1 |  |
| Xiaomi | Option1 |  |
| Fujitsu | Option 1 |  |
| Samsung | Option 1 | - |
| Nokia, Nokia Shanghai Bell | Option1 |  |
| DENSO | Option 1 | Option 1 does not require ASN.1 extension. Once servingCellMO is configured for MO with NCD-SSB, the measurement over the same frequency as NCD-SSB is regarded as intra-freq. And the other is regarded as intre-freq. It does not matter whether the measured SSB is cell-defining or not. |

**Summary – Q 2.2.8**

TBD

**Q 2.2.9** Do you think RAN1 working assumption regarding the use of CSI-RS in connected mode is acceptable from RAN2 standpoint? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes, but up to R4 | From RAN2 perspective, we can say it is possible from signaling perspective. The final decision should be up to R4 reply. |
| Qualcomm | See comment | In our view, the optional UE capability “Not Need for NCD-SSB” does not need to be tied to the support for CSI-RS. For example, network may configure measurement gaps for a UE which signals “Not Need for NCD-SSB” and “No support for CSI-RS”. |
| ZTE | Yes |  |
| Intel |  | Tend to agree currently CSI-RS cannot be used for RRM measurement, and therefore leave it to RAN4. |
| Sharp |  | up to RAN4 |
| vivo | No | 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. When 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 the timing of 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, From RAN2 perspective, the working assumption “Not need NCD-SSB: A RedCap UE can in addition optionally support relevant operation based on CSI-RS” is not acceptable considering that CSI-RS can’t work alone without SSB. |
| Spreadtrum | See comment | CSI-RS is an optional capability and RAN4 will make the final decision. From signaling perspective, it is possible. |
| Xiaomi | - | Depends on RAN4.RAN4 has agreed that CSI-RS are not used as a standalone mechanism for RRM measurements and the existing requirements rely on the presence of SSB signals. |
| Fujitsu | Yes |  |
| Samsung | - | Share the view with many others that it can be left to RAN4. |
| DENSO | Up to RAN4 | Agree that associated SSB is required for RRM measurement, albeit it is up to RAN4 to decide. |

**Summary – Q 2.2.9**

TBD

**Q 2.2.10** Do you think a RedCap UE, which does not support CSI-RS, should be able to report “Not need NCD-SSB” as an optional UE capability? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | Yes | As agreed in RAN1. |
| Qualcomm | Yes | See our comment to Q2.2.9. The motivation is that if for some reason, network does not configure NCD-SSB in a dedicated DL BWP for a RedCap UE which does not support CSI-RS, this UE can have the option of reporting “Not Need NCD-SSB” (measurement on CD-SSB can be done through gaps) so that network does not have to configure this UE’s dedicated DL BWPs around the default initial DL BWP, which can be congested.  |
| ZTE | - | The question is a bit unclear to us? Is “Not Need NCD-SSB” equal to “do not support NCD-SSB”? In our view, RAN1 already agreed that RedCap UEs should always use the RedCap specific initial BWP, if configured. This implies that RedCap UE should be able to operate on the specific initial BWP when enters RRC\_CONNECTED. So in case the BWP does not contain CD-SSB, the UE should be able to use NCD-SSB, so does “not needed NCD-SSB” mean the RedCap UE must support CSI-RS based RLM/BFD…? |
| Intel |  | We need to be careful on whether to support this scenario or not, especially in such late stage since we have to discuss what gap solution should be used if the scenario is supported.  |
| Sharp |  | Have no strong view. |
| vivo | - | If the intention for this question is to confirm RAN1 conclusion, we think it is clear from RAN1 conclusion below:* + For an RRC-configured active DL BWP in connected mode (if it does not include CD-SSB ~~and the entire CORESET#0~~) from RAN1 perspective,
		- A RedCap UE supporting mandatory FG 6-1 (but not optional FG 6-1a) expects it to contain NCD-SSB for serving cell but not CORESET#0/SIB
		- A RedCap UE can indicate the following as optional capability:
			* Not need NCD-SSB: A RedCap UE can in addition optionally support relevant operation based on CSI-RS (working assumption) and/or FG 6-1a by reporting optional capabilities.

It is noting that RAN1 has agreed “*A RedCap UE supporting mandatory FG 6-1 (but not optional FG 6-1a) expects it to contain NCD-SSB for serving cell but not CORESET#0/SIB*”. |
| Spreadtrum |  | No strong view. |
| Xiaomi | Yes | We don’t know why we need to bind UE’ capability of “Not Need NCD-SSB” equal to “do not support CSI-RS”. Agree with QC, that UE can use gap.  |
| Samsung | Yes | As agreed by RAN1, as vivo pointed out. |
| DENSO |  | We are not sure if `Not need (NCD-)SSB capability` is correspondent to FG 6-1a in fact, or something else. |

**Summary – Q 2.2.10**

TBD

**Q 2.2.11** Do you think it should be possible to use NCD-SSB to trigger the handover procedure, i.e., whether SSB indicated in *absoluteFrequencySSB* of *frequencyInfo-DL* IE in handover command must be CD-SSB? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No | We can postpone this and focus on other essential issues. Before making the decision, we need to analyses the whole spec impacts, e.g. whether SIB1 is included in HO command, whether DL syncnization is on NCD-SSB.Also, we have not decided on the neighbor cell measurement based on NCD-SSB, which is the pre-condition of this proposal. |
| Qualcomm | No |  |
| ZTE | Yes? | The question itself seems contradictory?The motivation of this proposal is that UE needs to read SIB1 after handover succeed, so the legacy field must be set to the frequency of CD-SSB of target cell. We see no need to signal NCD-SSB in legacy field, but includes CD-SSB frequency in a separate or newly defined IE. Most of all, the intention of this proposal is to clarify that RedCap UE must be informed about CD-SSB of target cell, and it should be indicated by the legacy field. |
| Intel |  | We do not see the problem to support NCD-SSB to trigger the handover procedure since the network can configure SMTC, to help UE find the CD-SSB. If no SMTC, the UE may spend 5ms to search for it. |
| Sharp | No |  |
| vivo | There are two questions! | For neighboring cell measurement, please see our reply to Q2.2.7.For serving cell measurement, RAN1 has agreed a RedCap UE supporting mandatory FG 6-1 (but not optional FG 6-1a) expects it to contain NCD-SSB for serving cell but not CORESET#0/SIB. Thus, from RAN2 point of view, after UE retunes to the separate initial BWP associated NCD-SSB, NCD-SSB should be used for the measurement for RRM in connected mode.Thus, we think NCD-SSB could be used to trigger the handover procedure. |
| Spreadtrum | No |  |
| Xiaomi | - | This depends on neighbor cell measurement based on NCD-SSB in Q2.2.7. |
| Fujitsu | Yes | It is possible to use NCD-SSB for HO, if SIB1 is included in HO command. Since the SIB1 IE is already contained in RRC reconfiguration in ASN.1, where is minor specification impact. |
| Samsung | - | Indeed, the question includes two contradictory questions, and we think NCD-SSB could be used to trigger the handover procedure. |
| DENSO | No? | If CD-SSB is used for handover, it works as today. If needed, NW switches BWP to the dedicated BWP with NCD-SSB, upon handover. |

**Summary – Q 2.2.11**

TBD

**Q 2.2.12** Do you think a non-RedCap UE should be able to use NCD-SSB instead of CD-SSB with an optional capability? Please elaborate your reply.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Huawei, HiSilicon | No | The motivation of supporting NCD-SSB is only for the UE with narrow bandwidth, e.g. for load balancing purpose among BWPs. |
| Qualcomm | Yes | We don’t see technical reasons that prevent non-RedCap UEs from using NCD-SSB. If supported, it would give network more flexibility in configuring UE’s dedicated BWPs, which is a good thing for both network and UE. |
| ZTE | Yes | Same view as Qualcomm.We see benefit to apply this NCD-SSB function also to non-RedCap UEs, like a non-RedCap UE that does not support CSI-RS based operation can optionally indicate the support of RLM/BFD/serving cell RRM on NCD-SSB.If network deploys the NCD-SSB, it would be good if it can be used by more UEs, not only limited to RedCap UEs.  |
| Intel | Postpone | We do not see the motivation on this. It can be supported only if it comes free. But we do not have time to do the evaluation since how to support NCD-SSB is still under the discussing.  |
| Sharp | No |  |
| vivo | Yes | We agree with Qualcomm. If network supports and configures NCD-SSB, it would benefit for both RedCap and non-RedCap UEs. |
| Spreadtrum | No | It can be discussed later and find the clear scenario and benefit for it. |
| Xiaomi | Postpone | We see benefit to extend to normal UE. But we are not sure the Sepc impact. Consider the limited time, it is better to postpone. |
| Fujitsu | Yes | Agree with QC. |
| Samsung | Postpone | We share the view with Intel and Xiaomi. |
| DENSO | No | We don’t see any motivations to apply NCD-SSB functions to non-RedCap UEs beyond what has been supported so far. |

**Summary – Q 2.2.12**

TBD

**Q 2.2.13** Please provide your comments here if you think there are any other issues that should be discussed for RedCap UEs in connected mode.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Similar to Q2.2.5 and Q2.2.6, It is better to confirm that NCD-SSB is used for RLM, BFD and TCI states when NCD-SSB is configured in the activate DL BWP, see below example of proposal:**Proposal X For connected mode operation if NCD-SSB is configured in a dedicated DL BWP, the UE assumes the SSB configured for NCD-SSB for RLM, BFD and TCI-state refer to the NCD-SSB if that DL BWP is activated.** |
| vivo | We agree to confirm NCD-SSB can be used for RLM/BFD/BFR. The details are discussed in our contribution [5], with the proposal:**Proposal 4: From RAN2 perspective, NCD-SSB should be used for the measurement for RLM/BFD and RRM in connected mode if the active BWP doesn’t include CD-SSB. The corresponding requirements for NCD-SSB measurement should be discussed and determined in RAN4.**  |
| DENSO | On RLM/BFD, it is straight forward that NCD-SSB is used if it is confined within the active BWP, and CD-SSB is not. The question is whether NCD-SSB is explicitly configured for each dedicated BWP or not, as commented to Q 2.2.5 |
|  |  |
|  |  |
|  |  |
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**Summary – Q 2.2.13**

TBD

# 3 Conclusion

Based on the discussion above rapporteur suggests a discussion on the following proposals:

[Proposal 1 …](#_Toc93433069)

# References

1. [R2-2200190](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200190.zip) Discussions on RedCap-specific BWPs Qualcomm Incorporated
2. [R2-2200287](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200287.zip) Open issues on Early identification, camping restrictions and NCD-SSB Intel Corporation
3. [R2-2200401](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200401.zip) BWP configuration for RedCap UE DENSO CORPORATION
4. [R2-2200554](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200554.zip) Identification and access restriction of RedCap UE, and NCD-SSB related issues Huawei, HiSilicon
5. [R2-2200597](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200597.zip) Remaining issues on NCD SSB, identification and access for RedCap vivo, Guangdong Genius
6. [R2-2200608](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200608.zip) Discussion on separate initial BWP and NCD-SSB for RedCap UE ZTE Corporation, Sanechips
7. [R2-2200830](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200830.zip) Using NCD-SSB or CSI-RS in DL BWPs for RedCap UEs Ericsson
8. [R2-2200831](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200831.zip) [DRAFT] Reply LS on the use of NCD-SSB or CSI-RS in DL BWPs for RedCap UEs Ericsson
9. [R2-2200862](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200862.zip) Discussion on use of NCD-SSB or CSI-RS in DL BWPs for RedCap UE CMCC
10. [R2-2201113](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201113.zip) RedCap UE power-saving aspects at cell re-selection Apple
11. [R2-2201461](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201461.zip) Aspects related to use of NCD-SSB MediaTek Inc.