3GPP TSG-RAN WG1 Meeting #106bis-e R1-21xxxxx

e-Meeting, 11th – 19th October 2021

**Agenda Item: 8.6.1.1**

**Title: FL summary #4 on reduced maximum UE bandwidth for RedCap**

**Source: Moderator (Ericsson)**

**Document for: Discussion, Decision**

# Introduction

This feature lead (FL) summary (FLS) concerns the Rel-17 work item (WI) for support of reduced capability (RedCap) NR devices [1]. Earlier RAN1 agreements for this WI are summarized in [2]. The final FLS for this agenda item from the previous RAN1 meeting can be found in [3].

This document summarizes contributions [4] – [30] submitted to agenda item 8.6.1.1 and relevant parts of contributions [31] – [33] submitted to agenda item 8.6.3 and captures this email discussion on reduced maximum UE bandwidth:

|  |
| --- |
| [106bis-e-NR-R17-RedCap-01] Email discussion regarding aspects related to reduced maximum UE bandwidth – Johan (Ericsson)   * 1st check point: October 14 * Final check point: October 19 |

The issues in this document are tagged and color coded with High Priority or Medium Priority. The issues that are in the focus of this round of the discussion in this meeting are furthermore tagged FL6. Feature lead summaries for earlier rounds of the discussion can be found in [34] – [36].

Follow the naming convention in this example:

* *RedCapBwFLS4-v000.docx*
* *RedCapBwFLS4-v001-CompanyA.docx*
* *RedCapBwFLS4-v002-CompanyA-CompanyB.docx*
* *RedCapBwFLS4-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” a spreadsheet file for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *RedCapBwFLS4-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *RedCapBwFLS4-v003-CompanyB-CompanyC.checkout*
* CompanyC checks that no one else has created a checkout file simultaneously, and if there is a collision, CompanyC tries to coordinate with the company who made the other checkout (see, e.g., contact list below).
* CompanyC then has 30 minutes to upload *RedCapBwFLS4-v003-CompanyB-CompanyC.docx*
* If no update is uploaded in 30 minutes, other companies can ignore the checkout file.
* Note that the file timestamps on the server are in UTC time.

In file names, please use the hyphen character (not the underline character) and include ‘v’ in front of the version number, as in the examples above and in line with the general recommendation (see slide 10 in [R1-2108693](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108693.zip)), otherwise the sorting of the files will be messed up (which can only be fixed by the RAN1 secretary).

To avoid excessive email load on the RAN1 email reflector, please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info in the table below.

**FL5 Question 1-1: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Qualcomm | Jing Lei | leijing@qti.qualcomm.com |
| Vivo | Xueming Pan | panxueming@vivo.com |
| OPPO | Weijie Xu | xuweijie@oppo.com |
| Nordic | Karol Schober | karol.schober@nordicsemi.no |
| Huawei, HiSilicon | Wang Yi | wangyi6@huawei.com |
| Xiaomi | Qin MU | muqin@xiaomi.com |
| Panasonic | Shotaro Maki | maki.shotaro@jp.panasonic.com |
| Sharp | Hiroki Takahashi | takahashi.hiroki@sharp.co.jp |
| Lenovo | Yuantao Zhang | zhangyt18@lenovo.com |
| Spreadtrum | Huayu Zhou | huayu.zhou@unisoc.com |
| CATT | Yongqiang FEI | feiyongqiang@catt.cn |
| Nokia | Rapeepat Ratasuk | rapeepat.ratasuk@nokia-bell-labs.com |
| Ericsson | Sandeep Narayanan Kadan Veedu | sandeep.narayanan.kadan.veedu@ericsson.com |
| Intel Corporation | Debdeep Chatterjee | debdeep.chatterjee@intel.com |
| China Telecom | Jing Guo | guojing6@chinatelecom.cn |
| DOCOMO | Shinya Kumagai | shinya.kumagai@docomo-lab.com |
| FUTUREWEI | Vip Desai | vipul.desai@futurewei.com |
| CMCC | Lijie HU | hulijie@chinamobile.com |
| NEC | Takahiro Sasaki | takahiro.sasaki@nec.com |
| LGE | Jay KIM | Jaehyung.kim@lge.com |
| Samsung | Feifei Sun | feifei.sun@samsung.com |
| MediaTek | Mohammed Al-Imari | Mohammed.Al-Imari@mediatek.com |
| ZTE | Youjun Hu | hu.youjun1@zte.com.cn |
| China Unicom | Lulu Wang | Wangll958@chinaunicom.cn |

# Initial UL BWP

## Separate initial UL BWP for RedCap

RAN1#105-e made the following agreements related to initial UL BWP:

|  |
| --- |
| Agreements:   * Working assumption: Both during and after initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.   + FFS: whether/how to avoid or minimize PUSCH resource fragmentation due to PUCCH transmission for the above case   + Support the case when the centre frequency is assumed to be the same for the initial DL and UL BWPs in TDD.     - FFS whether or not to additionally support the case when the centre frequency is different; if so, how to minimize centre frequency retuning   Working assumption:   * Both during and after initial access, even for the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can optionally be configured/defined for RedCap UEs. * RO sharing between RedCap and non-RedCap is not precluded. |

Moreover, we have the following proposal from the latest FLS in RAN1#106-e [3]:

|  |
| --- |
| Proposal: Confirm the following modified version of the working assumption from RAN1#105-e:   * Both during and after initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.   + If a separate initial DL BWP is configured, the centre frequency is assumed to be the same for the separate initial DL BWP and the separate initial UL BWP in TDD.   + If a separate initial DL BWP is not configured, the centre frequency is assumed to be the same for the MIB-configured initial DL BWP and the separate initial UL BWP in TDD.     - FFS whether or not to additionally support the case when the center frequency is different between the separate initial UL BWP and the initial DL BWP, and, if so, how to minimize center frequency retuning |

Regarding the initial UL BWP configuration during and after initial access, many contributions agree with the main bullets of the working assumptions from RAN1#105-e [6, 7, 11, 12, 13, 15, 21, 24, 25, 27]. That is: (1) during and after initial access, for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs, and (2) during and after initial access, even for the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can optionally be configured/defined for RedCap UEs.

Also, as already agreed in RAN1#106-e, ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs. Regarding RO sharing, the FL’s understanding is that ROs can be fully or partially shared between RedCap and non-RedCap UEs.

Based on expressed views and agreements in RAN1#105-e and RAN1#106-e, the following combined proposal regarding a separate initial UL BWP for RedCap can be considered.

**FL1 High Priority Proposal 2.1-1: Regarding a separate initial UL BWP for RedCap in both during and after initial access:**

* **For the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.**
* **For the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can optionally be configured/defined for RedCap UEs.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | Y  Clarification is needed for the 2nd bullet | For the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, configuring/defining a separate initial UL BWP for RedCap UEs by SIB will increase the signaling overhead. Clarification/justification is preferred regarding when/how the RedCap-specific initial UL BWP is configured/defined. |
| Vivo | Y |  |
| OPPO | Y | For shared RO scenario, when the span of RO bandwidth exceeds RedCap UE maximum bandwidth, how to configure/define a separate initial UL BWP for RedCap needs to be further discussed. |
| Nordic | Y |  |
| Huawei, HiSilicon | Y if with modifications | Our understanding is that a single separate initial UL BWP with a single frequency location for use, does not resolve some of the issues raised during initial access for e.g. RO vs SSB, PUCCH transmission for Msg4 (see R1-2108753).  **Modified Proposal 2.1-1: Regarding a separate initial UL BWP for RedCap in both during and after initial access:**   * **For the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP no wider than the RedCap UE maximum bandwidth is configured/defined for RedCap UEs.** * **For the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can optionally be configured/defined for RedCap UEs.** * **FFS how the configuration/determination is applied, e.g. by BWP switching or RF retuning** |
| ZTE, Sanechips | Y | We are fine with the FL proposal. Even for the scenario where the initial UL BWP for non-RedCap UEs is not configured to be wider than the RedCap UE bandwidth, a separate initial UL BWP can still be configured for RedCap UEs for the purpose of scheduling flexibility and early identification of RedCap. |
| TCL | Y | Fine with the FL proposal |
| Xiaomi | Y |  |
| Panasonic | Y | On the first bullet, "for the scenario where the initial UL BWP for non-RedCap UEs is configured to be wider than the RedCap UE bandwidth", our understanding is it does not contain the case the cell is barred to RedCap UEs. Although we can live with the current wording, the scenario means the case the cell support RedCap UEs is our interpretation. |
| Sharp | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Spreadtrum | Y |  |
| CATT | Y | Fine to agree on the ‘configured’ case and FFS the ‘defined’ case. |
| Nordic | Follow up | I guess Yi has cited this agreement  **Agreement**  Confirm the following working assumption from RAN1#105-e regarding RACH occasions.   * For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.   + Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.   Above highlighted part clearly says that there are no RedCap ROs outside initial UL BWP. We do not see a need to reopen the discussion again with Huawei FFS. |
| Nokia, NSB | Y | Our understanding is similar to Nordic that there are no RedCap ROs outside of the initial UL BWP. |
| Ericsson |  | There were discussions in the GTW session on whether the 2nd bullet should be removed or not. In our view, it is important to keep the 2nd bullet to have a more future-proof design (e.g., to handle congestion when the number of RedCap UEs increases) and to have more flexibility at the NW side on where to place the RedCap initial UL/DL BWP in the carrier.  We propose the following shorter proposal:   * **A separate initial UL BWP can be configured/defined for RedCap UEs and it can be signaled in SIB.**   + **This applies to both TDD and FDD cases.** |
| Intel | Y | We share similar understanding as Nordic and Nokia on ensuring all relevant ROs for RedCap are contained within the separate initial UL BWP.  We also agree that we need to agree to the second sub-bullet explicitly for the reasons cited by Ericsson as well as to realize RedCap UE early identification, depending on gNB choice, regardless of whether UL BWP #0 for non-RedCap UEs is larger than 20 MHz or not. |
| China Telecom |  | We think the above scenarios in FL proposal can be combined together to make things simple. The separate initial UL BWP can optionally be configured/defined for RedCap UEs via SIB. The configuration details about initial UL BWP need more discussion and clarification, like ROs, SSB, CORESET#0. |
| DOCOMO | Y |  |
| FUTUREWEI | Y | Ok with combining too. A minor wording suggestion (2 times)  “…be wider than the RedCap UE maximum bandwidth …”  Note that we have a previous agreement in RAN1#106,  For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.  Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.  and it was confirmed on the GTW there is no intent to reverse this previous agreement and not allow RO sharing for RedCap UEs. |
| CMCC | Y | In our understanding, the agreement copied by Nordic has two meanings,   * A separate initial UL BWP configured for RedCap UE has its own RO configuration, then a different SSB to RO mapping from non-RedCap UEs can be defined. In this case, these ROs can be dedicated for RedCap UEs as the note says. * A separate initial UL BWP configured for RedCap UE shares the RO with non-RedCap UEs. And two sub-interpretation can be made,   + Interpretation 1: the bandwidth of all the FDMed ROs is larger than maximum bandwidth of RedCap UE. So different UEs have different initial UL BWP to make sure the shared ROs associated with its best SSB fall within its maximum bandwidth. As show in the following figure.      * Interpretation 2: The bandwidth of all the FDMed ROs is larger than maximum bandwidth of RedCap UE. RedCap UE shares a separate initial UL BWP, with part of the shared non-RedCap ROs in the BWP associated with all the SSBs, e.g. one RO is associated with more than one SSBs.     The understanding about the shared RO needs to be aligned first.  For the second sub-bullet, we share the same view as Ericsson and Intel, and think it is necessary to have such agreement. |
| NEC | Y | In our understanding, RO needs to be configured within a separate initial UL BWP for RedCap UE.  On the second bullet, we don’t see much necessity to prohibit the case. |
| LGE | Y with modifications | We prefer to remove the “defined” from the two bullets and create a third bullet for FFS on the “defined”. |
| Apple | Y | Thanks to Intel for clarification on the 2nd bullet. We now understand the use case, i.e., at least for early indication, allowing separate initial UL BWP provides flexibility to avoid RO/preamble split.  Having said this, we are ok FL proposal to include both two bullets.  On CMCC question, our interpretation of previous agreement is Interpretation 2. |

|  |  |  |
| --- | --- | --- |
| Samsung |  | Suggest to remove “defined” and add “at least” before “configured”.  At least in our understanding, the motivation to support separated iDL BWP is to ensure the RO issue. i.e., configured a separate RO. In our understanding, the original Note on RO sharing is for gNB implementation. For example, gNB can configured same RO as for none-RedCap UE.  For CMCC’s question, our interpretation on the agreement (including the note) is neither 1 nor 2. But we think for sharing case, RO for non-RedCap shall fall into the separate iUL BWP for non-RedCap. However, RO for RedCap is separated configured in separate iUL BWP. |
| Lenovo, Motorola Mobility | Follow up | Our memory is that this “/defined” was added for the possibility of determining the position of separate initial UL BWP in frequency domain implicitly, instead of explicit configuration. We are fine to keep it in the proposal.  We are fine to have a shorter proposal as from Ericsson, or have both bullets in the proposal.  Regarding the ROs in the separate initial UL BWP, our understanding is that the previous agreement does not preclude that the separate initial UL BWP does not contain ROs (and ROs are then shared with non-RedCap UEs). It supports this separate initial UL BWP for RedCap includes ROs for RedCap UEs. (but not says not to support separate initial UL BWP without ROs). |
| Huawei, HiSilicon |  | To Karol, Debdeep, Rapeepat, Feifei  Thanks for the comments.  It is *NOT* our intention to let RedCap UE operates outside an initial UL BWP. However, it is not clear to us how it works as a complete solution as FUTUREWEI and CMCC explained in case of Interpretation 2 of CMCC fig. (as some of you also agree with this interpretation; other interpretation has the same question)    Specifically,   1. The initial BWP for RedCap is configured first - gNB does not know which SSB is the best for an unknown UE 2. A specific UE trying to access will measure SSB and find an RO with best measured SSB later – the RO may be e.g. RO6 in the above fig. 3. It is not possible for gNB to predict which SSB is the best, as different UEs sharing the same SSB sets but in different conditions/reception beams in the above case   Thus,  One can restrict that only the ROs within the pre-configured BWP can be used, while once a UE measure a best SSB outside the BWP, it needs to re-select another SSB based on other rules - this is feasible but require further discussion, as against the current RACH framework;  One can define a separate RO-SSB mapping such that the possible associated SSBs are all within the pre-configured BWP - this is feasible but require further discussion, as against the uniquely used RO-SSB mapping so far;  One can restrict the possible gNB configurations such that the above case does not happen - this is also feasible while require further conclusion, although obviously is not good and against the previous agreements: it does not guarantee to enable the RO with best SSB, nor these ROs can be shared with non-RedCap UEs.  The current proposal is in short incomplete. Whether/how to resolve this issue is not yet clearly carried out - instead of re-open. |
| OPPO |  | Thanks CMCC for the detailed interpretation.  First of all, we think that shared RO case shall be allowed even if the bandwidth of the configured ROs exceed RedCap UE’s maximum bandwidth.  Secondly, both interpretation 1 and interpretation 2 shall be supported since the flexibility to configure RO for non-RedCap UE shall not be sacrificed. Then at least for interpretation 1, it shall be discussed how the initial UL BWP is derived for a RedCap UE. As Huawei pointed out, a RO is selected based on UE’s best SSB, then the initial UL BWP shall include the RO selected by the UE. But on the other hand, the gNB is not clear which RO would be selected by the UE thus it is not possible for the gNB to configure the initial UL BWP for the UE. In order to align the understanding of UE and gNB on which initial UL BWP the UE will use during RACH procedure, it will make sense to set some rule that both UE and gNB has the same understanding. It is why we think here defined shall be kept there. |
| FL2 | Based on the received responses, the following updated proposal can be considered.  A corresponding proposal for separate initial DL BWP is provided in Proposal 3.1-1a.  A question on the number of separate initial UL BWPs has been added in Question 2.1-2.  **High Priority Proposal 2.1-1a:**   * **A separate initial UL BWP for RedCap UEs can be configured in SIB1.**   + **It can be used both during and after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial UL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD cases.**   + **FFS whether part of the configuration is implicitly signaled** | |
| vivo | Fine in general | Clarification on 3rd sub-bullet: Our understanding is that in case “**the initial UL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**” and the separate initial UL BWP is not configured, the cell does not support RedCap UE. Would be good to clarify on this. |
| Nokia, NSB | Y |  |
| Qualcomm | Y |  |
| Nordic | Y | @Huawei, Futurewei and CMCC  As you can see the note is sub-bullet of main bullet. This means that only if highlighted part is satisfied, then ROs can be shared between RedCap and non-RedCap UEs.   * For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.   + Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.   These ROs in separate Initial UL BWP shall be shared between “all” redcap UEs and “all” non-RedCap UEs.  Therefore, the advertised case of 8 FD ROs > 20Mhz is not allowed according to the agreement. For such case, gNB shall configure separate ROs for RedCap UE in the separate initial UL BWP. |
| Ericsson | Y |  |
| IDCC | Y |  |
| Intel | Y | Same understanding as elaborated by Nordic for the example of FDM-ed ROs spanning beyond max RedCap UE BW. |
| Lenovo, Motorola Mobility | Y |  |
| FUTUREWEI2 | Y |  |
| NEC | Y |  |
| DOCOMO | Y | But it has been pointed out multiple times that RAN2 will decide which SIB is used. Better to replace “SIB1” in the main bullet to “SIB” |
| Xiaomi | Generally Y | How to signal the initial UL BWP is up to RAN2. So the last FFS bullet is not necessary |
| CATT | Y |  |
| OPPO | Y for compromise | This proposal is relevant with Question 2.1-2.  If all companies think that for the case (that the total frequency span of 8 FDM-ed RACH occasions is greater than 20 MHz) is a corner case and it can be resolved by pure gNB configuration without any specification impact. We can accept this proposal as a compromise. |
| CMCC | Y |  |
| FL2 | The following agreement was made in the RAN1 online (GTW) session on Wednesday 13th October:  **Agreement:**   * **For a cell that allows a RedCap UE to access, network can configure a separate initial UL BWP for RedCap UEs in SIB**   + **It can be used both during and after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial UL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth**   + **This applies to both TDD and FDD (including FD FDD and HD FDD) cases** | |

RAN1#106-e made the following agreement:

* For enabling/supporting that the RACH occasion (RO) associated with the best SSB falls within the RedCap UE bandwidth, support separate initial UL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth), and this separate initial UL BWP for RedCap includes ROs for RedCap UEs.
  + Note: these ROs can be dedicated for RedCap UEs or shared with non-RedCap UEs.

Based on received responses to Proposal 2.1-1, it seems that different interpretations are possible for the above agreement.

**FL2 High Priority Question 2.1-2: Should it be possible to have more than one separate initial UL BWP for RedCap UEs? If yes, please elaborate on the purpose in the Comments field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | Y | For offloading purpose, if one separate initial UL BWP is not sufficient due to massive number of RedCap devices, more than one initial UL BWPs may be configured. |
| Nokia, NSB | N | We are not supportive of having more than one separate initial UL BWP for RedCap. Even if offloading is necessary, UEs can be moved to separate active UL BWP after initial access. |
| Qualcomm | N | Switching between multiple separate initial UL BWPs will complicate the procedures of RedCap UE during initial access and increase the signaling overhead. |
| Nordic | Y,but | Could be considered for future releases. Nokia offloading works only with BWP Option 1, in our opinion, but could be sufficient. |
| Ericsson | N | The case of ROs with best SSB falling outside RedCap BW is not common. The total frequency span of 8 FDM-ed RACH occasions is greater than 20 MHz in FR1 and 100 MHz in FR2 in the following configurations:  • Preamble Format 3 in FR1, L=839 (long preamble), 5 kHz SCS: total BW of 8 FDM-ed RACH occasions = 34.56 MHz  • FR1, L=139 (short preamble), 30 kHz SCS: total BW of 8 FDM-ed RACH occasions = 34.56 MHz  • FR2, L=139 (short preamble), 120 kHz SCS: total BW of 8 FDM-ed RACH occasions = 138.24 MHz  Also, if needed, proper gNB configuration can resolve this issue. Although the flexibility of the network configuration for non-RedCap UE can be impacted, such impact is not significant and sufficient capacity can still be achieved with less than 8 FDM-ed RACH occasions (e.g., 4 FDM-ed RACH occasions). Also, multiplexing in the time domain can be used to increase PRACH capacity.  Defining multiple initial UL BWP only for resolving RO-SSB related issue for special cases (mentioned above) is not efficient and it makes the coexistence of RedCap and non-RedCap more complicated. Specifically, it has negative impacts in terms of: 1) PUSCH resource fragmentation, 2) May need corresponding DL BWP configuration in TDD (in case center frequency alignment is preferred), 3) significant increase of overhead and reduced spectral/energy efficiency. |
| IDCC | N |  |
| Intel | N | Share the views from Nokia on offloading and from Ericsson on the lack of need to optimize for the case of FDM-ed RACH occasions spanning larger than 20/100 MHz in FR1/FR2 respectively. |
| Lenovo, Motorola Mobility | N |  |
| NEC | N |  |
| DOCOMO | N | Both Interpretations 1 and 2 in CMCC’s comment in Proposal 2.1-1 are possible based on the above agreement. However, it would be enough to configure only one separate initial UL BWP which contains ROs for RedCap UEs associated with all SSBs |
| Xiaomi | N | We don’t see the motivation of supporting more than one initial UL BWP. We see some companies support one initial UL BWP only include a part of ROs applied to RedCap and then define multiple UL BWP to cover all the ROs applied for RedCap. In our understanding, there are the following drawbacks   * Before determine select the proper RO, RedCap should determine UL BWP first. That would complicate the processing. * Furthermore, if more than one initial UL BWP is configured, then separate PUCCH resource would be configured within each initial UL BWP, which would cause more PUSCH fragement |
| CATT | Y | Open to consider. |
| OPPO |  | If all companies think that for the case (that the total frequency span of 8 FDM-ed RACH occasions is greater than 20 MHz) is a corner case and it can be resolved by pure gNB configuration without any specification impact. We can accept only one separate initial UL BWP for RedCap UEs. |
| CMCC | Y | We can accept configure more than one separate initial UL BWP for solving RO issue or offloading purpose. |
| Huawei, HiSilicon | Y | One use case is for the RO outside the UE max BW.  Network may configure the UE with legacy initial UL BWP corresponding to the legacy initial DL BWP containing SSB and ROs 0~3 (taking the example in CMCC fig), and configure a separate initial UL BWP containing ROs (4~7).  Another use case is that PRACH, PUSCH and PUCCH may be sent from different initial UL BWP.  In total, one legacy initial UL BWP + one separate initial UL BWP =2 initial UL BWP for RedCap UEs. Of course, at a given time, only one of the BWP is used for a particular UE. |
| LGE |  | Multiple initial UL BWPs may be considered as an alternative solution of resolving the 8-FDMed ROs without any restriction on the network, and also for offloading purpose. But it should not introduce any frequent BWP switching and a new BWP switching mechanism.  The question seems to be whether more than one separate initial UL BWPs needs to be configured for RedCap while the use cases mentioned by Huawei seem to be one separate initial UL BWP in addition to the initial UL BWP for non-RedCap UEs which is already covered by the agreement we just made in the GTW session. |
| Spreadtrum | N | Even for the current non-RedCap UE, there is only one initial UL BWP configured. We don’t see the need for the RedCap UE but see the additional complexities. |
| ZTE, Sanechips | N | On the one hand, the RO-SSB related issue can be properly resolved by gNB configuration. On the other hand, the configuration of more than one separate initial UL BWP for RedCap UEs would increase the signaling overhead and aggravate the PUSCH resource fragmentation problem. Therefore, the necessity of configuring multiple UL BWPs is not foreseen. Considering the TU and left meetings are limited, this kind of unnecessary issues can be de-prioritized. |
| CMCC2 |  | We think one separate initial UL BWP is enough to solve the RO issue and prefer to configure only one separate initial UL BWP.  When the separate initial UL BWP configures dedicated RO for RedCap UE, of course the RO associated with best SSB always locate within separate initial UL BWP.  When the separate initial UL BWP configured for RedCap UE shares the RO with non-RedCap UEs, separate initial UL BWP should contain the entire RO-SSB mapping relationship. Our first preference is interpretation 2. gNB can solve the RO issue by properly configure RO-SSB mapping. If RO configuration by gNB cannot guarantee entire mapping of non-RedCap RO and SSB in separate initial UL BWP, dedicated RO can be configured for RedCap.  Multiple separate initial UL BWP has additional benefit for offloading, which can be considered as an enhancement of current version. |
| FL3 | Most of the received responses (11 out of 18) think that it should not be possible to have more than one separate initial UL BWP for RedCap UEs, but a few received responses (5 out of 18) think that it should be possible, where one of the responses suggest considering it for Rel-18. Based on the received responses, the following proposal can be considered.  **High Priority Proposal 2.1-2a:**   * **In Rel-17, a single separate initial UL BWP for RedCap UEs can be configured in SIB.** | |
| MediaTek | Y |  |
| Qualcomm | Y | We support FL3 proposal.  In our view, configuring multiple separate initial UL BWPs for RedCap UE will incur/aggravate resource fragmentation of non-RedCap UE, increase the signaling overhead (e.g. configuring multiple initial UL BWPs in SIB), and degrade the spectral efficiency (e.g. PUCCH resources for RedCap UE need to be separately configured and distributed in multiple initial UL BWPs).  To ensure the RO of RedCap UE can be associated with all (and the “best”) SSB index transmitted by gNB, NW can consider at least the following solutions for a single separate initial UL BWP of RedCap UE:   1. Configure an appropriate PRACH SCS (≤ 15 kHz) when 8 FDM-ed ROs are included in the initial UL BWP of RedCap UE 2. Configure a FDM pattern with less than 8 ROs for RedCap UE 3. Joint configuration of FDM pattern of RO and PRACH mask for RedCap UE |
| CATT |  | OK for progress. Can we clarify that such single separate initial UL BWP is even from network’s view? If it is intended to mean it. |
| vivo |  | We are fine with the proposal. |
| Panasonic | Y | The gNB can configure proper RO configuration for RedCap UEs within separate initial UL BWP. So we don’t think there is an issue for SSB-RO mapping. |
| Intel | Y |  |
| DOCOMO | Y |  |
| Samsung | Y | Fine with the FL3 proposal.  On one hand, we didn’t see any necessary to introduce multi-separate initial UL BWP   * Issue of RO outside redcap BW can be solved by network configuration * Limited benefit for UL load balance   On the other hand, multi-separate initial UL BWP may bring further issues, like resource fragmentation, UL/DL BWP centre frequency issue in TDD, etc. |
| ZTE, Sanechips | Y |  |
| China Unicom | Y |  |
| LGE | Y |  |
| OPPO |  | Before we answer the question, I want to ask the following:  Whether the issue in the case (that the total frequency span of 8 FDM-ed RACH occasions is greater than 20 MHz) shall be resolved the specification or pure gNB configuration without any specification impact?  If it is to be solved by the spec, how to solve it?  If is purely based on the gNB’s implementation. Can we put a note here as in the following:  **High Priority Proposal 2.1-2a:**  **In Rel-17, a single separate initial UL BWP for RedCap UEs can be configured in SIB.**  Note: it is based on gNB’s implementation to guarantee this separate initial UL BWP includes ROs for RedCap UEs. |
| Sharp | Y |  |
| Huawei, HiSi | N | It is weird that majority are ok with having both CORESET#0 and a separate initial DL BWP for e.g. offloading, thus two initial DL BWPs for a specific RedCap UE, while not for the UL – which could be also for offloading (the load would be same for DL and UL thus both require offloads), diversity (PUCCH FH may have to be always disabled due to fragmenting PUSCH) purpose. The further resource fragment issue due to two UL BWPs does not hold as it is assumed to use PUCCH only on each side of each BWP, likely multiplexed/closed to two sides of common PUCCH respectively for non-RedCap UEs. Signaling overhead is also not accurate – the two BWPs can minimum just have difference on location/part of PUCCH hopping for example, thus the same as single UL BWP. For the case of DL, the additional signaling overhead exists. |
| SONY | N | We have similar views to Huawei.  We are open to there being more than one initial UL BWP from a network perspective. From a UE perspective, the UE would operate in a single initial UL BWP. Support of more than one initial UL BWP for Redcap UEs would help in highly loaded situations. To address some of the concerns raised, we have the following observations:   * **Signalling**. Both the initial UL BWPs can share most of the configuration signalling. There doesn’t have to be extra signalling involved for selecting an initial UL BWP: the UE can choose an initial UL BWP itself randomly. * **PUSCH fragmentation**. This is avoided or minimal if the initial UL BWPs are located at the edges of the carrier. * **PUCCH resource**. Each initial UL BWP could overlap and share the PUCCH resources of the carrier. Hence there is no need for increased PUCCH resource. * **Legacy UE only supports one initial UL BWP**. From a UE perspective, the Redcap UE also only supports a single initial UL BWP (even though the network can support more than one initial UL BWP).   **Extra specification**. We see little specification increase. As a default, the UE can choose one of the initial UL BWPs randomly. We are also open to considering more elaborate approaches, if necessary. |
| Lenovo, Motorola Mobility | Y |  |
| Nordic | Y |  |
| FUTUREWEI |  | Oppo has a point, in our view the “how to guarantee this separate initial UL BWP includes ROs for RedCap UEs when ROs are shared between RedCap and non-RedCap UEs” is still open and should be addressed. |
| NEC | Y |  |
| CMCC | Y |  |
| Ericsson | Y |  |
| IDCC | Y |  |
| Nokia, NSB | Y |  |
| FL5 | Most of the received responses think that it should not be possible to have more than one separate initial UL BWP for RedCap UEs, but some received responses think that it should be possible. It may be worthwhile to check whether a possible compromise could be to allow 1 or 2 separate initial UL BWPs, but no more than 2.  **High Priority Question 2.1-2b: Would it be acceptable (as a compromise) to allow up to 2 separate initial UL BWPs for RedCap UEs? If yes, please elaborate in the Comments field on how the 2 separate initial UL BWPs would be used (from UE perspective and from network perspective) and how they are related to the separate initial DL BWP(s).** | |
| DOCOMO | N | We still don’t see any necessity to introduce multiple separate initial UL BWPs for RedCap UEs. All ROs can be configured within a single initial UL BWP for RedCap UEs by the configuration dedicated to RedCap UEs. |
| CATT | Y probably | If 2 separate initial UL BWP can be used from networks view (but only 1 from UE’s view), then:  1. In FDD case, it is no problem if only 1 separate initial DL BWP is configured from network’s view. The RedCap UE shall couple the separate initial DL BWP and the selected separate initial UL BWP as one BWP pair.  2. In TDD case, it depends on whether center frequencies can be different even after the initial access:   * If the center frequencies must be aligned, 2 separate initial DL BWP should be configured from network’s view (maybe almost the same configuration except *locationAndBandwidth*). * Otherwise (allowing not aligned), similar to FDD case, only 1 separate initial DL BWP from network’s view is enough. |
| ZTE, Sanechips | N | Per our understanding, multiple initial UL BWPs (if configured) should be configured to be FDMed in the frequency domain to cover all shared ROs that span outside the maximum RedCap UE bandwidth. In this case, it is hard to place them all at the carrier edge or two sides of common PUCCH for non-RedCap UEs, which would definitely aggravate the PUSCH resource fragmentation problem. Besides, there is no urgent need for UL offloading at this stage and RedCap UEs can retune to the active BWP after initial access.  We are wondering how the center frequency is aligned in TDD when multiple separate initial UL BWPs are configured? |
| Panasonic | N | In case 2 separate initial UL BWPs are defined, it needs to specify how each RedCap UEs are distributed to these two initial UL BWPs, for example random selection, UE ID based, and so on. In order to reduce such design effort, our preference is to stick to only one initial BWP for Release 17 RedCap UEs.  We agree the view from OPPO and FUTUREWEI i.e. the need of the discussion how to configure dedicated RO for RedCap within separate initial UL BWP. |
| CMCC | N | We prefer configure one separate initial UL BWP. The introduction of separate initial UL BWP is to solve the coexistence problem, and one separate initial UL BWP can already solve the coexistence problem very well. Related to RO issue, we want to remind that sharing RO between RedCap and non-RedCap is not necessary, dedicated RO configuration always work.  If multiple separate initial UL BWP is supported, it will raise new coexistence problem, while the impact and solution are not clear now. |
| OPPO | Y | This separate initial UL BWP can be used as least in the following cases:   1. To cover ROs the initial UL BWP can not cover. From the UE side, it can be select the BWP based on the RO selected for PRACH transmission. 2. the separate initial UL BWP can be used to align the centre frequency of the separate initial DL BWP at least for TDD case, or vice versa. |
| Samsung |  | We prefer to configure only one initial UL BWP for RedCap in Rel-17, considering the limited TUs. We are open for multiple iUL BWP in Rel-18, in for massive connection. |
| MediaTek | N | In TDD the two separate initial UL BWPs would require two matching separate DL BWPs with same center frequencies.  We do not see the necessity of more offloading for the initial BWPs. On the other hand, resource fragmentation may get worse.  If FDM’ed shared RO’s cannot be covered with a single initial UL BWP then dedicated RO’s may still be configured for the RedCap UEs. |
| FUTUREWEI | Y | From the UE perspective, only one UL BWP is active. Some example scenarios are provided by oppo. |
| Intel | N | Not essential as discussed before, and especially risky when we are struggling to converge on solutions to handle a single separate initial UL BWP. |
| Ericsson | N | In our understanding, configuring 2 separate initial UL BWPs can result in significant overhead from potentially configuring additional SSB and CORESET/CSS in the corresponding DL BWPs. Additionally, this can also result in resource fragmentation even with disabled PUCCH FH. Especially, since RACH resources are contiguous in frequency, if two RedCap initial UL BWPs are used to cover all ROs, then in most cases it is not possible to place both initial UL BWPs at the edges, which results in PUSCH fragmentation: |
| Huawei, HiSi | Y | There are several use cases that can benefit from separate initial UL BWPs.  **Use Case**  Although companies consider the issue of RO outside BWP could be avoided by gNB scheduling, by configuring up to two BWPs this could be completely resolved without penalizing RO capacity for RedCap UEs and restriction on network configuring dedicated ROs.  Also, given limited UE max bandwidth, PUCCH hopping across a larger bandwidth is beneficial for UL coverage and PUCCH multiplexing. This can be achieved by max 2 UL BWPs, each of which contains PUCCH resources that can be multiplexed with or close to the common PUCCH resources at one side of the BWP for non-RedCap UEs. The configuration details of PUCCH (FH) can be further discussed, e.g. in Ericsson fig, to be without PUSCH fragmentation.  **Relationship with DL**  There can be no particular relationship with DL, if the center frequency does not need to be aligned with the initial UL BWP. Or, the max two DL initial BWPs have the same location as the two UL BWPs with aligned center frequency. |
| Qualcomm | N | We agree with the comments of Ericsson, DOCOMO, CMCC, MediaTek and ZTE. |
| NEC | N | We agree with DOCOMO, CMCC and other companies. Network can configure all RO within a single separate UL BWP. |
| FL6 | Most of the received responses think that it should not be possible to have more than one separate initial UL BWP for RedCap UEs, but some received responses think that it should be possible.  **High Priority Proposal 2.1-2c:**   * **In Rel-17, at least a single separate initial UL BWP for RedCap UEs can be configured in SIB.**   + **It is FFS till RAN1#107-e whether 2 separate initial UL BWPs can also be configured.** | |
| vivo | Y |  |
| Spreadtrum | Y |  |
| CATT | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| DOCOMO |  | We still believe that a single separate initial UL BWP is sufficient to configure all ROs and it is preferable to preclude the support of multiple separate initial UL BWPs in this meeting considering the remaining time, but OK to leave it as FFS. |
| CMCC | Y | We prefer to configure only one separate initial UL BWP for RedCap in Rel-17. We are also open for discussing multiple separate initial UL BWP in Rel-18. |
| NEC | Y | We also prefer a single separate initial UL BWP but OK with the FL proposal. |
| Sharp | Y | We prefer to configure only one separate initial UL BWP but OK for the progress. |
| Samsung | Y |  |

## PUCCH frequency hopping

Regarding PUCCH transmissions (for Msg4/MsgB HARQ feedback) during initial access, we have the following agreement and working assumption from RAN1#106-e:

|  |
| --- |
| Agreements:   * In case a separate initial UL BWP is configured for RedCap UEs, it is supported that the network can enable/disable intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs.   + Working assumption: The frequency hopping is enabled/disabled at least via SIB. |

Several contributions discuss the signalling solution for disabling/enabling the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs. Most of these contributions indicate that the PUCCH frequency hopping should be enabled/disabled only via SIB and that it is not preferred to use DCI [6, 10, 14, 15, 16, 24, 28, 29]. However, two contributions propose to use DCI (in addition to SIB) for enabling/disabling the PUCCH frequency hopping [4, 5].

Based on the above majority views and for the sake of progress, the following proposal can be considered.

**FL1 High Priority Proposal 2.2-1: Replace the RAN#106-e agreement and working assumption with:**

* **In case a separate initial UL BWP is configured for RedCap UEs, it is supported that the network can enable/disable intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs.**
  + **The frequency hopping is enabled/disabled ~~at least~~ via SIB.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | Y | If the RedCap-specific initial UL BWP fully overlaps with the initial UL BWP of non-RedCap UE, we don’t see a need to disable the intra-slot FH of PUCCH for RedCap UE, if the intra-slot FH of PUCCH for non-RedCap UE is still enabled. |
| Vivo | Y |  |
| OPPO | Y |  |
| Nordic | Y, but | It is not clear how would such disabling work. Could only half of PUCCH resources within Resource set be used? |
| Huawei, HiSilicon | FFS | There is no numerical result providing any effective analysis explaining why the FH function for PUCCH should be controlled by SIB. On the other hand, we find that PUCCH performance is degraded and it would be strongly desirable that enhancement can be ready for that if PUCCH FH has to be disabled and this enhancement needs to be well controlled by network – in a dynamic way considering user channel conditions. Also, there would be marginal spec impact if this can be indicated by dynamic PDCCH scheduling Msg4/MsgB.  Additionally, the frequency hopping across a large BW is beneficial and important for the common PUCCH performance. Further discussion on the potential support of this is proposed.  Thirdly, the resource multiplexing issue with non-RedCap UEs may require some further discussion, as in **Question 2.2-2**  Thus the proposal should be revised as  **Modified Proposal 2.2-1: Replace the RAN#106-e agreement and working assumption with:**   * **In case a separate initial UL BWP is used ~~configured~~ for RedCap UEs, it is supported that the network can enable/disable intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs.**   + **The frequency hopping ~~is~~ can be enabled/disabled ~~at least~~ via SIB and DCI scheduling Msg4/MsgB.** * **FFS inter-slot PUCCH frequency hopping outside UE maximum bandwidth** |
| ZTE, Sanechips | Y |  |
| TCL | Y | Fine with the FL proposal |
| Xiaomi | Y |  |
| Panasonic | Y |  |
| Sharp | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Spreadtrum | Y |  |
| CATT | Y |  |
| FL1 | The following agreement was made in the RAN1 online (GTW) session on Monday 11th October:  **Agreement: Confirm the working assumption:**   * **In case a separate initial UL BWP is configured for RedCap UEs, it is supported that the network can enable/disable intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs.**   + **The frequency hopping is enabled/disabled at least via SIB.** | |

Moreover, two contributions point out that when the PUCCH frequency hopping (FH) is disabled, the orthogonality between non-FH PUCCH and FH PUCCH transmissions needs to be ensured, e.g., by using two time-domain orthogonal cover codes (OCC) sequences.

* [4]: For PUCCH format 1, support PUCCH without frequency hopping to be transmitted with two OCC sequences (as stipulated for legacy FH PUCCH).
* [19]: When intra-slot PUCCH frequency hopping within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap UEs is disabled, UE generates two base sequences for the PUCCH as if intra-slot frequency hopping is enabled for the PUCCH transmission.

**Medium Priority Question 2.2-2: Are any standard changes desired in order to support multiplexing of non-FH and FH PUCCH transmissions in PUCCH resources for HARQ feedback for Msg4/MsgB? If yes, please elaborate.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Huawei, HiSilicon |  | The issue for PUCCH format 1 in [4] applies to PUCCH after initial access, instead of for HARQ for Msg4/MsgB. Therefore the question can be modified like  **Modified Question 2.2-2**  **Are any standard changes desired in order to support multiplexing of non-FH and FH PUCCH transmissions in PUCCH resources ~~for HARQ feedback for Msg4/MsgB~~? If yes, please elaborate.** |
| Panasonic |  | When the configuration on PUCCH for Msg4/B is separate for RedCap and non-RedCap, our view is the PRB doesn’t overlap with each other. In this case, no need to consider OCC sequence collision.   * For example, RedCap PUCCH can be configured in the PRBs adjacent to non-RedCap PUCCH resource so that PUSCH resource fragmentation is minimized   Or, if it is necessary to overlap those PUCCH resources in frequency, it may be beneficial to generate two sequences to avoid sequence collision as proposed by [4, 19]. |
| FUTUREWEI |  | Companies should check to see whether orthogonality is preserved when hopping is disabled. In our understanding of 38.211 clause 6.3.2.4.1, the text appears to support no intra-slot frequency hopping. The current RRC parameter *intraSlotFrequencyHopping* is set to enable with the description “Enabling intra-slot frequency hopping, applicable for all types of PUCCH formats. For long PUCCH over multiple slots, the intra and inter slot frequency hopping cannot be enabled at the same time for a UE. See TS 38.213 [13], clause 9.2.1.” |
| FL2  FL3  FL4  FL5 | The question has been updated based on the above comment from Huawei/HiSilicon.  **Medium Priority Question 2.2-2a: Are any standard changes desired in order to support multiplexing of non-FH and FH PUCCH transmissions in PUCCH resources? If yes, please elaborate.** | |
| vivo |  | We agree with Panasonic that NW can configure PUCCHs for RedCap (FH disabled) and non-RedCap UEs (FH enabled) on non-overlapping RBs. |
| Nordic | Yes | In our understanding for default PUCCH resources from *pucch-ResourceCommon* are used  resources 0-7 have First-hop on left and First-hop on right  resource 8-15 have First-hop on right and First-hop on left  and resource 0/1/2… and resource 8/9/10.. use the same sequence.  Now, when we disable hopping for pucch-ResrouceCommon , are all the resource mapped to First hop only, and how to distuquish resource 0 from 8? Is only half of resources used?  But perhaps we are missing something, in any case this should be clarified. |
| Intel | No | Not essential in our view – some multiplexing may be possible via proper assignment of PRBs to non-RedCap and RedCap UEs, etc., but for the most part, we expect the typical operation to follow as suggested by Panasonic and vivo. |
| DOCOMO | Y | Of course it is possible to multiplex RedCap UEs w/o FH and non-RedCap UEs w/ FH in TDM/FDM manner. However, as pointed out by our contribution [19], if their PUCCHs are overlapped, they would interfere with each other irrespective of the applied CS, unlike the overlap between non-RedCap UEs. We try to address the issue on the degradation of the number of multiplexed UEs by CS caused by FH disabling. |
| CATT | N | We raised a question on whether standard change is needed to prevent resource overlapping between non-FH and FH PUCCH in the last meeting. However, companies show confidence that gNB can guarantee such overlapping will not happen by properly configuring the separate initial UL BWP location by implementation.  Following the same logic, we do not think spec change is needed to support multiplexing non-FH and FH PUCCH, since gNB is able to avoid any overlapping of them. |
| Huawei, HiSi | Y | PUCCH performance enh. is becoming more critical as UL coverage reduced by e.g. 1Tx and potentially antenna efficiency, and reduced frequency diversity gain. |
| LGE | N | We have the same view that the typical network configuration would be to avoid overlapping PUCCH resources between PUCCH resources with FH and those without FH. Multiplexing PUCCH resources among RedCap UEs and also among non-RedCap UEs is still allowed, so we also think the proposed spec changes are not essential. |
| Qualcomm | FFS | Minimum impacts on spec and RedCap UE implementation should be ensured. |
| Samsung | N | Current spec support different PRB offset for common pucch which can solve this problem. We didn’t see it as necessary. |
| Sharp |  | We have same view with Panasonic and vivo. Non-overlapping resource allocation by separate PUCCH configuration can work. |
| ZTE, Sanechips |  | The spec description may need clarification, e.g., the *pucch-ResourceCommon*. The performance optimization may does not need. |
| Ericsson | FFS | According to TS 38.213, “An orthogonal cover code with index 0 is used for a PUCCH resource with PUCCH format 1 in Table 9.2.1-1”. The Table 9.2.1-1 in TS 38.213 corresponds to the PUCCH resource sets before dedicated PUCCH resource configuration (e.g., for Msg4 HARQ feedback). The OCC table from TS 38.211 is copied below, where the code with index 0 is highlighted.  Table 6.3.2.4.1-2: Orthogonal sequences  for PUCCH format 1.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  |  | | | | | | | |  |  |  |  |  |  |  | | 1 | [0] | - | - | - | - | - | - | | 2 | [0 0] | [0 1] | - | - | - | - | - | | 3 | [0 0 0] | [0 1 2] | [0 2 1] | - | - | - | - | | 4 | [0 0 0 0] | [0 2 0 2] | [0 0 2 2] | [0 2 2 0] | - | - | - | | 5 | [0 0 0 0 0] | [0 1 2 3 4] | [0 2 4 1 3] | [0 3 1 4 2] | [0 4 3 2 1] | - | - | | 6 | [0 0 0 0 0 0] | [0 1 2 3 4 5] | [0 2 4 0 2 4] | [0 3 0 3 0 3] | [0 4 2 0 4 2] | [0 5 4 3 2 1] | - | | 7 | [0 0 0 0 0 0 0] | [0 1 2 3 4 5 6] | [0 2 4 6 1 3 5] | [0 3 6 2 5 1 4] | [0 4 1 5 2 6 3] | [0 5 3 1 6 4 2] | [0 6 5 4 3 2 1] |   In the table above, if OCC with index 0 (PUCCH format 1) is used, the elements of OCC will be only ones. For example, if , the OCC *w0*(0, 1, 2, 3, 4) = [1 1 1 1 1]. Since the OCC is composed of only with ones, perhaps it does not matter if we have different lengths of OCCs for the cases with and without FH.  Since the OCC with index 0 is always used before dedicated PUCCH config, it may not be possible to multiplex PUCCH for UEs *without dedicated config* *using OCC*, even in legacy NR. However, it may be possible to multiplex PUCCH using different cyclic shifts (CS) of the same base sequence. It may also be possible to multiplex (using OCC/CS) PUCCH without FH for RedCap UEs before dedicated config and PUCCH with and without FH for RedCap/non-RedCap UEs after dedicated PUCCH config.  We would like to check if DOCOMO/Huawei/other companies share the same understanding as us on this issue. It is also not clear to us whether this is a new issue, considering the fact that after initial access, FH can be currently enabled/disabled for non-RedCap UEs. In this case, perhaps we can multiplex some non-RedCap UEs with FH and some other without FH. If yes, then this an existing case and it should perhaps not be a new issue with introduction of RedCap (?). |
| Huawei, HiSi | Y | Small enhancements with minimized spec impact can be considered. For the time being it may be safe to FFS - i.e. not close this question this time. |
| FL6 | Based on the received responses, the following proposal can be considered.  **Medium Priority Proposal 2.2-2b:**   * **FFS: What specification changes (if any) are needed to support that the network can enable/disable intra-slot PUCCH frequency hopping (FH) within the separate initial UL BWP in the PUCCH resource for HARQ feedback for Msg4/MsgB for RedCap** * **FFS: Whether any specification changes are needed and desired in order to support multiplexing of non-FH and FH PUCCH transmissions in PUCCH resources.** | |
| vivo | Y |  |
| Spreadtrum | Y |  |
| CATT | Y |  |
| DOCOMO | Y | In the current specification, FH is always enabled for PUCCH resource sets before dedicated PUCCH configuration. In addition, if FH is disabled for dedicated PUCCH, only one sequence would be generated (left figure shown below) according to the current specification. Thus, if FH is disabled for PUCCH for HARQ feedback for Msg4/MsgB for RedCap, only one sequence would be generated even for PUCCH before dedicated PUCCH configuration. If PUCCH for RedCap UE (without FH) and PUCCH for non-RedCap UE (with FH) is overlapped before RRC connection, they would interfere with each other irrespective of the applied CS since they have high cross-correlation. In order to avoid the interference, gNB can configure different CS for each overlapped PUCCHs, however, the applicable CS index can be limited and the multiplexing capacity for the PUCCH may be decreased compared to the capacity in current specification (i.e., between non-RedCap UEs). For PUCCH after dedicated PUCCH configuration, PUCCH resources can be configured UE specifically, so decrease of multiplexing capacity provided by CS may not be the critical issue. On the other hand, for PUCCH before dedicated PUCCH configuration, a PUCCH resource set is shared between different UEs including both RedCap and non-RedCap UEs, therefore ensuring the multiplexing capacity is more important than that of PUCCH after dedicated PUCCH configuration.    Based on the above, specification changes are desired to ensure the multiplexing capacity since we believe that the multiplexing capacity for the PUCCH is important aspect even for RedCap UEs considering future network and at least the following aspects should be clarified when FH is disabled.   * Sequence construction details of PUCCH for HARQ feedback for Msg4/MsgB * Which resource (1st hop or 2nd hop) shall be used |
| CMCC | Y |  |
| Sharp | Y |  |
| Samsung |  | We suggest to drop this proposal, and companies can discuss this in next RAN 1 meeting. |

One contribution also points out that when FH is disabled within the separate initial UL BWP, it is not clear which PRB index is to be used for the PUCCH transmission [19]. The contribution proposes to use either PRB index of first hop or second hop depending on the indicated . This proposal can be considered at a later stage after other more critical proposals have seen some progress.

# Initial and non-initial DL BWP

## Separate initial DL BWP

RAN1#105-e agreed the following working assumption related to separate initial DL BWP:

|  |
| --- |
| Working assumption:   * At least for TDD, an initial DL BWP for RedCap UEs (which is not expected to exceed the maximum RedCap UE bandwidth) can be optionally configured/defined separately from the initial DL BWP for non-RedCap UEs at least after initial access   + FFS the details of the configuration/definition     - The configuration for a separately configured initial DL BWP for RedCap UEs is signaled in SIB.     - whether to support that separate initial DL BWP for RedCap UEs can include a configuration of CORESET and CSS(s)     - whether part of the configuration can be defined instead of signaled   + If a separate initial DL BWP for RedCap UEs is configured/defined, this separate initial DL BWP for RedCap UEs can be used at least after initial access (i.e., at least after RRC Setup, RRC Resume, or RRC Reestablishment).     - FFS during the initial access   + FFS: whether a separately configured initial DL BWP for RedCap UEs needs to contain the entire CORESET #0, and, if not, the Redcap UE behaviour for CORESET #0 monitoring   + FFS: supported bandwidths in the separate initial DL BWP   + FFS: whether additional SSB is transmitted in the separately configured initial DL BWP for RedCap UEs   + FFS: FDD case |

Moreover, we have the following proposal from the latest FLS in RAN1#106-e [3]:

|  |
| --- |
| Proposal:   1. Regarding random access in idle/inactive mode in separate initial DL BWP for RedCap UEs in FR1,    1. If a separate initial DL BWP for RedCap UEs is configured in FR1, is configured for random access, including CORESET/CSS for random access.    2. If the separate initial DL BWP is configured for random access but not for paging, then the UE shall not expect SSB transmission in the separate initial DL BWP.       1. Note: The network may configure SSB in this case. 2. Regarding paging in idle/inactive mode in separate initial DL BWP for RedCap UEs in FR1,    1. From RAN1 perspective, if a separate initial DL BWP for RedCap UEs is configured in FR1, it can be configured for paging, including CORESET/CSS for paging.    2. FFS: If the separate initial DL BWP is configured for paging, then the UE [may expect / shall not expect] SSB transmission in the separate initial DL BWP.       1. FFS: Note: The network may configure SSB in this case. 3. Regarding CORESET#0 and SIB1 in idle/inactive/connected mode for RedCap UEs in FR1,    1. If a separate initial DL BWP for RedCap UEs is configured in FR1, then the UE shall not expect it to contain MIB-configured CORESET#0 or SIB1.       1. Note: The network may configure MIB-configured CORESET#0 or SIB1 to be within the separate initial DL BWP.    2. If an RRC-configured DL BWP is configured in FR1, then the UE shall not expect it to contain MIB-configured CORESET#0 or SIB1.       1. Note: The network may configure MIB-configured CORESET#0 or SIB1 to be within the RRC-configured DL BWP.    3. In connected mode, the UE is not required to monitor CORESET#0 periodically for SI updates.       1. FFS: How SI update notifications are indicated to RedCap UEs 4. Regarding connected mode in an RRC-configured active DL BWP for a RedCap UE in FR1,    1. Whether the UE can expect SSB transmission in the RRC-configured active DL BWP depends on its UE capabilities (e.g., whether it supports FG 6-1a or only FG 6-1).       1. A UE not supporting operation without SSB transmission in the RRC-configured active DL BWP may expect SSB transmission in the RRC-configured active DL BWP.          * This corresponds to mandatory RedCap UE feature.       2. A UE optionally supporting operation without SSB transmission in the RRC-configured active DL BWP shall not expect SSB transmission in the RRC-configured active DL BWP.          * This corresponds to optional RedCap UE feature.    2. 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       1. Note: According to 38.331 Annex B.2, BWP#0 is considered to be an RRC-configured BWP in BWP#0 configuration option 2 but not in BWP#0 configuration option 1. |

Most of the contributions (e.g., [4, 5, 6, 7, 11, 12, 13, 15, 16, 18, 24, 26, 27, 29]) agree that configuring/defining a separate initial DL BWP for RedCap UEs is beneficial for flexibility and offloading purposes and also it is needed in scenarios where non-RedCap initial DL BWP is larger than the RedCap UE bandwidth. In addition, several contributions indicate that the configuration for a separately configured initial DL BWP for RedCap UEs can be signaled in SIB [6, 11, 12, 15, 24, 26]. In addition, several contributions support that an initial DL BWP for RedCap UEs can be optionally configured/defined separately from the initial DL BWP for non-RedCap UEs in FDD as well [12, 18, 24, 27].

Although there are several FFSs that need to be addressed, there is a general agreement about the optional configuration of a separate initial DL BWP for RedCap. Therefore, the following proposal can be considered, with the understanding that the FFSs regarding various aspects including CORESET #0, CSSs and SSB will be discussed subsequently.

**FL1 High Priority Proposal 3.1-1:**

* **A separate initial DL BWP can be optionally configured/defined for RedCap UEs and it can be signaled in SIB.**
  + **This applies to both TDD and FDD cases.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm |  | We can agree with this proposal, if the conditions/motivations for the separate initial DL BWP configuration are provided same as Proposal 2.1-1. |
| vivo |  | We would like to clarify that this separate initial DL BWP can be used both during and after the initial access, hence we suggest modifying as below   * **A separate initial DL BWP can be optionally configured/defined for RedCap UEs both during and after initial access and it can be signaled in SIB.**   + **This applies to both TDD and FDD cases.** |
| OPPO |  | Besides the purpose of offloading, this separate initial DL BWP is also important for alignments of centre frequency of initial DL BWP and initial UL BWP.  Therefore, the configuration/definition shall consider both initial DL and initial UL BWP. |
| Nordic |  | We are generally fine, but since there are unresolved issues for the offloading case, we should confirm WA on for the case that we know works.   * **A separate initial DL BWP can be optionally configured/defined for RedCap UEs and it can be signaled in SIB.**   + **This applies to both TDD and FDD cases.**   + **This applies at least for the case when CORESET#0 and CD-SSB is within the separate initial DL BWP** |
| Huawei, HiSilicon | Y with modifications | Similar question as UL on how this single separate initial DL BWP interacts with the legacy initial DL BWP, i.e. BWP switching or RF retuning among different frequency locations.  Suggest to modify the proposal as  **Modified Proposal 3.1-1:**   * **A separate initial DL BWP can be optionally configured/defined for RedCap UEs and it can be signaled in SIB.**   + **This applies to both TDD and FDD cases.** * **FFS how the configuration/determination is applied, e.g. by BWP switching or RF retuning** |
| ZTE, Sanechips | Y | We are fine with the FL proposal. A separate initial DL BWP should be configured if BW of the legacy initial DL BWP exceeds the maximum RedCap UE bandwidth. As with TDD, a separate initial DL BWP can also be configured in FDD mode, which provides greater scheduling flexibility in the case of PDCCH blocking due to excessive number of accessed RedCap UEs. Besides, the configuration of the separate initial DL BWP applies a unified BWP configuration design for TDD and FDD. |
| TCL | Y | The question mentioned by Huawei needs further study |
| Xiaomi |  | The configuration of initial DL BWP should be discussed case by case. In some cases, the initial DL BWP should (rather than can be optionally) be configured for RedCap   * Case 1: when the SIB-configured initial DL BWP for non-RedCap is wider than RedCap’s maximum UE BW, then separate initial DL BWP **should be** configured/defined for RedCap * Case 2: in TDD, the separately configured initial UL BWP has different center frequency from the MIB-configured initial DL BWP, then separate initial DL BWP **should be** configured (NOTE: this case is also related to **Question 3.1-5,** we can touch this case after there is conclusion for **Question 3.1-5**) * For the remaining cases, the separate initial DL BWP **can be optionally** configured/defined for RedCap |
| Panasonic | Y |  |
| Sharp | Y | We are fine with the FL proposal. At least to support initial DL BWP with more than RedCap UE bandwidth for non-RedCap UEs, the separate initial DL BWP should be supported. Moreover, for TDD case, the separate initial DL BWP is needed for the center frequency alignment. |
| Lenovo, Motorola Mobility | Y |  |
| Spreadtrum | Y |  |
| CATT | Y | At least for the case of ‘after initial access’, and at least for the case when legacy SIB1-configured initial DL BWP is wider than the maximum RedCap UE BW, such separate initial DL BWP is needed. |
| Nokia, NSB | Y |  |
| Ericsson | Y | We propose the following update to avoid confusion:   * **A separate initial DL BWP can be ~~optionally~~ configured/defined for RedCap UEs and it can be signaled in SIB.**   + **This applies to both TDD and FDD cases.** |
| Intel | Y |  |
| China Telecom | Y | We are fine with FL proposal. And we think it could be used at least during initial access. |
| DOCOMO | Y |  |
| FUTUREWEI | Y | If no agreement is reached on a separate initial DL BWP, a RedCap UE will have to use the MIB-configured CORESET#0 during initial access. While using the MIB-configured CORESET#0 works, it has many drawbacks for the network when considering RedCap UEs.  To focus on at least initial access, the following modification is suggested   * A separate initial DL BWP can be optionally configured/defined for RedCap UEs for at least initial access and it can be signaled in SIB. |
| CMCC | Y | Separate initial DL BWP can be configured for offloading or for center frequency alignment. |
| NEC | Y |  |
| LGE | Y | Okay with the “configured”, but seems to need clarifications for the “defined”. |
| Apple |  | We think this should be discussed with other relevant proposals as part of package. |
| Samsung |  | For signaling the configuration, it needs be clarify if it’s SIB1 or other SIBs. We think SIB1 is needed to get configuration for RACH process.  Suggest to remove “/defined” and add “at least” before “configured” |
| OPPO |  | If this separate initial DL BWP is used to align the centre frequency of initial DL BWP and initial UL BWP, at least the centre frequency is defined by that of the initial UL BWP. |
| MediaTek |  | We should include the conditions for the separate DL BWP. We are fine with the updated proposal from Nordic. |
| FL2 | Based on the received responses to Proposal 3.1-1 and Proposal 3.1-4, the following updated proposal can be considered.  A corresponding proposal for separate initial UL BWP is provided in Proposal 2.1-1a.  **High Priority Proposal 3.1-1a:**   * **A separate initial DL BWP for RedCap UEs can be configured in SIB1.**   + **It can be used both during and after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD cases.**   + **FFS whether part of the configuration is implicitly signaled** | |
| vivo | Fine in general | Similar as for initial UL BWP, we would like to get clarification on 3rd sub-bullet. There seems to be different interpretation in case “**the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth”** and separate initial DL BWP is not configured.  Interpretation#1: In such case, the cell does not support RedCap UEs.  Interpretation#2: In such case, the cell can still support RedCap UEs and RedCap UEs uses initial DL BWP determined by CORESET#0 BW. |
| Nokia, NSB | Y |  |
| Qualcomm | Y |  |
| Nordic | N | Same concern as in GTW. If this shall be agreement, then additional FFS is necessary  **High Priority Proposal 3.1-1a:**   * **A separate initial DL BWP for RedCap UEs can be configured in SIB1.**   + **It can be used both during and after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD cases.**   + **FFS whether part of the configuration is implicitly signaled**   + **FFS whether offloading from MIB-CORESET#0 and/or CD-SSB is supported** |
| Ericsson | Y |  |
| IDCC | Y |  |
| Intel | Almost | We are mostly fine with the updated version, **except for the following bullet**:   * + **It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   In our understanding, the above is referring to “initial DL BWP for non-RedCap UEs that is configured by SIB1”, and for such a case, NW should not be mandated to configure separate initial DL BWP if initial DL BWP for non-RedCap UEs as configured by SIB1 is larger than max RedCap UE BW. If separate initial DL BWP is not provided, in such a case, RedCap UEs can continue to operate in initial DL BWP defined by CORESET #0 (as obtained from MIB). |
| Lenovo, Motorola Mobility | Y in general | For the first bullet, we prefer revision as below.  **It can be used after initial access. It can also be used during initial access in case it does not contain MIB-configured CORESET#0. Otherwise, MIB-configured CORESET#0 is used during initial access (same as legacy).** |
| FUTUREWEI2 | Y in principle | Additional clarification for the 3rd bullet: can the MIB-configured CORESET#0 be used for a RedCap UE when initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth? |
| NEC | Almost | Regarding the first sub-bullet, if “during initial access” is intended “random access”, we would be fine. There would be some FFS point in IDLE/INACTIVE as in **FL2 High Priority Proposal 3.2-4**. |
| DOCOMO | Y | But it has been pointed out multiple times that RAN2 will decide which SIB is used. Better to replace “SIB1” in the main bullet to “SIB” |
| Xiaomi | Partially Y | In TDD case, if center frequency alignment between initial UL BWP and initial DL BWP is required, then the separate initial DL BWP should be always configured if the center frequency of separately configured initial UL BWP is different from that of the MIB-configured initial DL BWP.  In addition, how to signal the configuration of initial DL BWP is up to RAN2  Thus, we suggest the following updates   * **A separate initial DL BWP for RedCap UEs can be configured in SIB1.**   + **It can be used both during and after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD cases.**   + **~~FFS whether part of the configuration is implicitly signaled~~**   + **FFS: it is always configured when the center frequency of separately configured initial UL BWP for RedCap is different from that of the MIB-configured initial DL BWP** |
| CATT | N | It is still sensitive and unclear the condition if Separate initial DL BWP can be used for ‘during initial access’. It should be clarified that, when separate initial DL BWP contains the entire MIB-configured CORESET#0, the RedCap UE shall use the initial DL BWP defined by CORESET#0 during initial access, and the separate initial DL BWP will be used after initial access. This is the principle of current NR spec.  Prefer to add a sub-bullet:  **High Priority Proposal 3.1-1a:**   * **A separate initial DL BWP for RedCap UEs can be configured in SIB1.**   + **It can be used both during and after initial access.**     - **In case the separate initial DL BWP contains entire MIB-configured CORESET#0, the initial DL BWP defined by MIB-configured CORESET#0 is used during initial access, and the separate initial DL BWP is used after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD cases.**   + **FFS whether part of the configuration is implicitly signaled** |
| OPPO | Partially Y | Agree with xiaomi’s revision.  For TDD case, the centre frequency of initial UL and initial DL BWP shall be the same |
| CMCC | Y | If separate initial DL BWP is always configured , separate initial DL BWP may contain CORESET #0. |
| FL2 | The following agreement was made in the RAN1 online (GTW) session on Wednesday 13th October:  **Working assumption:**   * **For a cell that allows a RedCap UE to access, network can configure a separate initial DL BWP for RedCap UEs in SIB.**   + **Working assumption: It can be used during initial access**   + **It can be used after initial access.**   + **It is no wider than the maximum RedCap UE bandwidth.**   + **FFS: It is always configured if the initial DL BWP for non-RedCap UEs is wider than the maximum RedCap UE bandwidth.**   + **This applies to both TDD and FDD (including FD FDD and HD FDD) cases.**   + **Working assumption: It applies at least after initial access for FR1 when MIB configured CORESET#0 is included** | |

Next, the FFSs related to the separate initial DL BWP for RedCap are discussed.

**CORESETs and CSSs in separate initial DL BWP for RedCap**

Many contributions propose that a separate SIB-configured initial DL BWP for RedCap (if configured) does not need to contain the entire CORESET #0 [4, 5, 6, 8, 10, 11, 16, 18, 26]. Also, several contributions mention that the separate initial DL BWP for RedCap UEs can include a configuration of CORESETs and CSS(s) [4, 6, 11, 12, 13, 16, 23, 24, 27, 29]. In addition, one contribution proposes to support paging on separate initial DL BWP [31]. One contribution proposes to down-select from either mandating the separate initial DL BWP to always overlap with CORESET#0 or introducing a RedCap-specific CORESET#0 where RedCap UEs monitors paging and SI, in order to avoid BWP switching [33]. If neither of these options are configured by the network, the contribution proposes to consider the cell as barred for RedCap UEs.

**FL1 High Priority Proposal 3.1-2:**

* **A separate SIB-configured initial DL BWP for RedCap UEs (if configured) does not need to contain the entire CORESET #0.**
  + **FFS: which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | N | Defining/configuring a separate initial DL BWP for RedCap UE does not necessarily mean CORESET#0 cannot be contained within this initial DL BWP.  When the SIB1-configured initial DL BWP of non-RedCap UE is wider than the max BW of RedCap UE (shown by the figure below), a separate initial DL BWP should be configured/defined for RedCap UE. In this case, the RedCap-specific initial DL BWP can be MIB-configured CORESET#0, or a SIB-configured separate initial DL BWP containing CORESET#0. |
| vivo | Y | Our understanding is that the FL proposal does not exclude the possibility to contain entire MIB-configured CORESET#0 within the separately configured initial DL BWP. |
| OPPO | Y | Or to make it clear. It can be modified as:   * **A separate SIB-configured initial DL BWP for RedCap UEs (if configured) does not ~~need to~~ necessarily contain the entire CORESET #0.**   + **FFS: which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP** |
| Nordic | N | We are NOT OK to support offloading from CORESET#0 unless NCD-SSB is agreed to be guaranteed at least in RRC   * **A separate SIB-configured initial DL BWP for RedCap UEs (if configured) does not need to contain the entire CORESET #0.**   + **FFS: which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP**   + **Note: This does not change the previous agreement that SSB in active BWP is a baseline capability.** |
| Huawei, HiSilicon | Y with modifications | * **A separate SIB-configured initial DL BWP for RedCap UEs (if configured) does not need to contain the entire CORESET #0.**   + **FFS: whether/which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP** |
| ZTE, Sanechips | Y | We are fine with the FL proposal. Mandatory inclusion of CORESET#0 limits the frequency-domain location and configuration flexibility of the separate initial DL BWP for RedCap UEs, which is detrimental to efficient resource utilization and PDCCH blocking resolution. Besides, if the separate SIB-configured initial DL BWP for RedCap UEs contains the entire CORESET#0 located in the carrier middle, the separate initial UL BWP for RedCap UEs also has to be placed in the carrier middle for TDD center frequency alignment, which will aggravate the PUSCH resource fragmentation.  The FFS bullet is overlapped with question 3.1-3. It is suggested to be removed. |
| TCL |  | Introducing a RedCap-specific CORESET#0 may be an option when the separate initial DL BWP does not contain the (legacy) CORESET#0 |
| Xiaomi | Y | We are fine with the FL proposal. |
| Panasonic | Y | We suggest to clarify that the CORESET#0 here is MIB-configured one and not RedCap-specific CORESET#0. Then it can be described as “~ not need to contain the entire **MIB-configured** CORESET #0” |
| Sharp | Y | One motivation to have the separate initial DL BWP is the center frequency alignment between initial DL/UL BWPs. Therefore, the position of separate initial DL BWP should be allowed to locate out of CORESET#0 to have flexibility to put the initial UL BWP on edge of the carrier. |
| Lenovo, Motorola Mobility | Y |  |
| Spreadtrum | Y |  |
| CATT | Y | It should be clear that the separate initial DL BWP may still entire MIB-configured CORESET#0, which is not precluded by this proposal. |
| Nokia, NSB | Y | We are fine with the proposal. Our understanding is that this does not preclude the case where the separate initial DL BWP contains CORESET#0. |
| Ericsson | Y | We are also fine with updates from Oppo and Panasonic. |
| Intel | Y | Fine to add the note from Nordic if it can help us move forward. |
| China Telecom | Y | In our understanding, the separate SIB-configured initial DL BWP for RedCap UEs (if configured) does not need to contain the entire CORESET #0 for flexibility and offloading purpose. The configuration details about initial DL BWP need more discussion and clarification. |
| DOCOMO | Y |  |
| FUTUREWEI | Y |  |
| CMCC | Y | Fine with Panasonic’s modification. |
| NEC | Y | To be clear a separate initial DL BWP may contain entire CORESET#0, it would be preferable to describe the proposal in more neutral way, e.g.  **A separate SIB-configured initial DL BWP for RedCap UEs may be configured either to contain or not to contain all RBs of the CORESET with index 0 configured by MIB.** |
| LGE | Y | Introducing CORESET#0 dedicated for RedCap or configuring CORESETs for supporting the equivalent functions of CORESET#0 can be considered. |
| Samsung | Y | We share similar view as vivo. This doesn’t mean separate initial DL BWP cannot contain CORESET #0. So, the case pointed out by Qualcomm is not excluded by this proposal. |
| MediaTek | N | The issue of how to do RRM/RLM/synchronization (e.g. by requiring NCD-SSB) need to be addressed first. |
| FL2 | Based on the received responses to Proposal 3.1-2 and Question 3.1-3, the following updated proposal can be considered.  **High Priority Proposal 3.1-2a:**   * **A separate SIB-configured initial DL BWP for RedCap UEs ~~(if configured) does not need to~~** **may be configured to either contain or not contain the entire MIB-configured CORESET #0.**   + **~~FFS: which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP~~**   + **It is configured with at least one CORESET/CSS.** | |
| Vivo | Y |  |
| Nokia, NSB | Y |  |
| Qualcomm |  | We can agree with this proposal if this separate SIB-configured initial DL BWP for RedCap UEs includes SSB and at least one CORESET/CSS |
| Nordic | N | This is already addressed in 3.2-4, and we are OK if agreed as part of Option 2 in 3.2-4, otherwise we do not support. |
| MediaTek | N | The proposal can be acceptable if a NCD-SSB is configured on the DL BWP for RedCap UEs |
| Ericsson | Y |  |
| IDCC | Y |  |
| Intel | Y |  |
| Lenovo, Motorola Mobility |  | The last bullet is not clear enough (especially considering the diverse view of mandatory RA-SS in the separate initial DL BWP). We prefer to remove “/CSS” and revise as “It is configured with at least one CORESET”. |
| FUTUREWEI2 |  | Clarification question: is the proposal for during initial access, after initial access, or both? |
| NEC | Y |  |
| DOCOMO | Y |  |
| Xiaomi | Generally Y | For the subbullet, if the separate initial DL BWP contains the MIB-configured CORESTE#0, then it is not necessarily to configure one CORESET/CSS, right?  Thus we suggest the following update for the subbullet   * **A separate SIB-configured initial DL BWP for RedCap UEs ~~(if configured) does not need to~~** **may be configured to either contain or not contain the entire MIB-configured CORESET #0.**   + **~~FFS: which CORESET(s) and CSS(s) that must be configured for separate initial DL BWP~~**   + **It ~~is configured with~~ contains at least one CORESET/CSS.** |
| CATT | Y |  |
| OPPO | Y |  |
| CMCC | Y |  |
| Huawei, HiSi | Y |  |
| ZTE, Sanechips | Y generally | The sub-bullet is not clear to us. Does the CORESET apply to USS or just the CSS or both? |
| FL3 | Based on the received responses, the following updates to the proposal can be considered. The FL recommendation is to treat this proposal together with Proposal 3.2-4a.  **High Priority Proposal 3.1-2b:**   * **A separate SIB-configured initial DL BWP for RedCap UEs** **may be configured to either contain or not contain the entire MIB-configured CORESET #0.**   + **It ~~is configured with~~ contains at least one CORESET~~/CSS~~.**   + **It can be used both during and after initial access.** | |
| MediaTek | N | Not clear why CSS has been removed.  Also, the BWP should contain an SSB as well. |
| Qualcomm | N | FL3 proposal is not clear. The FL proposal/working assumption presented at GTW session looks better to us.  In our view, the following cases should be supported as a starting point for further discussion:   * **During and after initial access, RedCap UE can operate on an initial DL BWP containing MIB-configured CORESET#0:**   + **Case 1**   the MIB-configured CORESET#0 is the initial DL BWP of RedCap UE during and after initial access   * + **Case 2**   a SIB-configured separate initial DL BWP containing MIB-configured CORESET#0 is used by RedCap UE during and after initial access   * + **Case 3**   the MIB-configured CORESET#0 is used as initial DL BWP of RedCap UE during initial access, and the SIB-configured initial DL BWP containing MIB-configured CORESET#0 is used as initial DL BWP of RedCap UE after initial access   * **During and after initial access, RedCap UE can operate on an SIB-configured separate initial DL BWP which does not contain the entire MIB-configured CORESET#0, if the initial DL BWP contains SSB and CSS for RA and paging** * **During initial access, RedCap UE operates on MIB-configured CORESET#0. After initial access, RedCap UE operates on an SIB-configured separate initial DL BWP containing SSB and paging CSS, but not containing the entire MIB-configured CORESET#0** |
| CATT | N | As we mentioned in the previous round, we need to discuss the ‘Condition of containing CORESET#0’ when separate initial DL BWP can or cannot be used for during initial access. Any new design shall not preclude a mature baseline in the NR so far. That is:  If separate initial DL BWP contains entire CORESET#0, a RedCap UE shall remain using the CORESET#0-defined initial DL BWP during initial access. And then, separate initial DL BWP can only be used after initial access.   * This follows the current NR mechanism and should be support by default. * It is obvious that such configuration is workable, and is not aiming at offloading, but just provide a suitable bandwidth for RedCap-specific initial DL BWP after initial access. * Such configuration saves a lot of indication cost in SIB1 since CORESET#0 and Type0#CSS is shared.   For the case separate initial DL BWP does not contain entire CORESET#0, we are fine that it can be used during initial access with dedicated new CORESET. |
| Spreadtrum | Y | Seems general enough. |
| vivo | N | We also do not understand the reason for deleting “CSS”  We feel it would be necessary to treat the following 3 proposals together as a package as they are more or less related to the SSB presence issue in the separate initial BWP. The discussion of the first two proposals may not be productive if the SSB issue is planned to be decided in next meeting (as proposed by FL)  **High Priority Proposal 3.1-2b:**  **High Priority Proposal 3.1-5b:**  **High Priority Proposal 3.2-4a:** |
| Panasonic | Y |  |
| Intel | Almost … | We think CSS should be added back. At least a CSS should be mapped to the CORESET for any practical use, especially for “during initial access” (aka idle/inactive modes in our understanding). |
| DOCOMO | Y |  |
| Samsung | N | The case pointed out by CATT needs to be clarified. We suggest to add FFS for **during initial access.**  Another clarification question, can the separate BWP used for before initial access, e.g., paging? Do we assume it belong to “during” or will be discussed separately? |
| ZTE, Sanechips | Y with modification | From our understanding, if the first sub-bullet means the separate SIB-configured initial DL BWP at least contains a cell-specific CORESET, including CORESET0, CORESET for paging or RAR, it excludes the case that the separate initial DL BWP without CORESET0 is only used in the connected mode and the RedCap UE monitors paging and RAR within CORESET0. Then, we would not be OK with it. Therefore, the following is suggested:  **It ~~is configured with~~ can contain at least one cell specific CORESET** |
| LGE |  | We also think the CSS should added back. |
| OPPO | Almost | It there is no CSS, how to use the CORESET? Thus we think the CSS should added back. |
| Sharp | Y |  |
| Lenovo, Motorola Mobility | Y | Maybe the 2nd bullet can be deleted, given that it is overlapped with the working assumption in 3.1-1 |
| Nordic | N | We do not support:    Could FL kindly clarify to us, why gNB would configure initial DL BWP with CORESET by without CSS?  For use during initial access with have WA, better to keep it WA for now |
| FUTUREWEI | Almost | Similar comments about the CSS |
| NEC | N | Removing CSS would be OK with understanding that RedCap UE behavior is depends on configuration of CSS sets.  We will be fine if during initial access of the second sub-bullet is FFS or WA. |
| CMCC | Y | CSS should be added back.  During initial access, if separate initial DL BWP contains entire CORESET#0, we think separate initial DL BWP or initial DL BWP defined by CORESET#0 can be used. The latter is the same as the current NR mechanism |
| Ericsson | Y | We prefer to keep CSS in the 1st the sub-bullet.  We note that the separate initial DL BWP for RedCap can also contain SSB, depending on the configuration. |
| IDCC |  | We are not sure why CSS is removed. |
| Nokia, NSB | Y | We also prefer to keep CSS. |
| FL4 | This proposal is merged with Proposal 3.2-4a into Proposal 3.2-4b. | |

**FL1 High Priority Question 3.1-3:**

* **For a separate initial DL BWP for RedCap, which of the following CSSs can/must be configured?**
  1. **Random access CSS**
  2. **Paging CSS**
  3. **Any other CSS?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Which ones of 1/2/3 can be configured?** | **Which ones of 1/2/3 must be configured?** | **Comments** |
| Qualcomm | 1, 2,  3 (e.g. CORESET/CSS associated with PEI and SDT) | 1, 2 | The RO of RedCap UE is expected to be contained within the initial UL BWP of RedCap UE. Therefore, the CSS for RA should be configured within the initial DL BWP of RedCap UE.  When operating in the separate initial DL BWP, RedCap UE is expected to receive notification of SI update and/or ETWS. Therefore, paging CSS should be configured in the initial DL BWP of RedCap UE.  In addition to RACH and paging, RedCap UE is expected to support small data transfer (SDT) for power saving and signaling overhead reduction. Besides, CSS for R17 PEI can be configured as well in the initial DL BWP of RedCap UE. |
| Vivo | 1 Random access CSS  2 Paging CSS  3 SIB, PEI, SDT related CSS) | 1 | 1 must be configured for a separately configured initial DL BWP.  2 is preferable to be configured, but if not configured, UE stays at legacy initial DL BWP for paging monitoring and switch to the separately configured initial DL BWP only when random access procedure is performed.  3 If PEI is configured, it is preferred to configure in the same DL BWP as paging CSS. |
| OPPO | 1 Random access CSS  2 Paging CSS | 1 Random access CSS | If separately configured initial DL BWP is used to align centre frequency of initial DL BWP and initial UL BWP, CSS for Random access CSS shall be configured.  CSS for paging can also be configured for offloading. If not, legacy MIB -configured initial DL BWP can be reused. |
| Nordic | SIB1, OSI, RA, Paging, PEI | If BWP shall be used for IDLE camping or SDT then  SIB1, OSI, RA, Paging  Otherwise, RA is enough |  |
| Huawei, HiSilicon | 1, 2 | None | The same as legacy that those are configurable |
| ZTE, Sanechips | 1 and 2 | None | For the purpose of offloading, mitigating the impacts on legacy UE during paging and RACH procedure, and keeping the center frequency alignment in TDD RACH procedure, random access and/or paging can be configured in the separate initial DL BWP. |
| TCL | 1,2 | 1 | Same comments of OPPO |
| Xiaomi | 1,2,3 | 1 | This proposal can be put lower priority. Before we discuss this issue, we should firstly decide the which RRC status the initial DL BWP can be applied for. |
| Panasonic | 1 and 2 |  | We think random access CSS should be possible to be configured for off-loading of Msg2/4.  We propose that paging CSS can be configured only when SSB (CD or non-CD) is also available in the separate initial DL BWP. Otherwise, paging CSS should not be configured but RedCap UE should follow CSS common with non-RedCap UEs.   * After a long sleep, the UE needs to be synchronized using SSB before the paging reception. It can be multiple SSBs depending on SINR conditions. If SSB is not available, the UE has to perform RF retuning to receive CD-SSB and then power consumption would increase. |
| Sharp | 1, 2, 3 | 1 | For RedCap UEs in IDLE/INACTIVE state, it should be up to gNB configuration on whether configure RedCap UEs to monitor PDCCH for paging/SIB in CORESET#0 or in seperate initial DL BWP. On the other hand, Random access CSS should be configured if the separate initial DL BWP is needed. |
| Lenovo, Motorola Mobility | 1, 2 | none | RedCap UEs perform RA in separate initial DL BWP if RA-SS is configured in the separate initial DL BWP. Otherwise, RA is performed in the MIB-configured CORESET#0.  RedCap UEs perform paging in separate initial DL BWP if paging-SS is configured in the separate initial DL BWP. Otherwise, paging is performed in the MIB-configured CORESET#0. |
| Spreadtrum | 1, 2, 3 (SDT related CSS which can be considered as RACH like) | 1 | We share the similar view as vivo. |
| CATT | 1, 2 | none | RedCap UE is always capable to use RACH CSS and Paging CSS in legacy initial DL BWP (defined by MIB-configured CORESET#0). None of the CSS ‘must be configured’, but ‘can be optionally configured’ for RedCap separately. |
| Nokia, NSB | 1, 2 | none | If the initial DL BWP contains CORESET#0, then this can be used for random access and paging. And also e.g. if random access CSS is not configured, then UE can still perform random access using CORESET#0. |
| Ericsson | RA, Paging, SIB1, OSI | None | Here we consider only idle/inactive states and Rel-15/16 features. |
| Intel | 1, 2, 3 (RMSI, OSI, PEI, SDT) | None | In terms of minimum configuration in separate initial DL BWP, we can compromise to mandate configuration of random access CSS (Type 1 CSS) for TDD for center-freq alignment between separate initial DL BWP and initial UL BWP in which UE is configured with ROs. |
| DOCOMO | 1, 2, 3 |  |  |
| FUTUREWEI | 1,2,3 | 1 | If the separate initial DL BWP is used for the RACH procedure, then the RA CSS is needed |
| CMCC | 1,2,3 | 1 | When separate initial DL BWP is configured to keep center frequency alignment with separate initial UL BWP, RACH CSS should be configured for corresponding downlink procedure, in this case, retuning during RACH between DL and UL BWP can be avoided.  RRC idle/inactive UEs can monitoring paging PDCCH on initial DL BWP defined by CORESET#0, which is also used by non-RedCap UEs. |
| NEC | 1, 2, 3 (Type0- PDCCH CSS set, Type0A-PDCCH CSS set, etc.) | None | RedCap UE follows Rel-15 UE behavior on monitoring CSS sets |
| LGE | 1, 2, 3 | None | Similar view with Lenovo. The search spaces for SIB1, OSI can also be configured. |
| Apple | 1,2,3 | None | Agree with Lenovo/Lge. |
| Samsung | 1 RACH CSS  2 paging CSS | 1. RACH CSS (if this separated can be used during initial access)  2. none (if this cannot be used during initial access) | RACH CSS depends on whether this separated initial DL BWP can be used during initial access.  For SIB, PEI, SDT related CSS, we need further study.  we think SDT related CSS can be treated as for Random access. PEI related paging, we think it can be further discussed after the decision on paging CSS. |
| MediaTek | 1, 2, 3 | 1 |  |
| FL2 | About half of the received responses think that RA CSS must be configured for the separate initial DL BWP, and about half think that there is no particular CSS that must be configured.  Some of the responses argue that RA CSS must be configured for initial UL/DL BWP center frequency alignment purpose. This aspect is treated in Proposal 3.1-5a.  Based on the received responses, Proposal 3.1-2a has been updated to say that the separate initial DL BWP is configured with at least one CORESET/CSS. | | |

**Use of separate initial DL BWP during initial access**

If a separate initial DL BWP for RedCap UEs is configured/defined, the separate initial DL BWP for RedCap UEs can be used during initial access [4, 6, 10, 11, 15, 18, 22, 27]. Contribution [6] states that for RedCap UEs, the IE *locationAndBandwidth* specified in the initial DL BWP can be applied and used during the initial access.

**FL1 High Priority Proposal 3.1-4: A separate initial DL BWP for RedCap UEs (if configured) can be used during the initial access.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | Y |  |
| vivo |  | See our comments for **Proposal 3.1-1.** |
| OPPO | Y | If separately configured initial DL BWP is used to align centre frequency of initial DL BWP and initial UL BWP, CSS for Random access CSS shall be configured.  Therefore, it can be used during initial access |
| Nordic | Y |  |
| Huawei, HiSilicon | Y |  |
| ZTE, Sanechips | Y | Similar motivation with question 3.1-3.  The relation between question 3.1-4 and 3.1-3 need clarification. |
| TCL | Y |  |
| Xiaomi |  | This proposal depends on the output of whether **center frequency should be aligned during initial access. If the answer is Yes, in some cases, a separate initial DL BWP MUST be used (rather than can be used ) during initial access** |
| Panasonic | Y |  |
| Sharp | Y | To avoid RF retuning during random access procedure in TDD, we prefer to use the separate initial DL BWP during the initial access. |
| Lenovo, Motorola Mobility | Y | If RA-SS is configured in the separate initial DL BWP, the separate initial BWP can be used during initial access. Otherwise, it is not used during initial access and RedCap UEs use MIB-configured CORESET#0. |
| Spreadtrum | Y |  |
| CATT | FFS | We would like to clarify that this should be conditional:  If separate initial DL BWP is configured and contains entire MIB-configured CORESET#0, the separate initial DL BWP is NOT be used during initial access. The RedCap UE shall use legacy initial DL BWP (defined by MIB-configured CORESET#0) during initial access. **This is the fallback option, and is the same with current NR framework** (imaging that no non-RedCap UE is in the network).  Else, if separate initial DL BWP is configured but does NOT contain entire MIB-configured CORESET#0, the separate initial DL BWP can be used during initial access (when RACH CSS is configured in this separate initial DL BWP). |
| Nokia, NSB | Y |  |
| Ericsson | Y |  |
| Intel | Y | The “use” during initial access depends on the PDCCH CCS types configured in the separate initial DL BWP. |
| China Telecom | Y | We are fine with FL proposal. However, the configuration details about initial DL BWP need more discussion and clarification. |
| DOCOMO | Y |  |
| FUTUREWEI | Y |  |
| CMCC | Y | At least it can be used for RACH related downlink transmission. |
| NEC | Conditionally Yes. | If different center frequency of initial UL/DL BWP is supported during initial access in TDD, MIB-configured CORESET#0 can be used as in Rel-15 and we don’t see much motivation to support this. Otherwise, Yes.  It is also not clear for us whether RedCap UE uses MIB-configured CORESET#0 in IDLE/INACTIVE except RA. |
| LGE | Y | The separate initial DL BWP for RedCap should be used during initial access to avoid RF retuning when an initial UL BWP for RedCap is configured with different center frequency from the MIB-configured CORESET#0 BWP in TDD. |
| Apple | Yes |  |
| Samsung |  | We can live with to make this as WA other than agreement, because we want to avoid a situation that there is no consensus on whether SSB can be transmitted or not.  Besides, we think CATT’s comment is valid and better to be clarified. |
| MediaTek | Y |  |
| FL2 | This proposal is merged with Proposal 3.1-1 into Proposal 3.1-1a. | |

**Initial UL/DL BWP center frequency in TDD**

Another key consideration is related to initial UL/DL BWP center frequency in TDD. Several contributions support/accept having the possibility of separate TDD center frequencies for initial UL/DL BWPs during initial access [4, 6, 10, 12, 19, 26]. However, some other contributions indicate that the same center frequency is preferred to be maintained for initial UL/DL BWPs [7, 14, 15, 25].

* [4]: During initial access, the alignment of the center frequency can be left to UE implementation without required by specification.
* [6]: During initial access, frequency retuning between initial DL and UL BWPs center frequencies is not expected to be an issue as far as the UE implementation is concerned, given the relaxed required switching time between DL and UL during initial access.
* [6]: With the support of separate center frequencies for initial UL/DL BWPs in TDD during initial access, all concerns regarding the PUSCH resource fragmentation and the presence of SSB and CORESET #0 within the initial DL BWP are resolved.
* [8]: At least after initial access, the center frequencies for separate initial UL/DL BWPs for RedCap UEs in TDD are the same.
  + FFS: during initial access
* [26]: For initial DL/UL BWPs during initial access procedure, the RF-retuning latency and power consumption maybe acceptable.
* [27]: During initial access, timeline relationship in Tx/Rx switching may need to take center frequency retuning into account if different center frequency between initial DL BWP and initial UL BWP is supported.
* [28]: Supporting initial DL/UL BWP pair with different center frequencies is specified as an optional capability for RedCap UE in TDD.

Based on the expressed views, the following question can be considered.

**FL1 High Priority Question 3.1-5: Regarding the initial UL/DL BWPs center frequencies in TDD during initial access, can the following options be considered for down selection? If yes, please indicate your preferred option(s). If no, please elaborate in the Comments field.**

* **Option 1: During initial access, the center frequencies for initial UL/DL BWPs can be different, and the initial DL BWP always contain CORESET #0 and SSB.**
* **Option 2: During initial access, the center frequencies for initial UL/DL BWPs are the same, but the initial DL BWP does not always contain CORESET #0 and SSB.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Y/N** | **Option(s)** | **Comments** |
| Qualcomm | N | Option 2 is not supported since it does not contain SSB | Option 2 is not acceptable to us.  Option 1 can be FFS if separate PRACH resources are configured for RedCap UE within the initial UL BWP of RedCap UE. Without early indication of RedCap UE type by msg1 or msgA preamble, NW cannot differentiate RedCap UE and non-RedCap UE. As a result, RedCap UE may receive an invalid grant which does not accommodate the center frequency change of DL/UL BWP. |
| Vivo |  |  | It seems necessary to clarify the proposal here is about the center frequency alignment between the separately configured initial UL BWP and initial DL BWP for RedCap UEs, since there might be a case where UE works on the separately configured initial UL BWP while share the legacy initial DL BWP with non-redcap UEs.  The SSB transmission issue does not need to be coupled with the center frequency alignment issue, and can be discussed separately as later sections (3.2 and 3.3). |
| OPPO |  |  | During initial access, the center frequencies for initial UL/DL BWPs shall be the same. Otherwise, it will complicate UE’s implementation and the timing during initial access shall be reviesed. |
| Nordic | N | Non of the options | * **Option 3: During initial access in TDD, the center frequencies for initial UL and CORESET#0 can be different**    + **CORESET#0 is within BW of initial UL BWP** |
| Huawei, HiSilicon | Y | Opt 2 is preferred | The issue of the centre frequency alignment and BWP with/without SSB should be **decoupled**.  On one hand, even if the centre frequency of UL and DL is different during initial access, the DL efficiency and other impact on network due to BWP mandated with SSB exists after initial access. Whether they are kept or not after initial access require further discussion and thus it does not tackle the fundamental issue.  On the other hand, supporting BWP without SSB from initial access can release the concern of BWP center frequency misalignment regardless of during and after initial access, and have minor spec impact and implementation impact to both gNB and UE. |
| ZTE, Sanechips | Y | 2 | The transmission of legacy SSB and CORESET#0 in the separate initial DL BWP for RedCap UEs is up to gNB configuration. Requiring that the separate initial DL BWP always contain SSB and CORESET#0 greatly limits its frequency-domain location and configuration flexibility, which is detrimental to efficient resource utilization and PDCCH blocking resolution. Besides, there is no strong motivation or necessity to mandate SSB transmission in the separate initial DL BWP.  Furthermore, to obtain a unified design, TDD center frequency alignment should be ensured during initial access as after initial access. It is noted that BWP#0 (i.e. the initial BWP) has two possible configuration options, i.e. BWP#0 configuration option 1 and BWP#0 configuration option 2. From the UE capability point of view, BWP#0 under configuration option 2 is considered as an RRC-configured BWP. In this case, RedCap UEs supporting only one BWP cannot meet different TDD center frequency alignment requirements during and after initial access. Therefore, TDD center frequency alignment should be mandatory both during and after initial access. |
| TCL | Y | Option 1 |  |
| Xiaomi |  |  | Same comment with vivo. Whether include SSB can be discussed separately. We could just focus on whether the center frequency of TDD should be aligned or not |
| Panasonic | Y |  | We think both options can be supported. Option 1 is beneficial to reduce resource overhead by duplicated CD-SSB or PDCCH CSS. Option 2 is also beneficial to reduce the RF retuning by a RedCap UE between DL and UL center frequencies. Which option to configure is up to the gNB. |
| Sharp |  |  | Here, if “CORESET #0 and SSB” in the FL proposal means legacy CORESET#0 and legacy CD-SSB, we are basically OK with option 2 for RACH procedure during initial access. Regarding additional common CORESET and additional NCD-SSB, we can separately discuss. |
| Lenovo, Motorola Mobility | N |  | During initial access, the center frequencies of initial DL/UL BWPs can be different if the separate initial DL BWP contains MIB-configured CORESET#0 (e.g., initial UL BWP in the carrier edge, but CORESET#0 not)  During initial access, the center frequencies of initial DL/UL BWPs are the same if the separate initial DL BWP (with RA-SS) does not contain CORESET#0 and SSB. |
| Spreadtrum | Y |  |  |
| CATT |  |  | Seems both options are useful. Option 1 may be used when initial DL BWP is shared and used for initial random access of RedCap. Option 2 can be used when separate initial DL BWP is configured and is also used for initial random access of RedCap.  If SSB is always required in the initial DL BWP during initial access, we prefer Option 1. Otherwise we are fine with both. |
| Nokia, NSB |  |  | We also share the view that the center frequency alignment can be considered separately from the SSB. |
| Ericsson | Y | 1 and/or 2 | We support both options. |
| Intel |  |  | Agree with vivo and others that the SSB and CORESET #0 issue should be decoupled from the DL-UL center frequency alignment issue.  On the DL-UL center frequency alignment issue, our views are summarized as below:   * It is not necessary to align center frequencies between DL and UL during idle/inactive modes since the DL-UL switches (and vice versa) are not frequent. * If the above is not acceptable, as compromise, we can accept to consider aligned center frequency between UL and DL between the initial UL BWP in which the RedCap UE transmits PRACH and the initial DL BWP in which it is expected to monitor for Type 1 PDCCH CSS for random access. (*Please note that we just realized a typo in our tdoc* ***R1-2109617 [18]*** *for Proposal 1 where it should say PDCCH CSS Type 1 instead of “CSS Type 2”:*   **Proposal 1 (from *R1-2109617 [18])*:**   * *A RedCap UE may expect that, in RRC idle or inactive modes, initial UL BWP configured for RedCap UEs for PRACH or MsgA transmissions shares the same center frequency as the initial DL BWP in which the RedCap UE is expected to monitor for Type* ***1****~~2~~ PDCCH CSS candidates for monitoring as part of the random access procedure.* |
| China Telecom |  |  | In our understanding, we support the center frequencies for initial UL/DL BWPs can be different in TDD at least during initial access. To achieve center frequencies alignment and offloading purpose, the initial DL BWP does not always contain CORESET #0 and SSB. |
| DOCOMO | Y | Option 1 | We think RAN1 needs to further discuss which scenarios/configurations Option 1 is applicable to, such as   * Shared initial DL/UL BWPs * Shared initial DL BWP and separate initial UL BWP * Separate initial DL/UL BWPs |
| FUTUREWEI | Y |  | Opt. 2 is aligned with a separate initial DL BWP for initial access. |
| CMCC | N |  | We also think both can be supported. Support option 1 can ensure SSB and CORESET#0 in initial DL BWP, but it cannot support downlink offloading. gNB can decide whether to configure a separate initial DL BWP different than CORESET#0 according to the resource utilization. |
| NEC |  |  | We prefer to discuss separately whether different center frequency of initial DL/UL BWP during initial access is supported in TDD. |
| LGE | N |  | During initial access, we prefer the center frequencies for initial UL/DL BWPs to be the same, and the initial DL BWP needs to contain the SSB. |
| Samsung |  |  | We are fine to list separate option includes during initial access, CORESET 0 is used as initial DL BWP (as proposed by Nordic), with clarification on the initial DL BWP is SIB-configured. |
| MediaTek | N |  | Option-1 will require re-tuning between UL and DL.  Option-2 doesn’t clarify if there is CSS in the separate DL BWP that can be used for initial access.  We can accept Option-2 with the following modification:   * CSS Type 1 need to be configured in the DL iBWP * NCD-SSB need be present in the DL BWP |
| FL2 | Based on the received responses to Proposal 3.1-5 and Question 3.1-3, the following updated proposal can be considered.  **High Priority Proposal 3.1-5a: Regarding the initial UL/DL BWPs center frequencies in TDD during random access, can the following options be considered for down selection? If yes, please indicate your preferred option(s). If no, please elaborate in the Comments field.**   * **Option 1:**   + **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.** * **Option 2:**   + **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.** | | |
| Vivo |  |  | We prefer option 2, but can accept option 1 for initial access procedure, if it is supported by majority of companies. |
| Nokia, NSB | Y | Option 1 |  |
| Qualcomm |  | We can accept Option 1 with additional condition on enabling early indication by msg1/msgA preamble | Since center frequency change of DL/UL BWP requires RF retuning for both DL-to-UL switching and UL-to-DL switching, this is different from the DL/UL switching of Type-A HD-FDD.  As a compromise, we can agree with Option 1 if RedCap UE is configured with separate PRACH resources to enable early indication by msg1/msgA PRACH. As a result, RedCap UE does not expect to monitor RAR (msg2) or get an invalid UL grant for msg3 before finishing the RF retuning for center frequency change of initial DL/UL BWP. |
| Nordic |  | Modified Option 2 | This sub-bullet is the same as agreed in Rel 15   * The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.   + MIB-CORESET#0 and initial UL BWP do not need to be aligned.   Moreover, in our understanding irrespective of BWP Option 1 or Option 2 initial DL BWP is configured in SIB1. These fields are not optional.  DownlinkConfigCommonSIB ::= SEQUENCE {  frequencyInfoDL FrequencyInfoDL-SIB,  initialDownlinkBWP BWP-DownlinkCommon,  bcch-Config BCCH-Config,  pcch-Config PCCH-Config,  …  }  BWP-DownlinkCommon ::= SEQUENCE {  genericParameters BWP,  pdcch-ConfigCommon SetupRelease { PDCCH-ConfigCommon } OPTIONAL, -- Need M  pdsch-ConfigCommon SetupRelease { PDSCH-ConfigCommon } OPTIONAL, -- Need M  ...  } |
| MediaTek |  | Option-2 | We don’t support Option-1 as it will require re-tuning between UL and DL. |
| Ericsson | Y | We prefer Option 1 | With the support of separate center frequencies for initial UL/DL BWPs in TDD during initial access, many concerns regarding the PUSCH resource fragmentation and the presence of SSB and CORESET #0 within the initial DL BWP can be resolved. |
| IDCC | Y | Option 1 | We prefer Option 1 since it provides some advantages as mentioned by Ericsson. RF retuning during initial access is tolerable. |
| Intel | Y | Option 1 | Our first preference is Option 1. In general, we agree with QC that for Option 1, the UE should be accommodated with sufficient time for RF retuning between Msg1 Tx and Msg2 Rx, Msg2 Rx to Msg3 Tx, Msg3 Tx to Msg4 Rx, etc., and towards this, we should consult RAN4 on the assumptions on RF retuning time (which we expect to be within few OFDM symbols) between DL and UL. |
| Lenovo, Motorola Mobility | Y | Option 1 |  |
| FUTUREWEI2 | Y |  | Option 2 is preferred but also OK to discuss Option 1 as a possible compromise. |
| NEC | Y | Either would be fine. | One question for clarification. Does option 1 includes (or is equivalent to) the case MIB-configured CORESET#0 is used for RedCap UE during RA? |
| DOCOMO | Y | Option 1 |  |
| Xiaomi | Y | Opt2 | In our understanding, the initial UL BWP is not only related to PRACH transmission and initial DL BWP is not only related to RA CSS monitoring.  We suggest the following update:  **Modified Proposal 3.1-5a: Regarding the initial UL/DL BWPs center frequencies in TDD during random access, can the following options be considered for down selection? If yes, please indicate your preferred option(s). If no, please elaborate in the Comments field.**   * **Option 1:**   + **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits UL message during RACH ~~PRACH~~ and the initial DL BWP where the RedCap UE monitors DL message during RACH ~~RA CSS~~.** * **Option 2:**   + **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits UL message during RACH ~~PRACH~~ and the initial DL BWP where the RedCap UE monitors DL message during RACH ~~RA CSS~~.** |
| CATT | Y | Option 1 | Even in the current NR, the center frequency initial DL BWP used for initial access (defined by CORESET#0) is not required to align with initial UL BWP.  For progress we are open to further discuss. Option 1 is preferred. |
| OPPO |  | Option 2 is preferred. | For option 1, the timing during RACH procedure shall be revised as proposed by Qualcomm |
| CMCC | Y | Option 1 |  |
| Huawei, HiSi |  | Option 3 | We don’t understand why it has to be coupled with RA. Simply said, the centre frequency can be aligned or not aligned is sufficient; or, the following   * **Option 3:**    + **The center frequencies are always aligned for separate initial DL BWP and separate initial UL BWP.**   + **The center frequencies are NOT necessarily aligned for legacy MIB-configured COREST0 and separate initial UL BWP** |
| LGE |  | Option 2 |  |
| ZTE, Sanechips | Y |  | It is noted that BWP#0 (i.e. the initial BWP) has two possible configuration options, i.e. BWP#0 configuration option 1 and BWP#0 configuration option 2. From the UE capability point of view, BWP#0 under configuration option 2 is considered as an RRC-configured BWP. In this case, RedCap UEs supporting only one BWP cannot meet different TDD center frequency alignment requirements during and after initial access.  We prefer option2. However, if the above issue can be resolved appropriately, we also can accept option 1. |
| FL3 | Based on the received responses, the following updated proposal can be considered. The FL recommendation is to treat this proposal together with Proposal 3.2-4a.  **High Priority Proposal 3.1-5b:**   * **Regarding the initial UL/DL BWPs center frequencies in TDD during random access, down-select between the following options:**   + **Option 1:**     - **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.**   + **Option 2:**     - **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.** * **Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned.** | | |
| MediaTek | N | Option-2 | We don’t support Option-1 as it will require re-tuning between UL and DL. |
| Qualcomm | N | Option 1 needs modification  We suggest to add Option 3 for further discussion | **Suggested changes for Proposal 3.1-5b:**   * **Regarding the initial UL/DL BWPs center frequencies in TDD during random access, down-select between from the following options:**   + **Option 1:**     - **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors CD-SSB and MIB-configured CORESET#0 ~~RA CSS~~.**     - **DL/UL switching gap is configured for RedCap UE, which is sufficient for RedCap UE to change the center frequencies of initial UL/DL BWP**     - **RedCap UE does not expect to transmit on UL or receive on DL within the DL/UL switching gap**   + **Option 2:**     - **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.**   + **Option 3:**     - **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS, paging CSS and SSB.**   **Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned.** |
| CATT | Y | Option 1 | With Option 1:  If the RedCap UE uses CORESET#0 for initial access (e.g. Separate initial DL BWP does not contain entire CORESET#0 and does not configure additional CORESET for RACH), the center frequencies need not be aligned.  If the RedCap UE uses Separate initial DL BWP for initial access, the center frequency can be aligned. |
| vivo | N |  | * + - 1. We are supportive of the updates by Qualcomm       2. We feel it would be necessary to treat the following 3 proposals together as a package as they are more or less related to the SSB presence issue in the separate initial BWP. The discussion of the first two proposals may not be productive if the SSB issue is planned to be decided in next meeting (as proposed by FL)   **High Priority Proposal 3.1-2b:**  **High Priority Proposal 3.1-5b:**  **High Priority Proposal 3.2-4a:** |
| Panasonic | Y | Option 1 |  |
| Intel | Y (see comments) | Option 1 | We can accept the additional clarifying bullets from QC for Option 1 and can also accept Option 2 as compromise.  However, we do not see the justification to add Option 3 as suggested by QC. We could perhaps modify Option 2 to say   * + **Option 2:**     - **The center frequencies are always aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE at least monitors RA CSS.**   This would allow for the use-case indicated in Option 3 wherein CSS Types 1, 2, and SSB are in the (separate) initial DL BWP. |
| DOCOMO | Y | Option 1 | Revision from Qualcomm can be considered for further discussion. We prefer to further discuss whether the DL/UL switching gap is configured or defined in spec.   * + **Option 1:**     - **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors CD-SSB and MIB-configured CORESET#0 ~~RA CSS~~.**     - **DL/UL switching gap is [defined/configured] for RedCap UE, which is sufficient for RedCap UE to change the center frequencies of initial UL/DL BWP**     - **RedCap UE does not expect to transmit on UL or receive on DL within the DL/UL switching gap** |
| Samsung |  | Depends on conclusion of others | Do we intend to drop the potential option that UE use CORESET 0 for RACH as BW of initial DL BWP? Otherwise, we prefer to add is as another option.  Or, the current wording of “initial DL BWP” can be either SIB-configured separate initial DL BWP, or it can be CORESET 0?  In short, we want to make sure that using CORSET 0 as the frequency range of initial DL BWP during initial access is not excluded in the proposal. |
| ZTE, Sanechips | Y with modification |  | It is noted that BWP#0 (i.e. the initial BWP) has two possible configuration options, i.e. BWP#0 configuration option 1 and BWP#0 configuration option 2, wherein the BWP#0 under configuration option 2 is considered as an RRC-configured BWP with dedicated configuration for a specific UE. Therefore, with BWP#0 configuration option 2, the separate initial BWP for RedCap UEs cannot meet different TDD center frequency alignment requirements during and after initial access. Therefore, for option1, the mentioned issue should be resolved and the following modification is suggested.   * + **Option 1:**     - **The center frequencies are NOT necessarily aligned for the initial UL BWP where the RedCap UE transmits PRACH and the initial DL BWP where the RedCap UE monitors RA CSS.**     - **FFS BWP#0 configuration option 2** |
| LGE | N |  | QC’s suggestion with the update from DOCOMO looks fine for us. |
| OPPO | N |  | QC’s revision shall be considered for further discussion |
| Lenovo, Motorola Mobility | Y | Option 1 | We understand   * The initial DL BWP can be the one defined by MIB-configured CORESET#0 or the separate initial DL BWP for RedCap UEs.   The initial UL BWP can be the one for non-RedCap UEs or the separate initial UL BWP for RedCap UEs. |
| Nordic | N |  | We do not support:  In our understanding we agreed on Option 2 already , Option 1 is FFS. We do not see the need to mandate TDD UE to retune during initial access. However, we are open to accept Option 1 if agreed together with Option 2 in 3.2.4a, this as part of compromise way forward. |
| FUTUREWEI | Y with modification |  | Intel’s modification of option 2 is ok. We can also consider QC’s updates to option 1 but not to add option |
| NEC | N |  | If option 1 would be down-selected, we would not see much motivation to support a separate initial DL BWP during random access as MIB-configured CORESET#0 can be used as Rel-15.  If option 1 is intended for or covers the case to use MIB-configured CORESET#0, we are fine to down-select among two options. |
| CMCC | Y | Option 1 | The wording of “initial UL BWP” and “initial DL BWP” need further clarification. In our understanding, “initial UL BWP” means separate initial UL BWP, “initial DL BWP” includes both SIB-configured separate initial DL BWP and initial DL BWP defined by CORESET 0.  With regard to retuning, option2 also needs retuning when CSS for paging is not configured in separate initial DL BWP. |
| Ericsson | Y | We prefer Option 1 | With the support of separate center frequencies for initial UL/DL BWPs in TDD during initial access, many concerns regarding the PUSCH resource fragmentation and the presence of SSB and CORESET #0 within the initial DL BWP can be resolved.  Option 2 can also be acceptable as a compromise, if SSB and CORESET#0 do not need to be included. |
| IDCC | Y | Option 1 |  |
| Nokia, NSB | Y | Option 1 |  |
| FL4 | This proposal is merged with Proposal 3.2-4a into Proposal 3.2-4b. | | |

## SSB transmissions

In this section, expressed views on transmission of additional SSBs in a separate initial DL BWP (if configured) and RRC-configured DL BWP.

**Whether to transmit additional SSBs in a separate initial DL BWP for RedCap**

There are different views on whether an additional SSB is transmitted in the separate initial DL BWP for RedCap. Some contributions [4, 6, 11, 12, 14, 16, 32] argue that transmission of additional SSBs in a separate initial DL BWP for RedCap is not needed and can result in significant overhead and increased inter-cell interference. Some other contributions propose that additional SSB in the separate initial DL BWP should be transmitted [13, 15, 17, 20, 24]. Moreover, several contributions indicate that transmission of additional SSB depends on the scenario considering CSSs (random access or paging), initial UL/DL BWP centre frequencies in TDD, DRX cycle, and SSB periodicity [6, 7, 8, 9, 18, 22, 23, 25, 26]. In particular, a few contributions propose that additional SSB transmission is not needed when the separate initial DL BWP does not contain paging CSS [6, 7, 9, 18, 22, 25, 26].

* [4]: Non-cell defining SSB as additional SSB would cause system performance degradation and significant implementation complexity to network, while does not ensure UE measurement performance.
* [6]: Whether the network configures an additional SSB to be transmitted in the separate initial DL BWP for RedCap should be based on the SSB monitoring periodicity (i.e., SMTC configuration) and the DRX cycle.
* [6]: If the separate initial DL BWP is only configured for random access, then the UE does not expect SSB transmission in the separate initial DL BWP. In this case, the network may or may not configure an SSB in the separate initial DL BWP for RedCap.
* [6]: By supporting different center frequencies for initial UL/DL BWPs for RedCap in TDD during initial access, the initial DL BWP can always contain CORESET#0 and SSB while minimizing the PUSCH resource fragmentation.
* [8]: The periodicity for additional non-CD SSB is configurable and up to 160ms, which is controlled by the network to reduce the overhead.
* [12]: The separately configured initial DL BWP for RedCap UEs does not need to contain SSB.
* [13]: For RedCap UE in RRC idle/inactive, whether the UE can expect SSB transmission in the separate initial DL BWP depends the measurement accuracy of SSB outside of separate initial DL BWP.
* [14]: The separate initial DL BWP under BWP#0 configuration option 2 should include SSB and CORESET#0.
* [16]: SSB is not transmitted in separate initial DL BWP if the separate initial DL BWP does not contain CORESET #0.
* [18]: A UE may NOT expect SSB to be always configured within the separate initial DL BWP if the separate initial DL BWP is only configured with PDCCH CSS Type 1 mapped to CORESET #0A.
* [20]: RedCap UE may always expect either CD-SSB in MIB-configured initial DL BWP or non-CD-SSB within the initial DL BWP for RedCap UE
* [26]: For a separate initial DL BWP configured with Type-1 CSS without paging monitoring, SSB may not be configured for the separate initial BWP.
* [26]: For a separate initial DL BWP configured with paging monitoring, a Redcap UE in RRC\_IDLE/INACTIVE state expects SSB transmission in the separate initial BWP if the UE monitors for paging on it.
* [32]: There is no/negligible impact on UE complexity and battery life due to UE RF retuning to measure on CD-SSB. Also, transmitting additional SSBs would have significant impact on system complexity, network planning, network energy savings, network capacity, inter-cell DL interference, UE data experience, and specifications.

**FL1 High Priority Proposal 3.2-1: Regarding SSB transmission in a separate initial DL BWP for RedCap in idle/inactive mode:**

* **If the separate initial DL BWP is only configured for random access but not for paging, then the UE shall not expect SSB transmission in the separate initial DL BWP.**
  + **Note: The network may or may not configure SSB in this case.**
  + **FFS: SSB presence when the separate initial DL BWP is configured for paging**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | N | Even if the separate initial DL BWP is configured for random access of RedCap UE, idle/inactive RedCap UE should get notification of SI update and ETWS by paging.  When paging CSS is configured for idle/inactive UE in the separate initial DL BWP, SSB should be transmitted in the same DL BWP. |
| Vivo |  | We think this proposal should be address together with **Proposal 3.2-3** and **Question 3.3-1** as a package for compromise, it would be hard trying to agree it alone. |
| OPPO | Y | For RAR reception ,there can be no SSB in this separate initial DL BWP. |
| Nordic | N | Depends on whether BWP is meant for camping or not. If BWP contains paging, OSI, SIB1 -> SSB is guaranteed. |
| Huawei, HiSilicon | Y |  |
| ZTE, Sanechips | Y | If the separate initial DL BWP is only configured for random access, the network may not configure SSB in the separate initial DL BWP. As with Rel-15/16 UEs, it is possible that the initial DL BWP does not contain SSB, especially for frequency-division multiplexing patterns 2 and 3 in FR2. Besides, RedCap UEs can switch to the MIB-configured initial DL BWP by RF retuning when needed to receive the legacy SSB.  For the ‘Note’, it seems to indicate that the additional SSB can be configured by the gNB. It is more appropriate to say “**The network can configure the separate initial DL BWP containing SSB or not in this case.**” |
| Panasonic | Y |  |
| Sharp | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Spreadtrum |  | We are open for SSB presence or not during RACH procedure, if it is helpful for progress. |
| CATT | Y | The UE shall not expect SSB transmission in the separate initial DL BWP, no matter it is configured for random access and/or paging. |
| Nokia, NSB | Y |  |
| Ericsson | Y |  |
| Intel | Y |  |
| China Telecom | Y |  |
| DOCOMO | Y |  |
| FUTUREWEI | Y |  |
| CMCC | Y |  |
| NEC | FFS | Maybe OK but we would like to clarify a point. Does this imply that in this case RedCap UE monitors SI and paging on MIB-configured CORESET#0 in IDLE/INACTIVE and accesses a separate initial DL BWP only for RA?  This would depends on outcome of **Proposal 3.1-4** |
| LGE | N | When the separate initial DL BWP is configured for paging, then SSB shall be transmitted in the separate initial DL BWP. |
| Apple |  | This should be packed together with others, **Question 3.2-2.** |
| Samsung |  | We’d like to clarify the meaning of the following note:  Note: The network may or may not configure SSB in this case.  Interpretation #1: Only for the case that the separate initial DL BWP contains CORESET #0, it “configure” SSB, which is the CD-SSB.  Interpretation #2: network may configure SSB in connected mode. But UE in idle/inactive mode cannot read it.  Interpretation #3: UE can work when there is no SSB configure and transmit in the separate iDL BWP. However, the specific supports the configuration of SSB in idle/inactive mode, e.g., in SIB.  We cannot agree Interpretation #3. If the intention is for Interpretation #1, we want to update the Note to  *Note: The network may ~~configure~~ transmit SSB in this case, i.e., when the separate initial DL BWP contains the CD-SSB frequency range.*  Or replace it with  *Note: The network may configure MIB-configured CORESET#0 or SIB1 to be within the separate initial DL BWP.*  In addition, we want to modified the main bullet as  *At least for the case that ~~If~~ the separate initial DL BWP is only configured for random access but not for paging, then the UE shall not expect SSB transmission in the separate initial DL BWP.*  Moreover, we like to delete the last FFS on SSB presence for paging. Because we need to discuss whether paging on separate iDL BWP is supported or note first. We support paging in the separate iDL BWP, but we cannot live with SSB in the spate iDL BWP. Alternatively, it can be changed to  *FFS: whether/how paging can be configured in the separate initial DL BWP.* |
| FL2 | See Proposal 3.2-4. | |

**FL1 High Priority Question 3.2-2: Regarding SSB transmission in a separate initial DL BWP for RedCap in idle/inactive mode:**

* **If the separate initial DL BWP is configured for paging, should the UE always be able to expect SSB transmission in the separate initial DL BWP?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | Y | SSB transmission is essential in the DL BWP configured with paging CSS |
| vivo | Y | If SSB transmission is not available in the initial DL BWP where UE monitors paging, paging detection performance may be degraded and UE power consumption will be increased.   * From decoding performance perspective, as discussed in UE power saving WI, at least one SSB prior to each paging occasion in the high SINR case, and two or three SSB in some low SINR case are required for UE IDLE mode loop convergence / time-frequency tracking. * From power consumption perspective, according to TR 38.840, the slot-average power level is 50 power units for BWP switching, additional power consumption per paging cycle caused by two times BWP switching to receive SSB and paging is at least (50 power unit) \* (3 slot) \* (2 times of BWP switching) = 300 power units for Type 2 BWP switching delay, which is much higher than the power used for receiving PDCCH + PDSCH of 120 power unit with 20MHz BW. In addition, the extra 300 power unit is the lower bound of the additional power consumption assuming no additional waiting time for SSB or paging PDCCH reception after the BWP switching. |
| OPPO | Y | Agree with vivo’s analysis.  Paging in this separate initial DL BWP is for offloading. If there is no SSB transmitted in this separate initial DL BWP, paging will be monitored in the legacy MIB-configured initial DL BWP. |
| Nordic | Y |  |
| Huawei, HiSilicon | N but | From gNB point of view, there is no fundamental difference for SSB reception prior to RAR or paging. The need for UE to perform SSB measurement during initial access for paging reception would not be frequent. For a UE being able to receive RAR without SSB, it is equivalent for UE to receive paging without SSB on the same BWP.  From UE point of view, (see [R1-2108753](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108753.zip) and [R1-2109752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109752.zip))   * the BWP with or without SSB differs from whether SSB is simultaneously processed with data within the same BWP – thus, operation without SSB is actually less complexity. * Without SSB, UE perform RF retuning for SSB measurement. This is mandatory supported by measurement gap in R15. So no complexity aspect is concerned. * Power consumption could be different however the impact is negligible (around 1%), based on the methodology in TR 38.840 and 50 power units for BWP switching.   Thus, we don’t see significant issue for UE not expecting SSB in this case either.  However, as also said from last meeting, we are ok to compromise in this case that there is network restriction for gNB to configure related DRX/paging/measurement configurations, such that a UE is not required to measure SSB to an extent that they consider will have non-trivial impact on their devices implementations. |
| ZTE, Sanechips | N | The transmission of legacy SSB in the separate initial DL BWP for RedCap UEs is up to gNB configuration. From the UE perspective, the UE shall not always expect SSB transmission in the separate initial DL BWP. For example, in TDD, to reduce the PUSCH resource fragmentation, for the case that the SSB is located on the edge of the system bandwidth, gNB can configure the separate initial DL BWP containing the legacy SSB; If SSB is located near to the center of the system bandwidth, gNB can configure no SSB in the separate initial DL BWP and the RedCap UE can retune to the MIB-configured initial DL BWP for the reception of legacy SSB. |
| Xiaomi | Y | If there is no SSB in the separate initial DL BWP, RedCap will comp on the MIB-configured initial DL BWP |
| Panasonic | Y |  |
| Sharp | Y | NCD-SSB should be transmitted in the separate initial DL BWP if the paging CSS in the separate initial DL BWP is configured for offloading purpose. |
| Lenovo, Motorola Mobility |  | It depends on if the measurement accuracy of SSB outside of separate initial DL BWP is accurate enough. |
| Spreadtrum | Y | It is up to gNB implementation whether to configure paging CSS in the separate initial DL BWP. |
| CATT | N |  |
| Nokia, NSB |  | Our preference is also that SSB is not required for BWP used for paging, as we don’t see strong need for the SSB in this case. However, we are fine to support the compromise from the last meeting where SSB is required for paging but not random access. |
| Ericsson | N | If the separate initial DL BWP is also configured for paging, SSB is contained in the separate initial DL BWP depending on the configuration of the DRX cycle and SMTC periodicity. For example, if the periodicity of the DRX cycle is long, there is sufficient time and flexibility to acquire the legacy/CD-SSB located outside of its initial DL BWP. Also, in this case, there wouldn’t be much impact to the UE power consumption (if at all). Therefore, depending on the SSB monitoring periodicity and the DRX cycle, additional SSBs are not required to be transmitted in the separate initial DL BWP for RedCap. The exact configuration of the DRX cycle and SMTC periodicity for which SSB shall/may not be present in the separate initial DL BWP can be decided in RAN4.  We also suggest treating FR1 and FR2 cases separately. |
| Intel | Can accept | While we don’t think it may be strictly necessary, it can help UE power consumption reduction such that the UE can camp on the separate initial DL BWP when paging is configured in the separate initial DL BWP. In such a case, having (NCD) SSB in the separate initial DL BWP can be beneficial for UE to wake up periodically, perform sync and measurements, and monitor for potential paging. |
| China Telecom | N | For paging, we think there is no need for UE to always expect SSB transmission in the separate initial DL BWP. |
| DOCOMO | Y |  |
| FUTUREWEI | Y |  |
| CMCC | N | Share similar view with ZTE. If paging CSS is configured on separate initial DL BWP, UE can switch to CD-SSB before paging PDCCH for sync. |
| NEC | FFS | Does this imply that in this case RedCap UE always camps on a separate initial DL BWP after cell search and RRM measurement is also performed on the separate initial DL BWP? In cell reselection, which SSB is used, namely CD-SSB or SSB on a separate initial DL BWP of neighboring cell?  This would depends on outcome of **Proposal 3.1-4** |
| LGE | Y | We see there are power consumption and performance issues without the SSBs in the separate initial DL BWP for paging. |
| Apple | Y |  |
| Samsung | N | As analyzed in some papers, power consumption is not an issue.  We don’t think there is any issue for UE to get time/freq tracking in CD-SSB outside of separate BWP and retune to the separate DL BWP for paging receiving. Otherwise, current BWP switching in NR cannot work (If UE requires time/frequency tracking in the same BWP with SSB).  In addition, as pointed out in our paper, transmit/configure another SSB will cause huge impact on RAN 2, and may or may not feasible.  Also, Idle mode TRS resources supported in Rel-17 PS can be used for synchronization/AGC for paging in the separate initial DL BWP. |
| MediaTek | Y |  |
| FL2 | See Proposal 3.2-4. | |

**Whether to transmit additional SSBs in an RRC-configured DL BWP for RedCap**

For RRC-configured DL BWP (e.g., non-initial BWP), the contributions generally agree that transmission of additional SSBs depends on the UE capability [4, 6, 13, 23, 28, 29, 30]. Specifically, for RedCap UEs supporting FG 6-1a, the network may or may not transmit additional SSBs in an RRC-configured active DL BWP, while additional SSB is transmitted for UEs with only basic FG 6-1 capability.

* [6]: For RedCap UEs supporting FG 6-1a, the network may or may not transmit additional SSBs in an RRC-configured active DL BWP.
* [10]: If SSB is always required in any active BWP of a RedCap UE in RRC\_CONNECTED state, the SSB issue will be a disaster to the network.
* [11]: To balance UE power saving and network overhead, the following alternatives can be considered:
  + RedCap UEs support FG 6-1a, no additional SSB is configured, RedCap UEs rely on CSI-RS/TRS for RRM and sync.
  + RedCap UEs support FG 6-1, the active DL BWPs overlap with CD-SSB, and the center frequency of DL BWP and UL BWP can be unaligned.
  + RedCap UEs support FG 6-1, while the SSB for RRM/sync can be non-CD SSB with large periodicity.
* [14]: The measurement gap/TRS/CSI-RS can be considered to accommodate SSB reception and CORESET#0 monitoring in a scenario where SSB and CORESET#0 is not transmitted within the UE BW.
* [28]: If a RedCap UE operates in an RRC-configured DL BWP without SSB, it expects to receive periodic TRS/CSI-RS in the SSB-less BWP.
* [29]: Support offloading from MIB-CORESET#0/CD-SSB, if at least in RRC connected mode and in RedCap UE’s active BWP, a RedCap UE with baseline capability may expect gNB to transmit an SSB within the active BWP.

**FL1 High Priority Proposal 3.2-3: Whether the UE can expect SSB transmission in the RRC-configured active DL BWP depends on its UE capabilities (e.g., whether it supports FG 6-1a or only** **FG 6-1).**

* **A UE not supporting operation without SSB transmission in the RRC-configured active DL BWP may expect SSB transmission in the RRC-configured active DL BWP.**
  + **FFS: details of SSB configuration (e.g., cell-defining SSB, non-cell-defining SSB, SSB periodicity)**
* **A UE supporting operation without SSB transmission in the RRC-configured active DL BWP shall not expect SSB transmission in the RRC-configured active DL BWP.**
* **FFS: RedCap UE capability for BWP operation**
  + **Only FG 6-1, FG 6-1a, or any new FG suitable for RedCap**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | N | A UE not supporting operation without SSB transmission in the RRC-configured active DL BWP ~~may~~ expect SSB transmission in the RRC-configured active DL BWP.  FG 6-1 is mandatory for RedCap UE in FR1  FG 6-1a is optional for RedCap UE in FR1 |
| vivo | N | The current formulation is not agreeable. We suggest the following update.  **Modified Proposal 3.2-3: Whether the UE can expect SSB transmission in the RRC-configured active DL BWP depends on its UE capabilities (e.g., whether it supports FG 6-1a or only FG 6-1).**   * **A UE not supporting operation without SSB transmission in the RRC-configured active DL BWP ~~may~~ expect SSB transmission in the RRC-configured active DL BWP.**   + **This corresponds to mandatory RedCap UE feature.**   + **FFS: details of SSB configuration (e.g., cell-defining SSB, non-cell-defining SSB, SSB periodicity)** * **A UE supporting operation without SSB transmission in the RRC-configured active DL BWP shall not expect SSB transmission in the RRC-configured active DL BWP.**   + **This corresponds to optional RedCap UE feature.** * **FFS: RedCap UE capability details for BWP operation**   + **Only FG 6-1, FG 6-1a, or any new FG suitable for RedCap** |
| OPPO |  | Agree with vivo’s revision. |
| Nordic | N | VIVO wording is OK, plus typo “expects” |
| Huawei, HiSilicon | N | We want to note that existing FG6-1 alone will not hold anymore anyway, if we agree to support a separate initial DL BWP without CORESET#0.  We want to also clarify that the existing FG6-1a only concerns UE specific RRC configured BWP. In that sense, our understanding is that the current proposal concerns more about the UE specific configurations to specific UEs. A BWP configured from SIB and applied after initial access may be assumed without SSB, i.e. irrelevant to the FG6-1a.  We are ok with the following  **Modified Proposal 3.2-3: Whether the UE can expect SSB transmission in the RRC-configured active DL BWP depends on its UE capabilities (e.g., whether it supports FG 6-1a or only FG 6-1).**   * **A UE not supporting operation without SSB transmission in the RRC-configured active DL BWP may expect SSB or CSI-RS transmission in the RRC-configured active DL BWP.**   + **FFS: details of SSB or CSI-RS configuration (e.g., cell-defining SSB, non-cell-defining SSB, SSB periodicity)** * **A UE supporting operation without SSB transmission in the RRC-configured active DL BWP shall not expect SSB transmission in the RRC-configured active DL BWP.** * **FFS: RedCap UE capability for BWP operation**   + **Only FG 6-1, FG 6-1a, or any new FG suitable for RedCap** |
| ZTE, Sanechips | Y | We are generally fine with the proposal. For the FFS in the first bullet, we may need to determine whether we should reuse the legacy SSB (including CD SSB and NCD SSB) firstly or just define a new SSB. Therefore, the following modification is suggested.  **FFS: details of SSB transmission in the RRC-configured active DL BWP (e.g., legacy SSB, new-defined SSB)** |
| Xiaomi |  | We support vivo’s version |
| Panasonic | N | We are not so sure whether the proposal is to allow a RedCap UE supporting operation without SSB transmission in the RRC-configured active DL or it discuss to clarify the possibility of RedCap UE capability and SSB transmission handling. Our view is “a RedCap UE not supporting operation without SSB transmission in the RRC-configured active DL BWP” should not be allowed in the specification. |
| Lenovo, Motorola Mobility |  | This depends on if FG6-1a is mandatory for RedCap UEs or not.  If FG6-1a is mandatory, seems the first bullet is not needed. |
| Spreadtrum |  | We support vivo’s version. |
| CATT |  | Huawei’s suggestion is OK for us. |
| Nokia, NSB | Y |  |
| Ericsson | N | We support Huawei’s revision. |
| Intel | Y, but … | We also agree with and would like to second the observation from Huawei that FG 6-1 and 6-1a would not apply directly, since CORESET #0 should not be coupled with this capability on SSB for RedCap UEs. |
| China Telecom | N | We are fine with Huawei’s suggestion. |
| DOCOMO | Y |  |
| CMCC |  | Fine with HuaWei’s suggestion. |
| NEC | Y | “may” will be fine for us. “may” allows UE whether it actually expects SSB or not. |
| LGE |  | We are fine with the FL proposal in general. Regarding the discussion on the mandatory/optional support of the BWP-related FGs, we think the FG 6-1 should be mandatory and the FG 6-1a is optional. |
| Apple |  | Support Vivo modification.  We also share view that a new UE feature capability is needed to focus on SSB only without CORESET#0.  We think this proposal should be discussed at first. |
| Samsung |  | For this proposal, we don’t think new signaling of SSB configuration is needed. Current system has UEs support or not support FG6-1a.  Therefore, we suggest to delete   * + **FFS: details of SSB configuration (e.g., cell-defining SSB, non-cell-defining SSB, SSB periodicity)**   In addition, we like to clarify the second bullet on the meaning of “shall not expect”. Does this mean UE support operation without SSB can operate on a BWP with SSB transmission as well? If so, we suggest to change to “does not” other than “shall not”. |
| MediaTek | N | We are fine with vivo’s update. |
| FL2 | See Proposal 3.2-4. | |

Based on the received responses to Questions 3.2-1, 3.2-2, 3.2-3, 3.3-1 and 3.3-2, the following proposal can be considered. The responses received so far for Question 3.3-1, which concerns whether to make FG 6-1a mandatory for RedCap UEs, were split roughly 50/50.

**FL2 High Priority Proposal 3.2-4: For FR1, select one of the following options:**

* **Option 1:**
  + **For separate initial DL BWP,**
    - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**
  + **For RRC-configured active DL BWP,**
    - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CSI-RS or CORESET#0/SIB1.**
* **Option 2:**
  + **For separate initial DL BWP configured for random access but not for paging,**
    - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**
  + **For separate initial DL BWP configured for paging,**
    - **RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**
  + **For RRC-configured active DL BWP,**
    - **RedCap UE expects it to contain CD-SSB or NCD-SSB or CSI-RS but not CORESET#0/SIB1.**
* **FFS:**
  + **Whether RedCap UE can/cannot expect SSB under certain conditions for SSB monitoring periodicity (i.e., SMTC configuration) and DRX cycle**
  + **Whether it is feasible to use NCD-SSB for serving cell measurement and QCL source**
  + **How SI update notifications and/or SI updates are signaled to RedCap UEs**
  + **FR2 case**
* **Note:**
  + **In all these cases, the network may choose to configure SSB or MIB-configured CORESET#0 or SIB1 to be within the respective DL BWP.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Y/N** | **Option** | **Comments** |
| vivo |  | Option 2 | For the FFS part:   * The motivation of 1st bullet under FFS needs to be clarified * For the 2nd bullet, we think it should be feasible, and FFS should be mainly on what additional spec effort is needed to make it work * It is not clear why the SI update issue (3rd bullet) is highlighted here |
| Qualcomm | N |  | For separate initial DL BWP, RedCap UE expects it to contain SSB (CD-SSB or NCD-SSB) and CORESET/CSS for RA and paging  For RRC-configured active DL BWP, RedCap UE with baseline capabilities expects it to contain SSB and CORESET/CSS for paging |
| Nordic |  | Option 2 | Regarding NCD-SSB, we do not understand why it should not be feasible. NCD-SSB would provide the same burst as CD-SSB. Contains PSS and SSS. NCD-SSB MIB indicates that no SIB1 is broadcast.  System update can be provided in dedicated manner, or if SIB1/ OSI SS is provided for RedCap UEs then broadcast can be used. |
| MediaTek | N |  | The SSB and the CSS/CORESET for random access should be configured in the separate initial DL BWP. |
| Ericsson | Y | We prefer Option 1. | We can accept Option 2 as a compromise.  We also propose to add cell selection/reselection in the 2nd bullet under FFS. As per TS 38.300, cell selection/reselection is always based on CD-SSB.  @Vivo: Regarding 1st bullet under FFS, we copy our response from an earlier question below.  *If the separate initial DL BWP is also configured for paging, SSB is contained in the separate initial DL BWP depending on the configuration of the DRX cycle and SMTC periodicity. For example, if the periodicity of the DRX cycle is long, there is sufficient time and flexibility to acquire the legacy/CD-SSB located outside of its initial DL BWP. Also, in this case, there wouldn’t be much impact to the UE power consumption (if at all). Therefore, depending on the SSB monitoring periodicity and the DRX cycle, additional SSBs are not required to be transmitted in the separate initial DL BWP for RedCap. The exact configuration of the DRX cycle and SMTC periodicity for which SSB shall/may not be present in the separate initial DL BWP can be decided in RAN4.* |
| IDCC | Y | Option 2 | Agree with Nordic on the SI update comments. |
| Intel | Y | Option 1 is preferred | We can also accept Option 2 as a compromise.  Agree with Nordic on mechanisms for SI update/delivery to RedCap UEs in connected mode. For UEs in idle/inactive modes, if separate initial DL BWP does not include CSS Types 0/0A, UE can rely on retuning to CORESET #0 in case it may need to reacquire any SI message. We do not see any issues with that for RRC\_Idle/Inactive modes. |
| FUTUREWEI2 |  |  | Of these two options, prefer Option 2. Some clarifications on the FFS may be needed. |
| NEC |  |  | We would like to clarify whether this will invalidate Rel-15 specification “Even though this field is only configured in the initial BWP (BWP#0) *controlResourceSetZero* can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions defined in TS 38.213 [13], clause 10 are satisfied.” [TS 38.331]  Preference would be option 2 but the first bullet would depend on **High Priority Proposal 3.1-5a**  We agree with Ericsson to add cell selection/reselection to FFS. |
| DOCOMO |  |  | We are fine with either option |
| Xiaomi |  | Option 2 | Since whether include the CORESET#0 is already discussed in **Proposal 3.1-2a,** then there is no need to discuss whether include CORESET#0/SIB1 in option 2 |
| CATT | N |  | In Option 1, ‘**CSI-RS**’ shall be deleted. A RedCap UE may count on CSI-RS if SSB is no contained.  Generally, we note that the usage of NCD-SSB is very limited in current NR. It cannot be used for measurement in many situations when the UE is in RRC\_CONNECTED state. If RAN1 would like to extend the usage of NCD-SSB, confirmation from RAN2/4 is needed. However, this makes the situation very complex. |
| OPPO |  | Option 2 |  |
| CMCC | Y | Option 1 is preferred | No matter separate initial DL BWP is configured for random access or for paging, it is not necessary for NW to configure SSB in BWP, UE can switch to CD-SSB for sync.  The word ‘CSI-RS’ in option1 shall be removed. |
| Huawei, HiSi |  | Option 1/ Option 3 | It is pending further discussion on whether NCD-SSB is feasible, as it is not currently supported.   * **Option 3:**   + **For separate initial DL BWP,**     - **RedCap UE does NOT expect it to contain CD-SSB or CORESET#0/SIB.**   + **For RRC-configured active DL BWP,**     - **RedCap UE expects it to contain CD-SSB or CSI-RS but not CORESET#0/SIB.**   Except NCD-SSB, Option 2 can be considered conditioned with paging is configurable, possibly with network configuration restrictions. |
| LGE |  |  | We have the same view with Qualcomm and MediaTek.  For the FFS, we have the same understanding on the SI update notifications as Nordic. The third sub-bullet under FFS can be removed if there is any other open issues with that. |
| Spreadtrum | Y | Option 2 | But we think it is hard to compromise to Option 2, especially for the RRC-configured DL BWP part. In our view, for RRC-configured DL BWP, it is definitely up to UE capability like FG 1-6 or 1-6a. We can discuss the RRC-configured DL BWP as UE feature. We suggest the group can agree the initial DL BWP part at first for ease of consensus.  For the initial DL BWP, if NW want to save the SSB overhead, it can avoid configuring paging CSS in the separate initial DL BWP. UE vendors strongly concern about the power consumption of paging. For RACH, it seems more UE vendors can compromise.  If some companies are afraid that it implies the baseline UE capability, we can note the baseline UE capability can be further discussed.  Perhaps, NW vendors can compromise the following simplified Option 2.   * **Option 2:**   + **For separate initial DL BWP configured for random access but not for paging,**     - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For separate initial DL BWP configured for paging,**     - **RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**   + **Note: It does not imply the baseline UE capability on SSB presence or not in the UE-specific DL BWP** |
| ZTE, Sanechips |  | Option 1 | The transmission of legacy SSB in the separate initial DL BWP for RedCap UEs is up to gNB configuration. The UE shall not always expect SSB transmission in the separate initial DL BWP. |
| FL3 | Based on the received responses, the following updated proposal can be considered. The FL recommendation is to treat this proposal together with Proposal 3.1-2b and Proposal 3.1-5b and potentially together with a proposal to send an LS based on the outcome of Question 3.2-5a.  **High Priority Proposal 3.2-4a: For FR1, select one of the following options in RAN1#107-e:**   * **Option 1:**   + **For separate initial DL BWP,**     - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB ~~or CSI-RS~~ or CORESET#0/SIB1.** * **Option 2:**   + **For separate initial DL BWP configured for random access but not for paging,**     - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For separate initial DL BWP configured for paging,**     - **RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**   + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**     - **Whether RedCap UE expects it to contain CD-SSB or NCD-SSB or CSI-RS depends on the UE capabilities.** * **FFS:**   + **Whether RedCap UE can/cannot expect SSB under certain conditions for SSB monitoring periodicity (i.e., SMTC configuration) and DRX cycle**   + **Whether it is feasible to use NCD-SSB ~~for serving cell measurement and QCL source~~ instead of CD-SSB for idle/inactive/connected mode RAN1/2/4 procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB**   + **How SI update notifications and/or SI updates are signaled to RedCap UEs**   + **FR2 case** * **Note:**   + **In all these cases, the network may choose to configure SSB or MIB-configured CORESET#0 or SIB1 to be within the respective DL BWP.** | | |
| MediaTek | N |  | We can accept option-2 with the following modifications:   * **Option 2:**   + **For separate initial DL BWP configured for random access but not for paging,**     - **RedCap UE does ~~NOT~~ expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For separate initial DL BWP configured for paging,**     - **RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**   + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**     - **~~Whether~~ RedCap UE expects it to contain CD-SSB or NCD-SSB ~~or CSI-RS depends on the UE capabilities~~.** |
| Qualcomm | N |  | We don’t agree with Option 1 and Option 2, which mandates FG 6-1a for RedCap UE and is not consist with the RAN1#105 agreement on FG 6-1 for FR1.  For the sake of progress, we can agree with this proposal if Option 3 is added, which is consistent with the RAN1#105 agreement on FG 6-1.  **Option 3:**   * **For separate initial DL BWP configured for random access and paging,**   + **RedCap UE expects it to contain CD-SSB or NCD-SSB (not both)**     - **If the initial DL BWP contains CD-SSB, RedCap UE expects it to contain CORESET#0/SIB1**     - **If the initial DL BWP contains NCD-SSB, RedCap UE does not expect it to contain CORESET#0/SIB1** * **For RRC-configured active DL BWP not containing CD-SSB,**   + **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**   + **Whether RedCap UE expects it to contain NCD-SSB or periodic CSI-RS depends on the UE capabilities.** * **For RRC-configured active DL BWP containing CD-SSB, RedCap UE expects it to contain CORESET#0/SIB1.** |
| CATT | Y | Option 1 | As also explained by Huawei and Samsung, the usage of NCD-SSB is very limited in current NR. It cannot be used in many *MeasObject*. We doubt that it is really helpful to use NCD-SSB in the active DL BWP. |
| Spreadtrum | Y |  |  |
| vivo | N |  | We agree that Proposal 3.1-2b, Proposal 3.1-5b and Proposal 3.2-4a should be treated together, but wondering if the intention to decide all of them together in next meeting?  For proposal 3.2-4a, we do not agree with either option 1 or option 2. Containing SSB (CD or NCD) within RRC configured DL BWP is very critical for UE operation and shall be made as mandatory UE feature. We cannot agree to leave this discussion to the UE feature session. We think UE vendors had shown enough sincerity in order to reach the agreement. We hope that a more balanced package to both sides can be considered in the next stage. |
| Panasonic | Y | Option 2 |  |
| Intel | Y | Option 1 | Our first preference is Option 1, but we can also compromise to Option 2.  In our understanding, Option 2 does NOT mandate FG 6-1a for RedCap UEs. Option 2 states that whether RedCap UEs expects CD/NCD-SSB or CSI-RS depends on UE capability – implying, UE may not be mandated to work without SSB in an RRC-configured active DL BWP. |
| DOCOMO | Y |  | We are fine with either option |
| Samsung | N but | Option1 | First of all, the note needs to be deleted.  We like to added another option 2b as   * **Option 2b:**   + **For separate initial DL BWP configured only for random access**      - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**     - **Whether RedCap UE expects it to contain CD-SSB or (FFS)NCD-SSB or CSI-RS depends on the UE capabilities.** |
| ZTE, Sanechips | Y | Option 1 |  |
| China Unicom | Y | Option 1 |  |
| LGE | N |  | Modification of Option 2 from MediaTek is preferred. Or, addition of Option 3 from QC is acceptable to us. |
| OPPO | N |  | Option 3 from QC is acceptable to us. |
| Lenovo, Motorola Mobility | Y | Option 1 | Option 1 is preferred. We may accept option 3 from Qualcomm to move forward, if the first bullet in option 3 does not mean RA-SS and paging SS shall together be configured. Besides, this also depends on 3.2-5a. |
| Nordic | N |  | We do not support:  We can accept Option 2 as compromise, but we cannot accept the already agreed high-lighted below part to be FFS again   * + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**     - **Whether RedCap UE expects it to contain CD-SSB or NCD-SSB or CSI-RS depends on the UE capabilities.**   And thus we would be fine with Samsung option 2b |
| FUTUREWEI | Y |  | We have a slight preference to option 2 but can also accept option 1 |
| NEC | N |  | Close to option 2.  Regarding the first sub-bullet of option2, if a RedCap UE does not require SSB for random access within initial DL BWP, we are OK with the first sub-bullet.  Regarding the second sub-bullet, we are not sure whether the second sub-bullet is intended also for IDLE/INACTIVE. We assume it is not intended for IDLE/INACTIVE. A RedCap UE may camp on MIB-configured CORESET#0 until initiating random access even if a separate initial DL BWP is configured. |
| CMCC | Y | Prefer Option1 | We are fine to down select in next meeting. We want to confirm that in option1, "RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1" means UE does not expect one of them. The intention is not to preclude both CD-SSB and NCD-SSB from DL BWP. |
| Ericsson | Y | We prefer Option 1 | We can consider Option 2 as a WA (pending RAN2/RAN4 confirmation) as a compromise if the following update is made.   * **Option 2:**   + **For separate initial DL BWP configured for random access but not for paging,**     - **RedCap UE does NOT expect it to contain CD-SSB or NCD-SSB or CORESET#0/SIB1.**   + **For separate initial DL BWP configured for paging,**     - **RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**   + **For RRC-configured active DL BWP,**     - **RedCap UE does NOT expect it to contain CORESET#0/SIB1.**     - **~~Whether~~ RedCap UE expects it to contain CD-SSB or NCD-SSB or CSI-RS ~~depends on the UE capabilities~~.**   The NW should not be forced to transmit both NCD-SSB and CSI-RS for serving UEs that do not support operation without CD-SSB in its active DL BWP. The NW should have the flexibility to transmit either NCD-SSB (if feasible) or CSI-RS.  Also, we prefer not to remove the 2nd sub-bullet under FFS. |
| IDCC | Y | Option 2 |  |
| Nokia, NSB | Y | Option 1 | We can also accept Option 2 as a compromise |
| FL4 | Based on the received responses, the following updated proposal can be considered, where parts of Proposal 3.1-2b, Proposal 3.1-5b and Question 3.2-5a have been taken into account. Potentially, Option 2 in the proposal could be agreed as a working assumption, to be confirmed or reverted depending on the response from RAN2 and RAN4 on the potential LS in Proposal 3.2-5b.  **High Priority Proposal 3.2-4b:**   * **For FR1, select one of the following options:**   + **Option 1:**     - **For a separate initial DL BWP,**       * **RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB1.**     - **For an RRC-configured active DL BWP,**       * **RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB1.**   + **Option 2:**     - **For a separate initial DL BWP,**       * **If it is configured only for random access, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB1.**       * **If it is configured for paging, RedCap UE expects it to contain CD-SSB or NCD-SSB but not CORESET#0/SIB1.**     - **For an RRC-configured active DL BWP,**       * **RedCap UE expects it to contain CD-SSB or NCD-SSB [FFS: or CSI-RS] but not CORESET#0/SIB1.**   + **Note: The network may choose to configure SSB or MIB-configured CORESET#0 or SIB1 to be within the respective DL BWP.**   + **FFS: FR2 case** * **For TDD, center frequencies are assumed to be the same for the initial DL and UL BWPs.**   + **Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned.** * **If a separate SIB-configured initial DL BWP for RedCap UEs is configured,**   + **It contains at least one CORESET/CSS.**   + **It can be used both during and after initial access.**     - **However, if it contains the entire CORESET#0, the RedCap UE shall use the CORESET#0-defined initial DL BWP during initial access.** | | |
| FL5 | Proposals 3.2-4b and 3.2-5b were discussed in the online (GTW) session on Friday 15th October. See follow-up proposal 3.2.5c below. | | |

Some of the received responses to Question 3.4-1 mention that NCD-SSB may currently not be applicable for serving-cell measurements and as QCL source.

**FL2 High Priority Question 3.2-5: Is it feasible to use NCD-SSB (rather than CD-SSB) in Options 1 and 2 (in Proposal 3.2-4)? Please elaborate on your answer in the Comments field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | Y | Although it is true that by current specification, UE always use CD-SSB for serving cell measurement and QCL source. However, there is no feasibility issue to use NCD-SSB within the UE DL BWP for the purposes. |
| Qualcomm | Y | * Both NCD-SSB and CD-SSB can be used for RRM/RLM/LR, tracking loops and AGC setting. * Compared with periodic CSI-RS/TRS, the overhead and NW cost to transmit NCD-SSB are smaller in most cases. * To improve the energy/spectral efficiency of NW, NCD-SSB can be transmitted on-demand to RedCap UE based on request sent on msg1 (shown by the illustration below) |
| Nordic | Y | Regarding NCD-SSB, we do not understand why it should not be feasible. NCD-SSB would provide the same burst as CD-SSB. Contains PSS and SSS. NCD-SSB MIB indicates that no SIB1 is broadcast. NCD-SSB may not be on synch raster.  In our understanding, NCD-SSB is e.g. the SSB of Scell, and is QCL source and is used for RRM measurements |
| Ericsson | FFS | The following aspects should be studied further:   * Whether it is feasible to use NCD-SSB for serving cell measurement and QCL source. * The PCIs of CD-SSB and NCD-SSB need not be the same [TS 38.300] * Cell selection/reselection in RRC\_IDLE is always based on CD-SSBs [TS 38.300] * Required RAN1/RAN2/RAN4 workload, if any. |
| Intel | Y | In general, we think it should be feasible to support to use NCD-SSB for RRM purposes. It is acknowledged that today, we do not support serving cell measurements and cell selection/reselection in RRC\_Idle based on NCD-SSB or as QCL source, but such can be defined by RAN2/RAN4. We do not see a fundamental issue as pointed out by Nordic/QC. |
| NEC | FFS | Agree with Ericsson. |
| DOCOMO |  | Regarding serving cell measurement, we can send an LS to RAN2/RAN4 to ask the feasibility. |
| Xiaomi | Y |  |
| CATT | N | As we mentioned above, the usage of NCD-SSB is very limited in current NR. It cannot be used for measurement in many situations when the UE is in RRC\_CONNECTED state.  If RAN1 would like to extend the usage of NCD-SSB, confirmation from RAN2/4 is needed. However, this makes the situation very complex. |
| OPPO | Y |  |
| CMCC | Y | It is ok to use NCD-SSB for RRM. The period of NCD-SSB can be larger than CD-SSB to reduce SSB overhead. |
| Huawei, HiSi | FFS | It is not currently supported in NR. The spec impact would not be trivial. |
| LGE | Y | We think it is feasible. Once we have a consensus on the benefit of extending the usage of the NCD-SSBs, we need to send the LS to RAN2/RAN4 ASAP. |
| Spreadtrum | Y |  |
| ZTE, Sanechips | FFS | Similar view with Ericsson. |
| FL3 | About half of the responses indicate that it is feasible to use NCD-SSB (rather than CD-SSB) in Options 1 and 2 (in Proposal 3.2-4), whereas about half of the responses indicate that it would not be trivial and/or that the feasibility would need to be confirmed by RAN2/RAN4.  According to received responses, RAN1 may need to ask for RAN2/RAN4 input regarding the feasibility of using NCD-SSB for, e.g., serving cell measurements, QCL source, cell selection, cell reselection, radio link monitoring, and link recovery, for RedCap UEs in Rel-17, and perhaps also whether the NCD-SSB period can be larger than the CD-SSB period.  Based on the received responses, the following question can be considered. If an LS is sent, it should be indicated in the LS that a response is needed before RAN1#107-e.  **High Priority Question 3.2-5a: Should RAN1 send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB? Please elaborate in the Comments field on what aspects to bring up in the potential LS.** | |
| Qualcomm | Y | We support sending LS to RAN2 and RAN4 to confirm the feasibility of NCD-SSB for RedCap UE in idle/inactive/connected mode |
| CATT |  | Tons of issues and large modification is needed to replace CD-SSB with NCD-SSB. We are worrying about the RAN2/4 heavy workload, and doubt that whether a fast feedback can be obtained (next RAN2/4 meeting will start around 2 weeks later). By default, using NCD-SSB instead of CD-SSB is not supported in current NR. |
| vivo | Y | We are fine to send LS to RAN2 and RAN4 to confirm the feasibility, but it would be better that the LS is sent after the “package proposal” is agreed in RAN1, so that RAN2 and RAN4 have better understanding of the intended use case considered by RAN1. |
| Panasonic | Y | Fine to ask RAN2 and RAN4 to confirm the feasibility of NCD-SSB for RedCap UE in idle/inactive/connected mode although we think it is feasible to use NCD-SSB. |
| Intel | Y | We are fine to send LS to RAN2/RAN4 to ask them to confirm on the feasibility of using NCD-SSB, but it is rather unlikely (likely, also impractical) to expect response before RAN1 #107-e. Nevertheless, we can proceed in RAN1 assuming feasibility (if use of NCD-SSB is agreed in RAN1), e.g., using working assumptions for related decisions, that can be revisited if any serious issues are identified by RAN2/RAN4. |
| DOCOMO |  | We are fine to send an LS to RAN2/4 to ask the feasibility of using NCD-SSB for the purpose listed in FL3 |
| Samsung |  | RAN 1 should be clear on what is expected for NCD-SSB first, as well as the benefit and necessity.  If LS is agreed to be sent, both feasibility and necessity (benefit) need to be asked as well. |
| ZTE, Sanechips | Y | Support to send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode. |
| LGE | Y | Okay to send the LS, but at the same time RAN1 can assume it is feasible to make a progress. |
| OPPO | Y | Ok to send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode. |
| Sharp | Y | We are fine to send an LS to RAN2/4 |
| Huawei, HiSi |  | If an LS to be sent, it should be firstly to confirm the support of NCD-SSB as well as the benefits/need. CD-SSB and CSI-RS should be prioritized in RAN1 relevant discussion/proposals for the moment.  Also, retuning time should be asked together as they are existing solutions. |
| Lenovo, Motorola Mobility | Y | Fine to send LS to RAN2/RAN4. |
| Nordic | Y,but | RAN1 shall formulate clear questions. |
| CMCC | Y | We are fine to send LS to RAN2/RAN4 to confirm on the feasibility of using NCD-SSB. |
| Ericsson | Y | All the mentioned aspects should be considered in the LS: serving cell measurements, QCL source, cell selection/reselection, RLM, BFD, link recovery, PCI aspects, CSI-RS as an alternative to SSB, etc., for RedCap UEs in Rel-17, and whether the NCD-SSB period can be larger than the CD-SSB period. |
| IDCC | Y |  |
| Nokia, NSB | Y |  |
| FL4 | The received responses are generally fine with sending an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB. Some responses express concerns about the limited time left in the WI and that the questions in the LS need to be clear. Two responses mention that the LS should also ask about use of CSI-RS as an alternative to CD-SSB, and one response mentions that the LS should also ask about retuning time. Based on the responses, the following Proposal 3.2-5b, Question 3.2-6 and Question 3.2-7 can be considered.  **High Priority Proposal 3.2-5b:**   * **Send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB.**   + **Prepare clear questions via email discussion until Monday 18th October.**   + **Indicate in the LS that a response is needed before RAN1#107-e.** | |
| FL5 | Proposals 3.2-4b and 3.2-5b were discussed in the online (GTW) session on Friday 15th October. See follow-up proposal 3.2.5c below. | |

Proposals 3.2-4b and 3.2-5b were discussed in the online (GTW) session on Friday 15th October.

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FL5 | The following corresponds to the latest version of the proposal that was under discussion in the online (GTW) session on Friday 15th October.  **High Priority Proposal 3.2-5c:**  **Take Option 2 as working assumption, which will be revisited based on the reply from RAN2/4.**   * **For FR1, select one of the following options:**   + **Option 1:**     - **For a separate initial DL BWP,**       * **RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**     - **For an RRC-configured active DL BWP,**       * **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 the entire CORESET#0),**       * **If it is configured for random access only, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**       * **If it is configured for paging, RedCap UE expects it to contain NCD-SSB but not CORESET#0/SIB.**     - **For an RRC-configured active DL BWP (if it does not include the entire CORESET#0),**       * **RedCap UE expects it to contain NCD-SSB [FFS: or CSI-RS] 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: FR2 case** * **Send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB.**   + **Prepare clear questions via email discussion until Monday 18th October.**   + **Indicate in the LS that a response is needed before RAN1#107-e.**   **The criteria for revisiting the working assumption are based on, e.g., if there are additional efforts from RAN2/4.**   * **For TDD, center frequencies are assumed to be the same for the initial DL and UL BWPs.**   + **Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned.** * **If a separate SIB-configured initial DL BWP for RedCap UEs is configured,**   + **It contains at least one CORESET/CSS.**   + **It can be used both during and after initial access.**     - **However, if it contains the entire CORESET#0, the RedCap UE shall use the CORESET#0-defined initial DL BWP during initial access.** | |
| DOCOMO |  | We are fine to take Option 2 as working assumption.  Regarding “or TDD, center frequencies are assumed to be the same for the initial DL and UL BWPs”, we are OK only if the initial DL BWP mentioned here means separate initial DL BWP for RedCap UEs. For shared MIB-configured initial DL BWP (CORESET#0 BW), we think it does not need to be aligned with separate initial UL BWP and the note clarifies the intention. |
| CATT |  | If making Option2 a WA is the only way we can move forward…  For the current description of CD and NCD-SSB, we think it is clear now (after several rounds polishing). Anyway, it will be beneficial for RAN2/RAN4 to know the contradictory part in RAN1. There is natual difference between CD and NCD SSB even from RAN1’s view.  For the newly added part, it should be revised a bit to make it more practical.  **The criteria for revisiting the working assumption are based on, e.g., if ~~there are~~ additional efforts from RAN2/4 is acceptable to guarantee the modification can be finished within Rel-17.**  For center frequencies part, can FL clarify it is aiming to say they should be aligned even during the initial random access? We also share similar concern with DOCOMO it is unclear for the range of initial DL/UL BWP, e.g. separate one?  For the last part, we are generally OK. In fact, we think ‘one CORESET/CSS’ may be updated as ‘one CORESET and one CSS’. It is not workable if only one of CORESET or CSS is configured. The current wording seems suggesting one between CORESET or CSS is enough. |
| ZTE, Sanechips | Y with modification | Agree with CATT regarding the ‘one CORESET and one CSS’. Moreover, from our understanding, similar as legacy, the separate initial DL BWP can also be only used in connected mode. Therefore, ‘**It contains at least one CORESET/CSS’** can be updated as **‘it can contain at least one CORESET and one CSS’.**  Regarding the center frequency alignment issue in TDD, to avoid confusion between the SIB-configured initial DL BWP and MIB-configured initial DL BWP (i.e., CORESET#0), the main bullet is suggested to be revised as:  **For TDD, center frequencies are assumed to be the same for the SIB-configured initial DL and UL BWPs.** |
| Panasonic | Y | For the description of CD-SSB or NCD-SSB, the main expertise is within RAN2 and RAN4. If CD-SSB or NCD-SSB is difficult to agree, within the option 2 description, just to describe it as "SSB". Then LS asks CD-SSB and/or NCD-SSB aspect to RAN2/4 could be one way instead of discussing CD/NCD-SSB within RAN1. |
| CMCC |  | We are fine with the SSB part.  For TDD alignment part, network can have the flexibility to configure whether center frequencies are aligned or not. The wording "initial UL/DL BWP" is not clear. Does "initial DL BWP" refers to both separate initial DL BWP and initial DL BWP defined by CORESET0? Does "initial UL BWP" in note refers to both separate initial UL BWP and initial UL BWP? |
| OPPO | Y | The bullet on the criteria shall be removed.  The LS sending to RAN2/4 is asking the feasibility. Anyway, there would be some additional efforts. It is not reasonable to set the criteria based on whether there is workload to other groups. |
| Samsung |  | We can compromise to option 2 as WA, with following changes:   * **Send an LS to RAN2 and RAN4 to ask about the ~~feasibility of~~ using NCD-SSB instead of CD-SSB for serving cell for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB, including the feasibility, specification efforts, potential impacts/coexistences with legacy UEs, potential performance impacts considering power boosting limitation of gNB..**   + **Prepare clear questions via email discussion until Monday 18th October.**   + **Indicate in the LS that a response is needed before RAN1#107-e.**   **The criteria for revisiting the working assumption are based on, e.g., performance, coexistences with legacy UEs, and if there are additional efforts from RAN2/4.** |
| MediaTek |  | We can accept Option-2 as WA with the following change:   * **Option 2:**   + **For a separate initial DL BWP (if it does not include the entire CORESET#0),**     - **If it is configured for random access only, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**     - **If it is configured for paging, RedCap UE expects it to contain NCD-SSB but not CORESET#0/SIB.**   + **For an ~~RRC-configured~~ active DL BWP in connected mode (if it does not include the entire CORESET#0),**     - **RedCap UE expects it to contain NCD-SSB [FFS: or CSI-RS] but not CORESET#0/SIB.**   This to ensure that if the “initial DL BWP” is the “active DL BWP” in connected mode, RedCap UE expects it to contain NCD-SSB. |
| FUTUREWEI |  | We are supportive of the efforts to reach this working assumption. However, we have a few questions for clarification.  As asked by CMCC and others, can clarification of what does initial DL BWP mean be provided? It is: MIB-configured CORESET#0, separate initial DL BWP, or SIB-configured initial BWP for non-RedCap UEs (under certain conditions)?  Similar comments about the notation “at least one CORESET/CSS”. To avoid confusion, suggest use “at least one CORESET and at least one CSS”  Similar question as raised by CATT and others. If the MIB-configured CORESET#0 is located in the center of the channel and the separate initial UL BWP is located at the low end of the channel, a UE performs a frequency retuning to reach the separate initial DL BWP located at the low end of the channel. For clarification, in our understanding FG6-1 and FG6-1a do not apply for this case in the RRC-inactive / RRC-idle state?  There is a statement in annex B2 of 38.331 “For BWP#0, the *BWP-DownlinkCommon* and *BWP-UplinkCommon* in *ServingCellConfigCommon* should match the parameters configured by MIB and SIB1 (if provided) in the corresponding serving cell.” Would the separate initial DL BWP under consideration with option 2 still satisfy the statement? |
| Intel |  | Can support Option 2 as working assumption.  However, some details need to be fixed as indicated below:   1. It is possible that the separate initial DL BWP does not include the entire CORESET #0 but already includes SSB, in such a case UE should NOT expect another NCD-SSB. A simple fix would be to just say “SSB” for the second sub-bullet under separate initial DL BWP. 2. Agree with MTK that just capturing “RRC-configured BWP” is not enough since we need to cover the case when a UE operates in connected mode in a separate initial DL BWP. This is different from non-RedCap UEs – for non-RedCap, the initial DL BWP always includes CORESET#0 and SSB. 3. Certainly, to enable use of NCD-SSB for serving cell msmts, etc., RAN2/4 efforts are likely needed, and they are anyway listed as secondary working groups. So, “additional efforts” should not be the reason to revert the WA. We suggest changing the criterion to “serious concerns from RAN2/RAN4”. 4. As commented before, the bullets on center frequency alignment in TDD are contradictory. Thus, if the aim is to avoid RF retuning for RedCap UEs, then the center frequency alignment should be defined for the UL BWP in which UE may transmit (which is, at least RACH for idle/inactive) and the DL BWP in which UE may receive (which is, Type 1 CSS for PDCCH and associated PDSCH for random access).   These four changes are suggested below (only relevant parts copied).   * + **Option 2:**     - **For a separate initial DL BWP (if it does not include the entire CORESET#0),**       * **If it is configured for random access only, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.**       * **If it is configured for paging, RedCap UE expects it to contain ~~NCD-~~SSB but not CORESET#0/SIB.**     - **For an ~~RRC-configured~~ active DL BWP in connected mode (if it does not include the entire CORESET#0),**       * **RedCap UE expects it to contain NCD-SSB [FFS: or CSI-RS] 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: FR2 case** * **Send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB.**   + **Prepare clear questions via email discussion until Monday 18th October.**   + **Indicate in the LS that a response is needed before RAN1#107-e.**   **The criteria for revisiting the working assumption are based on, e.g., if there are any serious concerns ~~additional efforts~~ from RAN2/4.**   * **For TDD, center frequencies are assumed to be the same for the initial ~~DL and~~ UL BWP~~s~~ in which the UE may transmit at least RACH and the initial DL BWP in which the UE is expected to receive PDCCH Type 1 CSS and associated PDSCH for random access.**   + **Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned for non-RedCap UEs.** |
| Ericsson | Y | We are fine with supporting Option 2 as WA.  Also, in our view, the fallback option can be Option 1, i.e., if RAN2/RAN4 indicates in the LS response that it is not feasible to use NCD-SSB (instead of CD-SSB), then Option 1 should be agreed by default. Otherwise, RAN1 may have to start the discussion from scratch, which may risk the timely completion of RedCap WI.  Regarding the following sub-bullet, we suggest changing “shall” to “can”. Also, consider changing “CORESET#0-defined initial DL BWP” to “bandwidth and location of the MIB-configured CORESET#0”.   * **However, if it contains the entire CORESET#0, the RedCap UE shall use the CORESET#0-defined initial DL BWP during initial access.** |
| Huawei, HiSi | Modification | We prefer to take Option 1 as WA while also send Option 2 in the LS, to see whether to confirm/revisit it upon RAN2/RAN4 decisions for safe, as we don’t know yet NCD-SSB is supported for targeted purpose or not. But can accept Option 2 as WA for the time being. For both cases, RAN1 should not just let it go in RAN2/RAN4 as leading group for the issue. It is encouraged for RAN1 to also evaluate the need to use NCD-SSB as replacement of CSI-RS and other existing alternatives, e.g. measurement gap, network restriction on DRX/Paging configuration. And, even if option 2 is confirmed next meeting, it should be clarified/confirmed further about whether a UE can expect CSI-RS as in the FFS part.  **The criteria for revisiting the working assumption are based on~~, e.g., if there are~~ whether RAN2/RAN4 confirm NCD-SSB for serving cell measurement is supported and have concern on supporting it based on required additional efforts ~~from RAN2/4~~ (if it is not yet supported).**  We think change NCD-SSB to general SSB may have problem as SSB without associated CORESET#0 is not defined as CD-SSB. So the case Intel mentioned may not apply.  We don’t think the additional changes from MTK is needed, as was discussed several rounds during GTW.  For TDD center frequency part that was not discussed via GTW, we suggest the following   * **For TDD, center frequencies are assumed to be the same for the separate initial DL (if it does not include the entire CORESET#0) and UL BWPs.** * **For TDD, center frequencies are not necessarily same for the initial DL (if it includes or is defined by the CORESET#0) and UL BWPs.** |
| Qualcomm | Y, with necessary clarifications for TDD operation and SI update of RedCap UE | Thanks for the hard work of FL as well as the efforts of all companies participating in the discussion.  Regarding RedCap UE’s operation in an SSB-less DL BWP, Qualcomm shares the same concerns as MediaTek, Apple, Spreadtrum, Vivo and other companies regarding the resultant increase in UE complexity and power consumption, as well as the non-trivial spec impacts in RAN1/2/4. Moreover, we believe the load imbalance, spectral efficiency loss and co-existence issues inherent to SSB-less DL BWP are not desirable for NW as well, especially for FR1 deployment of RedCap UE.  For the sake of progress, we can compromise and accept Option 2 in principle as the working assumption, considering NCD-SSB has been supported since NR R15 and the corresponding configurations/procedures have been specified in TS 38.213 and TS 38.300.  Although we can accept Option 2 in principle, it has not fully addressed the center frequency alignment of DL/UL BWP of RedCap UE in TDD operation. Therefore, we suggest to clarify the TDD operation for R17 RedCap UE as follows:   * *In TDD operation of a R17RedCap UE:*   + *same center frequencies are expected for its non-initial DL/UL BWP with the same BWP id*   + *center frequencies of its initial DL and UL BWPs can be the same or different*     - *if the center frequencies of its initial DL and UL BWPs are different,*       * *RedCap UE expects its initial DL BWP contains the entire CORESET#0 and CD-SSB*       * *RedCap UE expects dedicated/separate PRACH resources are configured in its initial DL BWP and early indication (of RedCap UE type) is enabled by SIB.*       * *Note: The motivation to enable early indication is to minimize the spec impacts and ensure the co-existence of RedCap and non-RedCap UE sharing the CORESET#0/ CD-SSB. As a result, sufficient DL/UL switching time for RedCap UE is accommodated, without compromising the timeline/performance of non-RedCap UE. This is also necessary for maintaining the R15/16 RACH procedure specified for non-RedCap UE, such as RAR window configuration, frequency hopping of msg3 within the initial UL BWP of non-RedCap UE and etc.*   Moreover, when the RedCap UE operates in a DL BWP which does not include the entire CORESET#0, it is unclear from Option 2 how the SI update for RedCap UE can be delivered. Therefore, we suggest to clarify the SI update of R17 RedCap UE as follows:   * *When there is SI update for a R17 RedCap UE and the RedCap UE is operating in a DL BWP which does not include the entire CORESET#0:*   + *the RedCap UE expects to receive dedicated RRC signaling or paging notification in the active DL BWP, if the RedCap UE is in RRC connected state*   + *the RedCap UE expects to receive paging notification in the initial DL BWP, if the RedCap UE is in RRC idle/inactive state and the initial DL BWP is configured with paging CSS*     - * *FFS: SI update for RRC idle/inactive RedCap UE operating in an initial DL BWP not configured with paging CSS*   + *Type-2 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported by RedCap UE in retrieving the modified SI transmitted within the BW of CORESET#0*   Finally, if RAN1 plans to have a default “fall-back” option for the working assumption in Option 2, we cannot agree with Option 1 as it is. The following revisions are needed for Option 1:  **Default Fall-back Option for Working Assumption Based on Option 2**   * For a separate initial DL BWP *(if it does not include 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 the entire CORESET#0),* RedCap UE does NOT expect it to contain SSB/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. * In TDD operation of a R17 RedCap UE:   + *same center frequencies are expected for its non-initial DL/UL BWP with the same BWP id*   + *center frequencies of its initial DL and UL BWPs can be the same or different*     - *if the center frequencies of its initial DL and UL BWPs are different,*       * *RedCap UE expects its initial DL BWP contains the entire CORESET#0 and CD-SSB*       * *RedCap UE expects dedicated/separate PRACH resources are configured in its initial DL BWP and early indication (of RedCap UE type) is enabled by SIB.*       * *Note: The motivation to enable early indication is to minimize the spec impacts and ensure the co-existence of RedCap and non-RedCap UE sharing the CORESET#0/ CD-SSB. As a result, sufficient DL/UL switching time for RedCap UE is accommodated, without compromising the timeline/performance of non-RedCap UE. This is also necessary for maintaining the R15/16 RACH procedure specified non-RedCap UE, such as RAR window configuration, frequency hopping of msg3 in the initial UL BWP of non-RedCap UE and etc.* * *When there is SI update for a R17 RedCap UE and the RedCap UE is operating in a DL BWP which does not include the entire CORESET#0:*   + *the RedCap UE expects to receive dedicated RRC signaling or paging notification in the active DL BWP, if the RedCap UE is in RRC connected state*   + *the RedCap UE expects to receive paging notification in the initial DL BWP, if the RedCap UE is in RRC idle/inactive state and the initial DL BWP is configured with paging CSS*     - * *FFS: SI update for RRC idle/inactive RedCap UE operating in an initial DL BWP not configured with paging CSS*   + *Type-2 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported by RedCap UE in retrieving the modified SI transmitted within the BW of CORESET#0* |
| NEC | Y | We are fine with option 2 as working assumption. |
| FL6 | Based on the received responses, the following proposal can be considered. Some suggestions in Qualcomm’s response are discussed separately in Questions 3.2-8 and 3.2-9.  **High Priority Proposal 3.2-5d:**  **Take Option 2 as working assumption, which will be revisited based on the reply from RAN2/4.**   * **For FR1, select one of the 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 only, 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 but not CORESET#0/SIB.**     - **For an RRC-configured active DL BWP (if it does not include CD-SSB and the entire CORESET#0),**       * **RedCap UE expects it to contain NCD-SSB [FFS: or CSI-RS] 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 conditions for SSB monitoring periodicity (i.e., SMTC configuration) and DRX cycle**   + **FFS: How SI update notifications and/or SI updates are signaled to RedCap UEs**   + **FFS: FR2 case** * **Send an LS to RAN2 and RAN4 to ask about the feasibility of using NCD-SSB instead of CD-SSB 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.**   + **~~Prepare clear questions via email discussion until Monday 18~~~~th~~ ~~October~~**   + **Draft the LS until Tuesday 19th October.**   + **Indicate in the LS that a response is needed before RAN1#107-e.**   **The criteria for revisiting the working assumption are based on, e.g., ~~if there are~~ whether the potential required additional efforts from RAN2/4 can be finished within Rel-17.**   * **For TDD, center frequencies are assumed to be the same for the initial DL and UL BWPs used during random access for RedCap UEs.**   + **~~Note: MIB-configured CORESET#0 and initial UL BWP do not need to be aligned.~~**   + **FFS: For Option 1 and Option 2, whether the case that the center frequencies are different is also supported, and whether RedCap UE can expect SSB and CORESET#0 in this case** * **If a separate SIB-configured initial DL BWP for RedCap UEs is configured,**   + **It contains at least one CORESET~~/~~ and at least one CSS.**   + **It can be used both during and after initial access.**     - **However, if it contains the entire CORESET#0, the RedCap UE shall use the bandwidth and location of the CORESET#0-defined initial DL BWP during initial access.** | |
| vivo |  | We are generally fine with the direction but still have some questions and comments as below.   1. It is not very clear what is the issue to be studied for the following FFS, some clarification would be needed    * **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.** 2. We doubt if the following FFS is still valid, as in Option 2 the UE behavior regarding SSB seems to be defined clearly already, there is no need to further discuss this.    * **FFS: For Option 1 and Option 2, whether RedCap UE can/cannot expect SSB under certain conditions for SSB monitoring periodicity (i.e., SMTC configuration) and DRX cycle** 3. The criteria for revisiting the working assumption does not need to be explicitly captured, the working assumption can be confirmed/reverted based on consensus and RAN2/4 input will definitely be taken into account. This is business as usual, there is not need to define any additional criteria. But it we have to define such criteria specifically for this case, we prefer the version proposed by Intel, as below  * **The criteria for revisiting the working assumption are based on, e.g., if there are any serious concerns ~~additional efforts~~ from RAN2/4.**  1. Suggest to change SSB to CD-SSB in the following FFS bullet, it is our understanding the intention to separate the RedCap UE DL and UL center frequency during initial access is to share the initial DL BWP with non-RedCap UEs as much as possible.    * **FFS: For Option 1 and Option 2, whether the case that the center frequencies are different is also supported,and whether RedCap UE can expect CD-SSB and CORESET#0 in this case** |
| Spreadtrum | Y | Prefer Option 2.  As a suggestion, “**RRC-configured active DL BWP**” could be “UE-specific RRC configured DL BWP” as used in FG 6-1. |
| CATT | Y | OK with the proposal and to have additional discussion in other sections. |
| Lenovo, Motorola Mobility |  | We are fine to have option 2 as the working assumption and wait for RAN2/RAN4 responses.  For center frequency alignment for TDD, we prefer to allow different center frequency for the initial DL and UL BWPs used during random access. This corresponds to the case when e.g., RA-SS is not configured in the separate initial DL BWP, then MIB-configured CORESET#0 (not center frequency aligned with the separate initial UL BWP) is used for random access. This is in high level similar with legacy where initial DL BWP is configured but is not used during initial access. |
| DOCOMO |  | We are fine with the updated proposal and to take Option 2 as working assumption. |
| CMCC |  | We are fine to take Option 2 as WA, and the fallback option can be Option 1.  We are fine with the TDD alignment part, with FFS, network can have the flexibility to configure whether center frequencies are aligned or not. The wording "initial UL/DL BWP" still needs clarify. In our understanding, "initial UL/DL BWP" in main bullet means separate initial UL/DL BWP, "initial DL BWP" in sub-bullet refers to both separate initial DL BWP and initial DL BWP defined by CORESET0. |
| NEC | OK | **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.**  Same question as vivo for this FFS point. |
| Sharp |  | We are OK to take Option 2 as working assumption. |
| Samsung |  | Several comments:  1. Suggest to add the following:   * **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 (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] but not CORESET#0/SIB.**   2. We don’t support add FFS for SI updates. It has been discussed several around that existing NR already provide several methods to resolve SI update issue.   * + **~~FFS: How SI update notifications and/or SI updates are signaled to RedCap UEs~~**   2. Propose following modifications, to delete “the feasibility of”. We assume what to ask can be agreed together as in other proposals.   1. **Send an LS to RAN2 and RAN4 to ask about ~~the~~ ~~feasibility of~~ using NCD-SSB instead of CD-SSB 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.**   3. The criteria:  **The criteria for revisiting the working assumption are based on, e.g., performance, coexistences with legacy UEs, and whether the potential required additional efforts from RAN2/4 can be finished within Rel-17.** |

**FL4/FL5 High Priority Question 3.2-6: Companies are invited to formulate clear questions from RAN1 to RAN2 and RAN4, respectively, for inclusion in the LS proposed in Proposal 3.2-5b.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| DOCOMO | Considering the aspects mentioned above, we should ask the feasibility of using NCD-SSB as an alternative to CD-SSB for RedCap UEs in Rel-17 for the following points respectively:   * [RAN2/4] Whether it is feasible to use NCD-SSB for serving cell measurement, QCL source, cell selection/reselection in RRC\_IDLE, RLM, BFD and link recovery. * [RAN2/4] Whether CSI-RS can be used as an alternative to CD-SSB. * [RAN2] Whether the PCIs of CD-SSB and NCD-SSB need not be the same. * [RAN2/4] Whether the NCD-SSB period can be larger than the CD-SSB period.   In addition to the above, assumption on the RF retuning time should be asked to RAN4. | |
| CATT | The following shall be considered:   * The difference of signal transmission between CD-SSB and NCD-SSB (e.g. power boosting). * The difference of measurement of CD-SSB and NCD-SSB. * The difference of measurement of CSI-RS and NCD-SSB. * Any limitation on the configuration of NCD-SSB (e.g. number, raster, …)   And also a general question on whether using NCD-SSB instead of CD-SSB for idle/inactive/connected mode is feasible. | |
| ZTE, Sanechips | All the mentioned aspects regarding the feasibility of using NCD-SSB shall be checked, e.g., RO selection, serving cell measurements, QCL source, cell selection/reselection, radio link monitoring, and link recovery, for RedCap UEs in Rel-17, and whether the NCD-SSB period can be larger than the CD-SSB period. | |
| CMCC | The following can be considered:   * Whether it is feasible to use NCD-SSB for serving cell measurement, QCL source in idle and connected mode. * Whether CSI-RS can be used as an alternative to CD-SSB for serving cell measurement. * Any limitation on the configuration of NCD-SSB. * Whether the NCD-SSB period can be larger than the CD-SSB period. * Whether RO selection can be based on NCD-SSB. | |
| OPPO | [RAN2] Whether it is feasible to use NCD-SSB for serving cell measurement?  Whether the PCIs of CD-SSB and NCD-SSB need to be the same or can be configured?  [RAN4] the SS raster for the NCD-SSB | |
| Samsung | The following question can be considered:   * **Feasibility** (RAN 2/4): as listed by DoCoMo and ZTE * **Co-existence** (RAN 2): Whether there is co- coexistences issue with legacy UEs, including the configuration restriction * **Performance** (RAN 2/4): whether there is performance impact, due to, e.g., larger periodicity of SSBs, the limitation power boosting limitation for the transmission of multiple SSBs for serving cell. | |
| MediaTek | * What is the required periodicity for NCD-SSB to enable RLM/RRM/synchronization. * Feasibility of using NCD-SSB for mobility measurement. | |
| Intel | We think the questions from DCM are sufficient.  Coexistence and performance aspects would naturally be part of the “feasibility consideration” if these concerns would be serious.  We certainly do not need to ask about performance impact to RAN4 when expecting them to respond within less than a WG meeting cycle. We do not think it is necessary or even reasonable to expect RAN4 to provide any meaningful responses on performance impact beyond what we already can estimate from the questions themselves and RAN1 expertise. | |
| Ericsson | The comments from DOCOMO/CATT/ZTE/CMCC/Samsung capture most of the relevant questions. In addition, SSB-based Beam Level Mobility (cf. Clause 9.2.3, TS 38.300) may also be added to the list. | |
| Huawei, HiSi | Agree with most of the above. | |
| Qualcomm | We think the working assumption based on revised Option 2 of 3.2.5-c should be included in the LS to RAN2/4. In addition, we think the following introduction and questions can be included in the LS sent to RAN2 and RAN4:  *To support BW reduction and power saving of R17 RedCap UE, RAN1 has studied the transmission of NCD-SSB in the RedCap-specific DL BWP without CD-SSB. In FR1, the overhead of NCD-SSB has been evaluated for NR TDD bands, assuming channel BW is in the range of 40 to 100 MHz, SSB periodicity is in the range of 20 to 160 ms, and max number of SSB beams(4 or 8) are transmitted per SSB burst (more details can be found in FL summary R1-2110377 and the references therein).*  *If NCD-SSB is transmitted in FR1 within the initial/non-initial DL BWP of R17 RedCap UE, the following assumptions are made by RAN1 for SSB transmission and measurements of RedCap UE:*   1. *CD-SSB specified in NR R15 is transmitted on the serving cell of RedCap UE, which is used by RedCap UE and co-existing non-RedCap UE for cell search and SI acquisition;* 2. *NCD-SSB (TS 38.300, TS 38.213) is transmitted in the initial/non-initial DL BWP of RedCap UE without CD-SSB, wherein:* 3. *the serving cell of RedCap UE has channel BW of 40 MHz or larger;* 4. *the periodicity of NCD-SSB is 20 ms or longer;* 5. *the block indexes of NCD-SSB are the same as those of CD-SSB, which are provided by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon;* 6. *the NCD-SSB is QCL’ed with the CD-SSB with the same block index;* 7. *the placement (e.g. with respect to that of CD-SSB), TX power (if different from that of CD-SSB) and periodicity of NCD-SSB are explicitly signaled to RedCap UE and co-existing non-RedCap UE;* 8. *when the RedCap UE operates in the initial/non-initial DL BWP without CD-SSB, the NCD-SSB is used by RedCap UE for serving cell measurements of RRM/RLM, BFD, link recovery, time/frequency tracking and AGC.*   *RAN1 respectfully requests RAN2 and RAN4 to provide feedback on the assumptions above for NCD-SSB transmission in FR1 and the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures of a R17 RedCap UE. Specifically, RAN1 would like RAN2/ RAN4 to respond to the following questions before RAN1#107e meeting:*   1. *whether it is feasible to use NCD-SSB for serving cell measurements of RRM/RLM ,BFD, link recovery, time/frequency tracking and AGC* 2. *whether it is feasible to use NCD-SSB as QCL source of other DL channels transmitted in the initial/non-initial DL BWP* *of RedCap UE* 3. *whether/when the PCIs indicated by the NCD-SSB and CD-SSB can be the same, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE* 4. *if periodicities and/or TX power of NCD-SSB are different from those of CD-SSB, whether there are any performance impacts and how to mitigate the negative impacts if any* 5. *whether it is necessary to introduce configuration limitations for NCD-SSB* 6. *if neither NCD-SSB nor CD-SSB is transmitted in the initial/non-initial DL BWP of RedCap UE, whether it is feasible for transmit periodic CSI-RS as an alternative of SSB in the initial/non-initial BWP of RedCap UE and what are the potential impacts on NW (signaling support, overhead of CSI-RS and supplementary RS needed as alternatives of SSB, configuration limitations) and UE (complexity, performance)*   *Furthermore, RAN1 would like RAN4 to confirm the following BWP switch delay for a R17 RedCap UE, when the BWP switching of RedCap UE is triggered by a DCI or a timer configured by higher layer:*   1. *Type-2 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported as a mandatory capability of R17 RedCap UE* 2. *Type-1 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported as an optional capability of R17 RedCap UE* | |
| NEC | We are fine with proposals above. It would be good to ask RAN4 whether a NCD-SSB should be on a synch raster in the LS. Place a NCD-SSB on a synch raster would increase cell search effort of all type of UEs. | |
| FL6 | Based on the received responses, the following proposal can be considered, which is based on the text proposal in Qualcomm’s response and modified to take the responses received from other companies into account as well. Some other suggestions in Qualcomm’s response are discussed separately in Questions 3.2-10 and 3.2-11.  **High Priority Question 3.2-6a: Companies are invited to provide their views on the following LS text proposal and indicate whether they support including the text proposal in the LS to RAN2/RAN4 or not.**   |  | | --- | | *RAN1 respectfully requests RAN2 and RAN4 to provide feedback on the assumptions above for NCD-SSB transmission in FR1 and the feasibility of using NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures of a R17 RedCap UE. Specifically, RAN1 would like RAN2/ RAN4 to respond to the following questions before RAN1#107e meeting:*   1. *[RAN2/4] whether it is feasible to use NCD-SSB for serving and non-serving cell measurements for 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 transmitted in idle and 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, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE* 4. *whether/when periodicities and/or TX power of NCD-SSB can be 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), e.g., to ensure coexistence with legacy UEs* 6. *[RAN2/4] if neither NCD-SSB nor CD-SSB is transmitted in the initial/non-initial DL BWP of RedCap UE, whether it is feasible to transmit periodic CSI-RS as an alternative of SSB in the initial/non-initial BWP of RedCap UE* | | |
| vivo |  | We suppose the WA on Option 2 will also be included in the LS so that RAN2/4 can better understand the context of these questions. We think it would be better to additionally include some other background information (e.g. previous agreement on separate initial DL BWP), this could be nice to have, companies can also communicate internally if it would cause a lot of discussion to decide which agreement to include/not include.  It would be good to clarify the question 1) above is for both IDLE and CONNECTED modes.  We are not sure question 6) should be asked at current stage, using CSI-RS is not an agreement or working assumption yet, just an FFS under option 2. We suggest to focus on CD-SSB issues at current stage as those are required for RAN1 to determine the confirmation of WA on option 2. If question 6) is preferred by majority of companies we could keep it but we should also explicitly clarify that CSI-RS is an alternative solution to NCD-SSB proposed by companies, but has not been agreed in RAN1. |
| CATT | Y | Agree above all.  Seems the ‘[RAN2/4]’ is missing in (4).  Regarding to (6), we think it can be included, since this seems the last chance to ask RAN2/4 about the CSI-RS. Otherwise, it seems we can only count on RF retuning/very restrictive configuration on separate initial DL BWP. |
| Lenovo, Motorola Mobility | Y |  |
| DOCOMO | Y |  |
| CMCC | Y |  |
| Sharp | Y |  |
| Samsung |  | We suggest the following changes:  *RAN1 respectfully requests RAN2 and RAN4 to provide feedback on the assumptions above for NCD-SSB transmission in FR1 and the ~~feasibility of~~ use~~ing~~ of NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures of a R17 RedCap UE. Specifically, RAN1 would like RAN2/ RAN4 to respond to the following questions before RAN1#107e meeting:*   1. *[RAN2/4] whether it is feasible to use NCD-SSB for serving and non-serving cell measurements for 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 transmitted in idle and 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, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE* 4. *[RAN 4]whether/when periodicities and/or TX power of NCD-SSB can be different from those of CD-SSB, if both NCD-SSB and CD-SSB are transmitted on the serving cell of RedCap UE, and the potential performance impact of using NCD-SSB instead of CD-SSB?* 5. *[RAN2/4] whether it is necessary to introduce configuration limitations for NCD-SSB (e.g., regarding frequency locations), e.g., to ensure coexistence with legacy UEs* 6. *[RAN2/4] if neither NCD-SSB nor CD-SSB is transmitted in the initial/non-initial DL BWP of RedCap UE, whether it is feasible to transmit periodic CSI-RS as an alternative of SSB in the initial/non-initial BWP of RedCap UE* 7. *[RAN2/4] Whether/ when there is co-coexistences issue with non-RedCap UEs, including the configuration restriction?* 8. *[RAN 2/4] any other potential impacts identified by RAN2/4 on support NCD-SSB for measurement?* |

**FL4/FL5 High Priority Question 3.2-7: What are the RAN1 impacts from supporting the use of NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| DOCOMO | If it is found feasible to use NCD-SSB for QCL source, RLM, BFD and link recovery, it should be clarified in RAN1 spec whether CD-SSB or NCD-SSB is used for those purposes. | |
| CATT | The following shall be considered:   * All the parts related to *ssb-PositionsInBurst* may need to be adjusted (e.g. RACH resource mapping, TDD collision handling). * The description ion *kSSB* of a NCD-SSB, if the frequency location is free without restriction. * PRS description on the serving cell determination | |
| ZTE, Sanechips | 1. Mapping relation between NCD-SSB and ROs 2. Overlapping issue for NCD-SSB and other DL physic channels 3. Collision handling rule for HD-FDD UE between NCD-SSB and UL. | |
| CMCC | 1) The configuration of NCD-SSB, e.g. the period, number  2) whether NCD-SSB is used for serving cell measurement, QCL source in idle and connected mode.  3) HD-FDD collision handling between NCD-SSB and UL   1. Mapping between NCD-SSB and RO | |
| Samsung | Not limited to:   1. QCL related 2. RO mapping considering the gNB implementation restriction. 3. Rate matching of NCD-SSB 4. Collision handling for HD-FDD 5. Backward compatibility, e.g., rate matching over NCD-SSB for non-RedCap UE. | |
| Intel | Mostly related to specifying support of NCD-SSB and its configuration. We do not think any new mechanisms/solutions for coexistence/rate-matching are necessary – they should simply follow those defined today for the most part. Further details would depend on RAN4 feedback. | |
| Ericsson | The comments from DOCOMO/CATT/ZTE/CMCC/Samsung capture most of the relevant impacts. In addition, SSB-based Beam Level Mobility (cf. Clause 9.2.3, TS 38.300) may also be added to the list.  Our view is that RAN1 should try to sort out these issues until RAN1#107-e. If the spec impacts are manageable and would not risk timely completion of the RedCap WI, we are fine with supporting the use of NCD-SSB, i.e., Option 2 in P3.2-5c. Otherwise, RAN1 should agree to Option 1. | |
| Huawei, HiSi | Agree with DOCOMO/CATT/ZTE/CMCC/Samsung. | |
| Qualcomm | We think the RAN1 impacts to support NCD-SSB are minor/manageable, because:   * NCD-SSB was introduced in NR R15 * Based on NR R15/16 spec, NCD-SSB and CD-SSB can be transmitted on the same cell * By default, NCD-SSB can re-use the *ssb-PositionsInBurst* indication for CD-SSB in SIB1. As a result, UE expects the NCD-SSB is QCL’ed with the CD-SSB with the same SSB block index * In addition to the FD placement on/off the NR sync raster (TS 38.104), NCD-SSB can be differentiated from CD-SSB by the k\_SSB value indicated in MIB (TS 38.213) * In NR R15/16, serving cell RRM/RLM/LR measurement requirements have been specified for CSI-RS, which can be transmitted outside the initial DL BWP of non-RedCap UE * When a NR R15/16/17 non-RedCap UE operates on FDD bands, it expects to support FD-FDD and does not need to handle the directional collision between NCD-SSB and UL * For a R17 HD-FDD RedCap UE operating on FDD band, no more than one SSB is transmitted within its initial or non-initial DL BWP. Therefore, a HD-FDD RedCap UE is not expected to handle directional collision of CD-SSB vs UL and NCD-SSB vs UL simultaneously. Furthermore, most FDD bands have BW less than 40 MHz, which does not require the transmission of NCD-SSB for RedCap UE. | |
| FL6 | **Medium Priority Proposal 3.2-7a:**   * **FFS: How to support (in RAN1 specifications) the use of NCD-SSB instead of CD-SSB for idle/inactive/connected mode procedures for a Rel-17 RedCap UE operating with an initial or non-initial DL BWP not containing CD-SSB** | |
| vivo | Y | We agree with several comments above that the RAN1 spec impact to support NCB-SSB are mostly minor and existing solutions for CD-SSB can be largely reused. |
| Spreadtrum | Y | We share the similar view as QC and vivo that the RAN1 impact is minor. |
| CATT | Y | Assuming that RAN2/4 confirms replacing CD-SSB with NCD-SSB is feasible. |
| DOCOMO | Y | It can be discussed depending on the LS reply from RAN2/4. |
| Sharp | Y |  |
| Samsung |  | If we can agree on WA for Opt 2. We should study the spec impact to support NCD-SSB.  We don’t think the impact on RAN 1 is minor. |

The questions below were triggered by Qualcomm’s responses to Proposal 3.2-5c and Question 3.2-6.

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FL6 | **High Priority Question 3.2-8: Companies are invited to provide their views on the following proposal suggested in Qualcomm’s response to Proposal 3.2-5c and indicate whether they support the proposal or not.**   * *In TDD operation of a R17RedCap UE:*   + *same center frequencies are expected for its non-initial DL/UL BWP with the same BWP id*   + *center frequencies of its initial DL and UL BWPs can be the same or different*     - *if the center frequencies of its initial DL and UL BWPs are different,*       * *RedCap UE expects its initial DL BWP contains the entire CORESET#0 and CD-SSB*       * *RedCap UE expects dedicated/separate PRACH resources are configured in its initial DL BWP and early indication (of RedCap UE type) is enabled by SIB.*       * *Note: The motivation to enable early indication is to minimize the spec impacts and ensure the co-existence of RedCap and non-RedCap UE sharing the CORESET#0/CD-SSB. As a result, sufficient DL/UL switching time for RedCap UE is accommodated without compromising the timeline/performance of non-RedCap UE. This is also necessary for maintaining the R15/16 RACH procedure specified for non-RedCap UE, such as RAR window configuration, frequency hopping of msg3 within the initial UL BWP of non-RedCap UE and etc.* | |
| vivo |  | We agree with the first sub-bullet “*same center frequencies are expected for its non-initial DL/UL BWP with the same BWP id* ”  We understand the 2nd sub-bullet “*center frequencies of its initial DL and UL BWPs can be the same or different*” is related to the newly added FFS bullet in **High Priority Proposal 3.2-5d** “**FFS: For Option 1 and Option 2, whether the case that the center frequencies are different is also supported, and whether RedCap UE can expect SSB and CORESET#0 in this case**”. We think it can be further discussion, however, we do not think early indication should be mandated if the center frequency is different between initial DL BWP and initial UL BWP for RedCap UEs. NW can perform conservative scheduling to allow sufficient switching time for RedCap UEs, if the cost for PRACH partitioning would be considered as too high in some use cases. |
| CATT | Y and N | Y with the 1st bullet. But  (1) For the 2nd sub-bullet ‘*RedCap UE expects dedicated/separate PRACH resources are configured in its initial DL BWP and early indication (of RedCap UE type) is enabled by SIB.’,* does it intended to say ‘*initial UL BWP*’?  (2) Although this is a workable scenario, we doubt there is a need to enforce gNB to configure dedicated PRACH resource in this case. If shared PRACH resource is applied and RF retuning is needed for RedCap UE, the gNB should be able to properly handle the timing of Msg2 DCI. Conservative scheduling (as also mentioned by vivo and other companies) can also be applied to Msg3 scheduling, and early indication in Msg3 for RedCap is still possible (some examples can be found in R1-2109233). No additional spec impact is expected.  In real deployment, it is practical to consider there is naturally a non-zero gap (several symbols or even slot) between Msg1 transmission and Msg2 DCI reception. A gNB has to receive and detect the PRACH preamble(s) using coherent detection. After that, the gNB has to determine whether it is CBRA or CFRA, whether and how TC-RNTI is allocated, how to generate Msg2 DCI and find a reasonable PDCCH monitoring occasion in the CSS to carry… these need some effort (and subsequently, time) in gNB implementation. |
| Lenovo, Motorola Mobility |  | We agree with the 1st bullet. The 2nd bullet has overlap with 3.2-5d. We are open to discuss if early identification is mandatory when the center frequencies of its initial DL and UL BWPs are different (if supported). |
| DOCOMO | Y | One editorial comment:  *dedicated/separate PRACH resources are configured in its initial UL~~DL~~ BWP* |
| CMCC |  | Y with the 1st bullet, the 2nd sub-bullet needs further discussion, RO may be shared between RedCap and non-RedCap. |
| NEC |  | Agree with the first sub-bullet.  We don’t fully understand why explicit early indication is mandated in case dedicated/separate PRACH resources are configured in the second sub-bullet.  In case initial UL and DL BWP are used in CONNECTED in TDD, center frequencies of initial UL and DL BWP cannot be different. |
| Samsung |  | We agree with the first bullet, but don’t agree with the second one. We think the second one will lead to duplicated feature of option 1 or 2. |

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FL6 | **High Priority Question 3.2-9: Companies are invited to provide their views on the following proposal suggested in Qualcomm’s response to Proposal 3.2-5c and indicate whether they support the proposal or not.**   * *When there is SI update for a R17 RedCap UE and the RedCap UE is operating in a DL BWP which does not include the entire CORESET#0:*   + *the RedCap UE expects to receive dedicated RRC signaling or paging notification in the active DL BWP, if the RedCap UE is in RRC connected state*   + *the RedCap UE expects to receive paging notification in the initial DL BWP, if the RedCap UE is in RRC idle/inactive state and the initial DL BWP is configured with paging CSS*     - * *FFS: SI update for RRC idle/inactive RedCap UE operating in an initial DL BWP not configured with paging CSS*   + *Type-2 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported by RedCap UE in retrieving the modified SI transmitted within the BW of CORESET#0* | |
| vivo |  | We support the proposal above. |
| Spreadtrum | Y |  |
| CATT | Y in general | OK with most of the proposal. Not sure we need the last sub-bullet here. It seems natural if a RedCap UE supports Type-1 BWP switching delay, it can still use Type-1 BWP switching delay for retrieving the modified SI.  Moreover, since SI is periodic, it seems not a big issue even if an updated SI is missing due to switching delay. The RedCap UE can monitor the updated SI in the next round periodicity. |
| Lenovo, Motorola Mobility | Y |  |
| DOCOMO |  | For the RedCap UE in RRC idle/inactive state, paging should be received in the BWP which contains SSB. If NCD-SSB is configured, BWP for paging reception can be different depending on which of CD-SSB or NCD-SSB is associated with paging reception. Thus, for the 2nd sub-bullet, if SSB which associates with paging reception is configured for non-initial BWP, we think a UE would not receive paging notification in the initial DL BWP but receive it in non-initial DL BWP. |
| CMCC | Y |  |
| Samsung |  | More study is needed, assuming one of option can be agreed as WA, and we should assume current spec as default and only focus on the necessary change. |

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FL6 | **High Priority Question 3.2-10: Companies are invited to provide their views on the following LS text proposal suggested in Qualcomm’s response to Question 3.2-6 and indicate whether they support including the text proposal in the LS to RAN2/RAN4 or not.**   * *If NCD-SSB is transmitted in FR1 within the initial/non-initial DL BWP of R17 RedCap UE, the following assumptions are made by RAN1 for SSB transmission and measurements of RedCap UE:*  1. *CD-SSB specified in NR R15 is transmitted on the serving cell of RedCap UE, which is used by RedCap UE and co-existing non-RedCap UE for cell search and SI acquisition* 2. *NCD-SSB (TS 38.300, TS 38.213) is transmitted in the initial/non-initial DL BWP of RedCap UE without CD-SSB, wherein:* 3. *the serving cell of RedCap UE has channel BW of 40 MHz or larger* 4. *the periodicity of NCD-SSB is 20 ms or longer* 5. *the block indexes of NCD-SSB are the same as those of CD-SSB, which are provided by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon* 6. *the NCD-SSB is QCL’ed with the CD-SSB with the same block index* 7. *the placement (e.g., with respect to that of CD-SSB), TX power (if different from that of CD-SSB) and periodicity of NCD-SSB are explicitly signaled to RedCap UE and co-existing non-RedCap UE* 8. *when the RedCap UE operates in the initial/non-initial DL BWP without CD-SSB, the NCD-SSB is used by RedCap UE for serving cell measurements of RRM/RLM, BFD, link recovery, time/frequency tracking and AGC.* | |
| vivo |  | We think the proposal above is technically reasonable, but if the plan to agree all of them in this meeting, or just considered as an issue list to be addressed in next meeting? |
| Spreadtrum | Y |  |
| CATT | Y | Fine with these assumptions.  Just another question, if it is agreed, will such assumptions change to specification? E.g. mandating the periodicity of NCD-SSB as ‘>= 20 ms’. |
| Lenovo, Motorola Mobility | Y |  |
| DOCOMO | Y |  |
| CMCC | Y |  |
| Sharp | Y |  |
| Samsung | N | This can be further discussed in next meeting. Some of the proposal might need RAN2/4 input. We think we need to wait for their reply LS instead. E.g., tx power assumption. |

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FL6 | **High Priority Question 3.2-11: Companies are invited to provide their views on the following LS text proposal suggested in Qualcomm’s response to Question 3.2-6 and indicate whether they support including the text proposal in the LS to RAN2/RAN4 or not.**   * *Furthermore, RAN1 would like RAN4 to confirm the following BWP switch delay for a R17 RedCap UE, when the BWP switching of RedCap UE is triggered by a DCI or a timer configured by higher layer:*   + *Type-2 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported as a mandatory capability of R17 RedCap UE*   + *Type-1 BWP switch delay specified in Table 8.6.2-1 of TS 38.133 is supported as an optional capability of R17 RedCap UE* | |
| vivo |  | We support to include the above information to the LS to RAN4. |
| Spreadtrum | Y |  |
| CATT |  | Currently, regarding to *bwp-SwitchingDelay*, it is ‘Mandatory to support either type 1 or type 2 with capability signalling’. Is there any issue to keep the same definition for RedCap UE? |
| DOCOMO | Y |  |
| CMCC | Y |  |
| Sharp | Y |  |
| Samsung |  | Similar question as CATT |

## Non-initial DL BWP operation

RAN1#105-e made the following agreement related to non-initial BWP operation:

|  |
| --- |
| Agreements: Take the following as an agreement, revised from the RAN1#104bis-e working assumption:   * A RedCap UE cannot be configured with a non-initial (DL or UL) BWP (i.e., a BWP with a non-zero index) wider than the maximum bandwidth of the RedCap UE.   + At least for FR1, FG 6-1 (“Basic BWP operation with restriction” as described in TR 38.822) is used as a starting point for the mandatory RedCap UE type capability.     - This does not preclude support of FG 6-1a (“BWP operation without restriction on BW of BWP(s)” as described in TR 38.822) as a UE capability for RedCap UEs. |

Several contributions provide their views on non-initial BWP operation and in particular FG 6-1a “BWP operation without restriction on BW of BWPs”. In some of the contributions, it is proposed to make FG 6-1a mandatory for RedCap [4, 6, 10, 11, 12, 14, 27]. As discussed in these contributions, FG 6-1a is beneficial in three aspects: 1) for multiplexing of SSB/CORESET#0 that are beyond the UE maximum bandwidth, 2) to be able to place the UL BWP at the band edge in TDD where CORESET#0 may not be present, and 3) to reduce the overhead of requiring BWP to contain SSB.

In some other contributions, it is proposed to have FG 6-1a as an optional feature for RedCap [24, 28, 29, 30]. Meanwhile, a few contributions propose to have new or modified FGs for RedCap [6, 7, 18, 26].

* [6]: The RedCap UE should support FG 6-1a or at least its special case where an RRC-configured DL BWP contains SSB but not CORESET #0.
* [7]: Define new capabilities like FG 6-1/6-1a/6-2/6-3/6-4 to consider SSB and CORESET of CSS presence in the UE-specific DL BWP.
* [18]: FGs #6-1 and 6-1a (at least FGs #6-1) should be adapted for RedCap UEs such that RedCap UEs mandatorily support operation in active DL BWPs that may not necessarily include CORESET #0.
* [26]: Introducing a new UE feature for Redcap to indicate whether it supports an active BWP configured with UE-specific search space (USS) without SSB, denoting as Feature-X
  + A UE not supporting Feature-X expects SSB transmission in the active DL BWP configured with USS.
* [28]: If RedCap UE supports FG 6-1a and operates in a RRC-configured DL BWP without SSB, it expects to receive:
  + periodic TRS for time/frequency tracking
  + dedicated RRC signalling for SI update
  + dedicated BFR-CSIRS-RACH resource, if BFR-CSI-RS is configured in the active BWP
* [28]: If RedCap UE supports FG 6-1a and operates in an active DL BWP with SSB but without CORESET#0 (or CSS for RMSI/OSI), it expects to receive:
  + periodic TRS for time/frequency tracking
  + CORESET/CSS for paging, or dedicated RRC signalling for SI update if paging CSS is not configured
  + dedicated BFR-CSIRS-RACH resource, if BFR-CSI-RS is configured in the active BWP
* [32]: Non-initial DL BWP can be configured for RedCap UEs in a location which does not contain CD-SSB and MIB-configured CORESET#0.

**FL1 High Priority Question 3.3-1: Should RedCap UEs support FG 6-1a as a mandatory feature? If yes, if some additional features or signaling need to be supported to facilitate this, please elaborate in the Comments field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | N | Supporting FG 6-1a as mandatory feature is against the principle of UE complexity reduction for R17 RedCap WI |
| vivo | N | “supporting operation without SSB transmission in the RRC-configured active DL BWP” shall be optional for RedCap UEs. |
| OPPO | N | Supporting FG 6-1a as mandatory feature is against the principle of UE complexity reduction for R17 RedCap WI. |
| Nordic | N |  |
| Huawei, HiSilicon | Y | There is no evident analysis why FG6-1a increases UE cost. There could be minor impact on UE power consumption however given the analysis in [R1-2109752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109752.zip) we think that is negligible. Even with that, towards a balance we can compromise as proposed in Proposal 3.2-3.  Preferably, the existing FG 6-1a can be mandatory for RedCap, or can be modified to address some concerns for mandating it, e.g.   * Adding CSI-RS for UE to expect, if a UE does not support BWP without SSB only, or * Adding network configuration restriction in order to not mandating UE to retune too frequent, if companies can accept FG 6-1a as mandatory together with this restriction |
| ZTE, Sanechips | Y | The separate initial DL BWP becomes UE-specific RRC configured under BWP#0 configuration option 2. In this case, if separate initial DL BWP without SSB or CORESET0 is configured, the RRC configured BWP without SSB or CORESET0 is also supported.  Specifically, for traffic offloading and TDD center frequency alignment purposes, both the separate initial DL BWP and other UE-specific RRC configured non-initial BWPs do not necessarily contain CORESET#0. Furthermore, mandatory FG 6-1a allows frequency-domain locations of UE-specific RRC configured BWPs not to be restricted by SSB/CORESET#0, which helps to mitigate the PUSCH resource fragmentation problem.  Therefore, we believe that RedCap UEs should support FG 6-1a as a mandatory feature if separate initial DL BWP without SSB can be configured. Consequently, FG 6-1 is not needed. |
| Xiaomi | N |  |
| Panasonic | Y |  |
| Lenovo, Motorola Mobility | Y | We can accept FG6-1a is mandatory for RedCap UEs, since a separate initial DL BWP (if configured in cell edge) might not contain MIB-configured CORESET#0 already. |
| Spreadtrum | N |  |
| CATT | Y | A modified FG 6-1a can be used, in which the RedCap UE shall be able to operate in an active initial DL BWP without SSB only (removing CORESET#0) |
| Nokia, NSB | Y |  |
| Ericsson | See comment | The RedCap UE should support FG 6-1a or at least its special case where an RRC-configured DL BWP contains SSB but not CORESET #0. |
| Intel | See comment | As mentioned in the response to the previous Question (**Proposal 3.2-3**), RedCap UE should at least mandatorily support operation wherein active DL BWP has SSB but does NOT include CORESET #0. |
| China Telecom | Y | In our understanding, RedCap UEs can support FG 6-1a as a mandatory feature. Some RedCap-specific revisions on FG 6-1a can be made to clarify the details on the separate BWP configured/defined for RedCap UEs. |
| DOCOMO |  | This question can be discussed after some progress is made in **Proposal 3.2-3** |
| FUTUREWEI | Y |  |
| CMCC | Y | Since the active BWP may not contain CORESET#0, FG6-1 does not hold.  Or a new FG that UE expect CSI-RS or NCD-SSB configurable by gNB. |
| LGE | N | Same comment with QC and vivo. |
| Apple | N |  |
| Samsung | Y | But we can be open to some other compromise proposal, e.g., if either SSB or CSI-RS. |
| MediaTek | N |  |
| FL2 | See Proposal 3.2-4. | |

**FL1 High Priority Question 3.3-2: Should any new or modified FG be defined for RedCap BWP operation (e.g., RRC-configured DL BWP contains an SSB, but it does not contain CORESET #0)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm |  | FFS |
| vivo |  | We prefer to introduce new FGs for RedCap UEs, e.g. one new FG for 6-1 like operation (but not necessarily contain MIB-configured CORESET#0), another new FG for 6-1a like operation. |
| OPPO | Y | This is new FG May be named as 6-1‘  It can be “supporting operation with SSB transmission but not necessarily contain MIB-configured CORESET#0” |
| Nordic |  | If offloading from CORESET#0 is supported, then 6-1 must be updated, but no change to SSB part of 6-1 |
| ZTE, Sanechips |  | It depends on the discussion of other issues. If 6-1a is mandatory, then no any new or modified FG need to be defined. If 6-1a is optional, whether new or modified FG is needed depends on the other issues discussion, e.g., SSB presence and CORESET0 configuration in separate initial DL BWP. |
| Spreadtrum | Y |  |
| Ericsson | See comment | The RedCap UE should support FG 6-1a or at least its special case where an RRC-configured DL BWP contains SSB but not CORESET #0. |
| Intel | Y | FGs 6-1 and 6-1a should be adapted/updated for RedCap such that they only consider expectation on SSB in RRC-configured active DL BWP, but not necessarily presence of CORESET #0. |
| China Telecom | Y | Some RedCap-specific revisions on FG 6-1a or FG 6-1 can be made to clarify the details on the separate BWP configured/defined for RedCap UEs. And we are open to introduce new FG for RedCap UEs if indeed necessary. |
| DOCOMO |  | This question can be discussed after some progress is made in **Proposal 3.2-3** |
| CMCC | Y | Share the same view as ZTE.  Our first preference is to mandatory support FG6-1a. The overhead can be high if SSB is always transmitted on active DL BWP of connected UEs, when such BWPs are not overlapped for offloading.  For compromise, when A UE does not support operation without SSB transmission in the RRC-configured active DL BWP, the SSB it expects can be NCD-SSB with larger periodicity. |
| LGE |  | Not sure if it is needed. Can come back to this after the conclusion on the support of the existing FGs (6-1 and 6-1a). |
| Apple | Y |  |
| Samsung |  | Needs further clarification. Does this SSB means the CD-SSB or non-CD SSB for serving cell? |
| FL2 | See Proposal 3.2-4. | |

## RF retuning and BWP switching

In RAN1#105-e, no consensus could be reached regarding whether an LS should be sent to RAN4 for their input on RF switching time. Many aspects related to BWP switching for UL and/or DL BWPs, as well as for initial and/or non-initial BWPs are already accounted for in the previous sections. For example, issues related to initial UL/DL BWP center frequency in TDD, and issues related to SSB or CORESET #0 potentially not being transmitted in initial/non-initial BWP for RedCap. Depending on the outcome of previous sections on initial UL/DL BWPs, RF retuning and/or BWP switching aspects may need to be discussed. Also, one contribution proposes that RRC configuration based, DCI-based and timer-based BWP switching are supported by RedCap UEs [31].

**FL1 High Priority Question 3.4-1: Is there a need to send an LS to RAN4 to ask for input on RF retuning and/or BWP switching? If yes, please elaborate in the Comments field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Qualcomm | FFS | RF retuning/BWP switching faster than the timeline of non-RedCap UE should not be supported by R17 RedCap UE.  Type-2 BWP switching delay is supported as a baseline capability for BWP switching of RedCap UE. |
| Vivo |  | Faster RF retuning and/or BWP switching is not essential features to finalize Rel-17 RedCap feature, therefore should not be pursued any further.  If any communication with RAN4 is needed, we think RAN1 should make the assumption that existing BWP switching delay are reused for RedCap UEs and confirm such assumption with RAN4. |
| OPPO | Y | Many issues related to BWP switching and RF retuning.  For example, if there is no SSB in the separate initial DL BWP, the UE needs to get synchronization from the MIB-configured initial DL BWP.  If there is no SSB in the active BWP, the UE may retune to the MIB-configured initial DL BWP for RRM measurement. |
| Nordic | N |  |
| Huawei, HiSilicon | Y | FL has well described the issue/scenarios – similar comments as in [4].  There is no BWP switching during initial access in R15 and **there is no baseline capability (one type is required to be reported in R15)**. Thus, this needs to be revisited for RedCap in order to support BWP operation with separate initial BWP. |
| ZTE, Sanechips | Y but | The motivation of the LS is trying to ask RAN4 whether the legacy RF retuning and/or BWP switching can be reused, instead of any optimization of the switching time. |
| TCL | Y | Same comments with Huawei |
| Panasonic |  | There would be no need to ask for input on RF retuning and/or BWP switching except RAN1 agree to reduce the delay on them. |
| Spreadtrum | N |  |
| Nokia, NSB | N |  |
| Ericsson | Y | We support sending LS to RAN4 regarding:   * Applicability of NCD-SSB for carrying out RAN4 procedures (RRM/RLM/LR). To our understanding, currently NCD-SSB cannot be used for serving cell measurements or as QCL sources. * RF switching delay in scenarios where SSB and/or CORESET#0 are not contained within the RedCap DL BWP. |
| Intel | Y, but … | We’d be supportive of an LS to RAN4, but rather to inform them of our decisions. In our view, the time to ask for inputs from RAN4 to guide our design itself is past. Thus, we can inform them based on our decisions and RAN4 can provide feedback if they say any significant issues with RAN1 design. This includes consideration of using NCD-SSB for serving cell RRM. |
| China Telecom | Y | It would be good to send LS to RAN4 to ask for input on RF retuning and/or BWP switching for the sake of RedCap WI progress. |
| DOCOMO |  | This question can be discussed after some progress is made in previous sections |
| CMCC | Y | Since center frequency unalignment is on table for discussion, and BWP switching for SSB is also under discussion, a LS can be send to RAN4. |
| LGE | N | From our perspective, there is no consensus to further pursue RedCap-specific fast RF retuning or BWP switching. And there has been no consensus on the content of the LS either. |
| Samsung | FFS | We need to identify the use case first. E.g., if a UE support different center frequency. |
| FL2 | See Question 3.2-5. | |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| [1] | [RP-211574](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_92e/Docs/RP-211574.zip) | Revised WID on support of reduced capability NR devices | Ericsson |
| [2] | [R1-2108271](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2108271.zip) | RAN1 agreements for Rel-17 NR RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2108632](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108632.zip) | FL summary #7 on reduced maximum UE bandwidth for RedCap | Moderator (Ericsson) |
| [4] | [R1-2108753](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108753.zip) | Reduced maximum UE bandwidth | Huawei, HiSilicon |
| [5] | [R1-2108802](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108802.zip) | Further discussion on Bandwidth Reduction for RedCap UEs | FUTUREWEI |
| [6] | [R1-2108820](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108820.zip) | Reduced maximum UE bandwidth for RedCap | Ericsson |
| [7] | [R1-2108913](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108913.zip) | Discussion on aspects related to reduced maximum UE bandwidth | Spreadtrum Communications |
| [8] | [R1-2108981](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108981.zip) | Discussion on reduced maximum UE bandwidth | vivo, Guangdong Genius |
| [9] | [R1-2109082](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109082.zip) | Discussion on reduced UE bandwidth | OPPO |
| [10] | [R1-2109230](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109230.zip) | Discussion on reduced maximum UE bandwidth | CATT |
| [11] | [R1-2109287](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109287.zip) | Discussion on reduced maximum UE bandwidth | CMCC |
| [12] | [R1-2109310](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109310.zip) | Bandwidth Reduction for Reduced Capability Devices | Nokia, Nokia Shanghai Bell |
| [13] | [R1-2109326](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109326.zip) | Reduced maximum UE bandwidth for RedCap | Lenovo, Motorola Mobility |
| [14] | [R1-2109332](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109332.zip) | Bandwidth reduction for reduced capability NR devices | ZTE, Sanechips |
| [15] | [R1-2109417](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109417.zip) | Discussion on the remaining issues of reduced UE bandwidth for RedCap | Xiaomi |
| [16] | [R1-2109496](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109496.zip) | UE complexity reduction | Samsung |
| [17] | [R1-2109573](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109573.zip) | On reduced maximum bandwidth for RedCap UEs | MediaTek Inc. |
| [18] | [R1-2110481](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110481.zip) | Support of reduced max UE BW for RedCap (update of [R1-2109617](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109617.zip)) | Intel Corporation |
| [19] | [R1-2109685](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109685.zip) | Discussion on reduced maximum UE bandwidth for RedCap | NTT DOCOMO, INC. |
| [20] | [R1-2109759](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109759.zip) | Discussion on reduced maximum UE bandwidth for RedCap | NEC |
| [21] | [R1-2109796](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109796.zip) | Discussion on reduced maximum UE bandwidth for RedCap | Sony |
| [22] | [R1-2109841](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109841.zip) | Aspects related to reduced maximum UE bandwidth for RedCap | Panasonic Corporation |
| [23] | [R1-2109948](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109948.zip) | Discussion on reduced maximum bandwidth for RedCap UEs | InterDigital, Inc. |
| [24] | [R1-2109975](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109975.zip) | Aspects related to the reduced maximum UE bandwidth of RedCap | LG Electronics |
| [25] | [R1-2109996](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109996.zip) | Discussion on reduced maximum UE bandwidth | Sharp |
| [26] | [R1-2110040](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110040.zip) | Reduced maximum UE bandwidth for Redcap | Apple |
| [27] | [R1-2110105](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110105.zip) | Discussion on aspects related to reduced maximum UE bandwidth | ASUSTeK |
| [28] | [R1-2110193](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110193.zip) | BW Reduction for RedCap UE | Qualcomm Incorporated |
| [29] | [R1-2110279](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110279.zip) | On aspects related to reduced maximum UE BW | Nordic Semiconductor ASA |
| [30] | [R1-2110314](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110314.zip) | Reduced maximum UE bandwidth for RedCap | DENSO CORPORATION |
| [31] | [R1-2109291](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109291.zip) | Discussion other aspects of RedCap UE | CMCC |
| [32] | [R1-2109752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109752.zip) | On RedCap UE RF retuning | Huawei, HiSilicon |
| [33] | [R1-2109951](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109951.zip) | Considerations for RedCap initial BWP | InterDigital, Inc. |
| [34] | [R1-2110377](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110377.zip) | FL summary #1 on reduced maximum UE bandwidth for RedCap | Moderator (Ericsson) |
| [35] | [R1-2110378](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110378.zip) | FL summary #2 on reduced maximum UE bandwidth for RedCap | Moderator (Ericsson) |
| [36] | [R1-2110379](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110379.zip) | FL summary #3 on reduced maximum UE bandwidth for RedCap | Moderator (Ericsson) |