3GPP TSG-RAN WG1 Meeting #109-e R1-22xxxxx

e-Meeting, 9th – 20th May 2022

**Agenda Item: 8.6.2**

**Title: FL summary #2 for maintenance on HD-FDD for RedCap**

**Source: Moderator (Qualcomm Inc.)**

**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], which also includes links to earlier FLSs.

This document captures this email discussion on maintenance issues for HD-FDD for RedCap:

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| [109-e-R17\_RedCap-02] Email discussion under 8.6.2 for maintenance on HD-FDD, for issue 1, 2 and 3 under High Priority Proposal 3-1c in the FL summary [R1-2205107](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2205107.zip)– Chao (Qualcomm)   * Discussion and decision by May 18 |

The three issues mentioned above are the following ones:

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| 1. Collision handling between SSB and RACH related transmissions    * See references [5, 8, 10, 12, 16, 18, 21, 22, 25, 28, 30, 32] 2. Available slot/symbol determination for PUCCH and PUSCH    * See references [10, 16, 18, 26, 30] 3. Lower priority: Collision handling between NCD-SSB and UL transmission    * See reference [30] |

Each one of the issues listed above is treated in its own section in this document. The feedback forms in this document are tagged and color coded with High Priority or Medium Priority. The aspects that are in the focus of this round of the discussion are furthermore tagged FL2.

**FL1 Question: Please consider entering contact info below for the points of contact for this email discussion.**

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| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| vivo | Xueming Pan | panxueming@vivo.com |
| Nordic | Karol Schober | karol.schober@nordicsemi.no |
| Qualcomm | Jing Lei | leijing@qti.qualcomm.com |
| DOCOMO | Shinya Kumagai | shinya.kumagai@docomo-lab.com |
| Nokia | Rapeepat Ratasuk | rapeepat.ratasuk@nokia-bell-labs.com |
| ZTE | Youjun Hu | hu.youjun1@zte.com.cn |
| Samsung | Seunghoon Choi | seunghoon.choi@samsung.com |
| CATT | Yongqiang FEI | feiyongqiang@catt.cn |
| Sharp | Liqing Liu | liu.liqing@sharp.co.jp |
| Ericsson | Johan Bergman | johan.bergman@ericsson.com |
| CMCC | Lijie Hu | hulijie@chinamobile.com |
| OPPO | Zhisong Zuo | zuozhisong@oppo.com |
| LGE | Jay KIM | jaehyung.kim@lge.com |
| Spreadtrum | Sicong Zhao | Sicong.zhao@unisoc.com |

# 1 Issue #1: Collision handling between SSB and RACH related transmissions

For Case 5 of SSB overlapping with Msg3 (re)transmission and HARQ-ACK for Msg4/MsgB, majority majority does not view any critical issue for prioritizing SSB over Msg3 or PUCCH for Msg4/MsgB and supports to confirm the WA from RAN1#108-e. It is also noted in [5, 30] that there is no need for RAN1 specification change if the WA from RAN1#108-e is agreed since the specification text does not differentiate between dynamically scheduled PUSCH, CG-PUSCH, and PUSCH scheduled by RAR UL grant.

In [10], it is proposed that the collision cases involving SSB should consider only the SSB in the active BWP, and the WA should be confirmed with clarifying that the SSB refers to the one that present in the active BWP.

[12] presents view on whether the same prioritity rule is reused for the collision of SSB vs. msg2/msg4/Type-1 CSS when a separate initial DL BWP without SSB is configured for RACH for RedCap UEs. It is viewed in [10] that during the RACH procedure, e.g., from the transmission of the Msg.1 to the transmission of the PUCCH for Msg.4, the RedCap UE in idle/inactive mode does not need to monitor paging or CD-SSB in case a separate initial DL BWP without CD-SSB is configured.

**FL1 High Priority Proposal 1-1: Confirm the following WA from RAN1#108-e:**

* For Case 5 of SSB overlapping with Msg3 (re)transmission or PUCCH for Msg4/MsgB, reuse the same handling as for other dynamically scheduled UL transmission and prioritize the SSB
  + Note: Whether the above collision rule is reused for Msg3 PUSCH repetition is up to the agreement in the CE WI.

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| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| Nordic | Y |  |
| Qualcomm | Y |  |
| Apple | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| ZTE, Sanechips |  | Comment 1:  NCD-SSB is configured after RRC connection. During initial access, the UE can not acquire the NCD-SSB position and receive the NCD-SSB. Therefore, for case 5, the SSB here only refers to CD-SSB, instead of NCD-SSB. Regarding the NCD-SSB, we can leave it to the separate discussion, i.e., issue#3.  Comment 2:  If the separate initial DL BWP without CD-SSB is used for random access procedure, then during random access procedure, the UE does not need to receive paging in CORESET#0 and also does not expect the SSB according to the agreement. If the SSB only refers to the one that present in the active BWP(**Question 1-2**), then this WA would not be applied for the case that the separate initial DL BWP does not contain CD-SSB. Therefore, considering the **Question 1-2** addresses this issue, we think this WA should be decided together with **Question 1-2.**  For the case that separate initial DL BWP does not contain CD-SSB, we think the following agreement would be applied. In this case, UE would send the msg3/PUCCH for msg4, instead of receiving SSB via BWP switching.  Agreement: [38.213, 38.331]   * For FR1,   + For a separate initial DL BWP (if it does not include CD-SSB and the entire CORESET#0) from RAN1 perspective,     - If it is configured for random access while not for paging in idle/inactive mode, RedCap UE does NOT expect it to contain SSB/CORESET#0/SIB.     - Note: RAN1 assumes REDCAP UE performing Random access in the separate DL BWP does not need to monitor paging in a BWP containing CORESET#0 |
| Spreadtrum | Y |  |
| Samsung | Y |  |
| Intel | Y |  |
| CATT | Y |  |
| Sharp | Y |  |
| Ericsson | Y |  |
| CMCC | Y |  |
| OPPO | Y |  |
| Huawei, HiSilicon | Y |  |
| LGE | Y |  |
| FL2 | @ZTE: It is well known that NCD-SSB is configured after RRC connection setup. The proposal here is about potential collision between SSB and Msg3 (re)transmission and HARQ-ACK for Msg4/MsgB, and therefore it is for UEs in RRC idle/inactive mode. From the moderator point of view, there is no need to further clarify that the SSB here refers to the CD-SSB. Regarding your comment #2, I think it will be addressed in **FL1 High Priority Question 1-2.** It is not necessary to decide the WA together with **Question 1-2.**  Given the majority companies support the proposal, the FL suggestion is to confirm the WA rather than reopening the discussion. Also, the FL shares the same view with companies that there is no need for RAN1 specification change if the WA is agreed.  **So, @ZTE, could you live with the proposal for sake of progress?**  **FL1 High Priority Proposal 1-1: Confirm the following WA from RAN1#108-e:**   * For Case 5 of SSB overlapping with Msg3 (re)transmission or PUCCH for Msg4/MsgB, reuse the same handling as for other dynamically scheduled UL transmission and prioritize the SSB   + Note: Whether the above collision rule is reused for Msg3 PUSCH repetition is up to the agreement in the CE WI. | |
| vivo | Y |  |
| CMCC | Y |  |
| ZTE, Sanechips | Y | Thanks for the FL’s efforts. We think since question 1-2 also get most support, it can also be incorporated into this WA.  **FL1 High Priority Proposal 1-1: Confirm the following WA from RAN1#108-e:**   * For Case 5 of SSB overlapping with Msg3 (re)transmission or PUCCH for Msg4/MsgB, reuse the same handling as for other dynamically scheduled UL transmission and prioritize the SSB   + Note: Whether the above collision rule is reused for Msg3 PUSCH repetition is up to the agreement in the CE WI.   + Note: the SSB refers to the one that present in the active BWP for collision handling between SSB and UL transmission   Or we also can confirm it after the TP for question 1-2 is agreed. |
| Spreadtrum | Y |  |
| Ericsson | Y |  |
| LGE | Y |  |
| Samsung | Y |  |
| Nordic | Y |  |
| Intel | Y |  |

**FL1 High Priority Question 1-2: Companies are invited to provide views on whether the SSB refers to the one that present in the active BWP for collision handling between SSB and RACH related transmission?**

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| **Company** | **Y/N** | **Comments** |
| vivo | Y with modification | About the collision cases involving SSB, it makes sense to consider only the SSB (either CD-SSB or NCD-SSB) present in the active BWP. Therefore, we would like to make the following modification:  **“the SSB refers to the one that present in the active BWP for collision handling between SSB and ~~RACH related~~ UL transmissions, i.e., dynamically scheduled or configured UL transmissions.”** |
| Nordic | Y | RAN1 spec talks about SSB only, and only SSB within BWP matters. This is in our opinion current specification. |
| Qualcomm | Y | If the active DL BWP of a HD-FDD RedCap UE includes an SSB transmitted by the serving cell, the collision handling between SSB and UL transmissions dynamically scheduled or configured in the active UL BWP of the RedCap UE refers to the SSB in the active DL BWP. |
| Apple | Y |  |
| DOCOMO | Y | SSB in the active DL BWP is considered for the collision handling |
| Nokia, NSB | Y | Agree that this refers to the SSB in the active DL BWP |
| ZTE, Sanechips | Y | We agree that the SSB for collision handling only refers to be within the active BWP.  When the active BWP, e.g., separate initial DL BWP, does not contain SSB, we think the mentioned agreement would be applied. In this case, UE would send the msg3/PUCCH for msg4, instead of receiving SSB via BWP switching.  For NCD-SSB, before UE acquiring the NCD-SSB configuration, the collision between NCD-SSB and UL transmission does not exist and there is no need to consider the collision. |
| Spreadtrum | Y |  |
| Samsung | Y | We think the SSB refers to one in the active BWP and it is current spec in our view. |
| Intel | Y | Our understanding is all related agreements for collision handling till now assume the SSB is present in the active DL BWP. |
| CATT | Y | This should be a natural assumption during the whole discussion. |
| Sharp | Y |  |
| Ericsson | Y |  |
| CMCC | Y |  |
| OPPO | Y | We have the same understanding with the current specification |
| Huawei, HiSilicon | Y |  |
| LGE | Y | We also think the SSB in the context of collision handling refers to the SSB in the active DL BWP. |
| FL2 | Based on the received response, the majority companies agree that the SSB in the conext of collision handling refers to the SSB in the active DL BWP. The vivo’s modification to extend the UL transmission to general UL transmission also makes sense. Therefore, the following **FL2 High Priority Proposal 1-2** based on the TP in [10] can be considered.  To address ZTE’s concern on the separate initial DL BWP without CD-SSB, **FL2 High Priority Proposed Conclusion 1-3** is proposed for consideration.  **Companies are invited to comment on the following FL proposals.**  **FL2 High Priority Proposal 1-2:**   * Endorse the following text proposal to TS 38.213, clause 17.2  |  | | --- | | **17.2 Half-Duplex UE in paired spectrum**  ===================== Unchanged parts are omitted =====================  If a HD-UE would transmit a PUSCH, or PUCCH, or SRS based on a configuration by higher layers and the HD-UE is indicated presence of SS/PBCH blocks in the active DL BWP by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*, the HD-UE does not transmit  - PUSCH or PUCCH if a last symbol of the PUSCH or PUCCH transmission would not be at least [4, TS 38.211] prior to a first symbol of the next earliest SS/PBCH block  - PUSCH or PUCCH if a first symbol of the PUSCH or PUCCH transmission would not be at least [4, TS 38.211] after a last symbol of the previous latest SS/PBCH block  - SRS in symbols that would not be at least prior to a first symbol of the next earliest SS/PBCH block  - SRS in symbols that would not be at least after a last symbol of the previous latest SS/PBCH block  If a HD-UE would transmit a PRACH based on a detected DCI format, or PUSCH, or PUCCH, or SRS and the HD-UE is indicated presence of SS/PBCH blocks in the active DL BWP by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* in a set of symbols, the HD-UE does not transmit PUSCH or PUCCH or PRACH if a transmission would overlap with any symbol from the set of symbols and the HD-UE does not transmit SRS in the set of symbols.  If a HD-UE would transmit a PRACH or MsgA PUSCH triggered by higher layers in a set of symbols and would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS, or is indicated presence of SS/PBCH blocks in the active DL BWP by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* in symbols that include any symbol from the set of symbols, the HD-UE can select based on its implementation whether to either transmit the PRACH or the MsgA PUSCH or receive the PDSCH, or the CSI-RS, or the PL RS, or the PDCCH, or the SS/PBCH blocks.  If a HD-UE would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS based on a configuration by higher layers or is indicated presence of SS/PBCH blocks in the active DL BWP by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* in a set of symbols, and the HD-UE would transmit PRACH or MsgA PUSCH triggered by higher layers starting or ending at a symbol that is earlier or later than or , respectively, from the last or first symbol in the set of symbols, the HD-UE can select based on its implementation whether to either transmit the PRACH or the MsgA PUSCH or receive the PDSCH, or the CSI-RS, or the DL PRS, or the PDCCH, or the SS/PBCH blocks.  ===================== Unchanged parts are omitted ===================== |   **FL2 High Priority Proposed Conclusion 1-3:**   * It is RAN1 understanding that the RedCap UE in idle/inactive mode does not need to monitor SSB during the RACH procedure when a separate initital BWP associated with no SSB is configured for RACH | |
| Qualcomm |  | We are fine with the TP, but cannot accept the conclusion which is beyond the scope of HD-FDD discussion.  When an idle/inactive RedCap UE is performing RA procedure in an SSB-less initial DL BWP, RAN1 has agreed that the RedCap UE does not need to monitor paging CSS outside the initial DL BWP. However, the situation is different for SSB, since the RedCap UE needs to measure SSB during the RA procedure, at least to maintain the tracking loops, re-select the RO when needed, and estimate the PL for ULPC of PRACH/PUSCH/PUCCH. Note RAN2 has agreed that the SS-RSRP measurement can be left to RedCap UE implementation before msg1/msgA retransmission, but it does not mean the RedCap UE does not need to monitor SSB throughout the RA procedure. |
| vivo |  | We support the TP.  About the conclusion, we do not support it and share QC’s views that whether to measure SSB during RACH procedure is left to RedCap UE implementation per RAN2 agreements. |
| CMCC |  | Ok with TP but not ok with conclusion 1-3 since RedCap may measure SSB during the RA procedure before msg1/msgA retransmission. |
| OPPO |  | OK with others, except conclusion 1-3. |
| ZTE, Sanechips |  | We support the TP.  To avoid the msg2/msg4/type1-CSS/msg3/PUCCH for msg4 missing, the conclusion is needed. We also agree that the UE still can receive SSB in available symbols (except the symbols of msg2/msg4/type1-CSS/msg3/PUCCH for msg4 ) during RACH procedure. Therefore, the following update is made:   * It is RAN1 understanding that the RedCap UE in idle/inactive mode does not need to monitor SSB during the RACH procedure of receiving msg2/msg4/type-1 CSS or transmitting msg3/PUCCH for msg4 when a separate initital BWP associated with no SSB is configured for RACH |
| Spreadtrum |  | We are also ok with TP but not ok with conclusion 1-3(share QC’s views on conclusion 1-3). |
| Ericsson |  | We support the TP. We think the proposed conclusion is not needed. |
| LGE |  | We are okay with the TP. But, we do not support the proposed conclusion. |
| Samsung |  | For proposed TP: We are OK with the TP  For proposed conclusion: We have similar concern with QC. |
| Nordic |  | TP is OK, but it is editorial in our opinion, as “within active DL BWP” current spec. |
| Intel |  | We are okay with the TP. We do not support the conclusion for the same concern as QC. |
| CATT |  | There maybe some issue in the proposed conclusion, at least it is unclear whether the duration between ‘RACH failure’ and ‘restart a RACH’ is regarded as during RACH procedure. RAN2 agreed and only agreed that between ‘RACH failure’ and ‘restart a RACH’, it is up to UE whether to retune and measure SSB.  Therefore, ZTE’s version seems right. But if we do not have much time to discuss, it seems safe to just adopt the TP (which we support, of course) without any conclusion. |

# 2 Issue #2: Available slot/symbol determination for PUCCH and PUSCH

For the issue of determining available slots for PUCCH/PUSCH repetition, it is proposed in [16, 18, 26] to have a unified solution for both PUSCH and PUCCH repetition that the slot in which a PUCCH/PUSCH transmission does not have sufficient gap with the SSB is not counted as available slots for PUCCH/PUSCH repetition.

In [30] it is proposed to firstly clarify whether or not the “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and dynamic PUSCH or PUCCH repetition is allowed.

The similar view is expressed in [10] that if the “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and dynamic UL transmission is treated as error case the UE behaviour and specification will become quite complicated especially for PUSCH/PUCCH repetition with K>1.

In [30], it is also discussed whether the invalid symbols for PUSCH repetition Type B should also include the symbols that are not at least before the first symbol or not at least after the last symbol indicated for SSB.

Based on the received response, it seems reasonable, at least from the moderator’s view, to allow the “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and dynamically scheduled UL to simplify UE behaviour and specification errort. Based on this, a unified solution for determining available slots can be considered for PUCCH/PUSCH repetition based on a configured grant and scheduled by a PDCCH.

**FL1 High Priority Proposal 2-1:**

* The “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and dynamically scheduled UL may happen, i.e., allowed for HD-FDD UEs

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| **Company** | **Y/N** | **Comments** |
| vivo | Y | As analyzed in our contribution, allowing “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and dynamic scheduled UL happen can simplify UE behaviour and specification a lot. |
| Nordic | N, but | We do not think this should be a general rule. Saying this, we could be fine with allowing exceptions for validation purposes below. |
| Qualcomm | N | It is necessary to clarify if the SSB is an CD-SSB or NCD-SSB.  If the SSB is an NCD-SSB configured by RRC and the HD UE capability is known to NW, such “back-to-back non-overlapping UL/DL without sufficient gap” between SSB and dynamically scheduled UL can be avoided by NW. |
| DOCOMO | Y | At least for PUCCH/PUSCH repetition case it should be allowed |
| Nokia, NSB | Y | We prefer to have the same solution for PUCCH and PUSCH repetition and therefore this should be allowed |
| ZTE, Sanechips | Y | We suggest a unified solution to solve the collision between SSB and dynamically scheduled UL/dedicated configured UL, and since in RAN1#107-e meeting, collision between SSB and dedicated configured UL is allowed, the Proposal 2-1 can be also supported. |
| Samsung | Y | Our view is that it should be allowed in order to simplify UE behaviour and specification and also to reduce gNB scheduling burden. |
| Intel | Y | Our previous comments to this FL proposal is negative since gNB can manage the time resource of a dynamically scheduled UL transmission to avoid collisions. However, if there is a benefit to have a unified solution to handle colissions between SSB and all UL transmission, we would be fine to the proposal. |
| CATT | Y | Although we think the network is able to avoid such case, a unified handling rule for PUCCH and PUSCH is acceptable. |
| Sharp | Y | We share the same views with other companies on the benefit of the unified solution. |
| Ericsson |  | We are ok with the proposal. It seems that the intention of this proposal is to allow possible unification/simplification of UE behaviors (e.g., in Proposal 2-3) regarding “collision” due to overlapping and back-to-back without sufficient gap.  However, the proposal only covers SSB vs. dynamic UL which seems rather adhoc (only when interacting with *AvailableSlotCounting*). Currently, there exist other cases, e.g., dynamic UL vs. other configured DL, or dynamic DL vs. configured UL, or cell specific PDCCH vs. dedicated configured UL, where the back-to-back without sufficient gap results in an error case, while the overlapping cases (even with just one overlapping symbol) and the non-overlapping case with sufficient gap (e.g., with one symbol gap) both have corresponding UE behaviors defined. In our view, this kind of scenario alone unnecessarily leads to 3 different UE behaviors. Thus, in the same spirit as this proposal's intention, we suggest considering revising the proposal to include other applicable cases of non-overlapping without sufficient gap as well. |
| CMCC | Y |  |
| OPPO | N | We wonder if this can be valid with the specification, as it says in 38.211 section 4, that UE do not expect UL transmission not with sufficient gap.  This question seems does not affect the next question to solve the following simplication of available slot counting for HD-FDD |
| Huawei, HiSilicon | Y | In our view, this case can be allowed for HD-FDD UEs. And this scenario is same as the case of SSB overlapping with dynamically scheduled UL. Thus, we can reuse the same handling and prioritize the SSB.  The principle that how to count the number of aviliable slot for PUCCH/PUSCH repetition can also be reused. There’ no need to re-discuss proposal 2-2/2-3. |
| LGE | Y | We think it should be allowed in the interest of unified solution |
| FL2 | Given the input, majority is in principle okay, but several companies have concern to make it as a general rule. if we cannot reach a consensus on Proposal 2-1, it is still necessary to allow some exceptions for addressing the issue of available slot determination for PUCCH/PUSCH repetition. | |
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If the above FL proposal is agreed, then the following proposals can be considered.

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

* For a HD-UE in paired spectrum and for a PUCCH transmission over slots
  + A slot is not counted in the number of slots if a PUCCH transmission in the slot does not start or end at least or , respectively, from the last or first symbol in the set of symbols with SSB transmission

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| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| ZTE, Sanechips | Y |  |
| Samsung | Y |  |
| Intel | Y |  |
| CATT | Y |  |
| Sharp | Y | Unified solution of available slots counting for dynamic and configured UL is preferred. However, if we fail to reach a consensus on Proposal 2-1, it is still necessary to solve the issue of available slots counting for configured PUCCH/PUSCH repetitions. |
| Ericsson |  | We do not see a strong need to unify UE behaviors for determining available slots for PUCCH and PUSCH repetition. In the current spec, for FDD operation, the UE determines *consecutive* slots for PUCCH repetition.  *“For paired spectrum or supplementary uplink band, the UE determines the slots for a PUCCH transmission as the consecutive slots starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting.”*  Unlike PUSCH repetition, there is no new mechanism for available slot counting for coverage enhancement purpose. Moreover, for Rel/17 RedCap, it was not identified that PUCCH is coverage limited. Thus, we see no need to define a new behavior specifically for HD-FDD UEs in this case. |
| CMCC | Y |  |
| OPPO | Y | That bullet can be capatured in spec. |
| Huawei, HiSilicon |  | No new action needed as replied in previous question. |
| LGE | Y | In the interest of unified solution. |
| FL2 | @Ericssion: The current spec defines different UE behaviour for available slots determination for PUCCH repetition for TDD and FDD. For TDD, as seen from the following text, the slot with UL symbols overlapping with SSB are not counted for PUCCH repetition. As discussed in last RAN1 meeting, majority companies view that PUCCH repetition performance will be serious degraded if existing FDD rule is adopted for the HD-FDD, and therefore propose to use a similar TDD rule for HD-FDD UEs. The proposal here is to further enhance the TDD rule by including the switching time for available slot determination for HD-FDD since it has been agreed the back-to-back non-overlapping UL/DL without sufficient gap between SSB and configured PUCCH is allowed.  *“For unpaired spectrum, the UE determines the slots for a PUCCH transmission starting from a slot indicated to the UE as described in clause 9.2.3 for HARQ-ACK reporting, or a slot determined as described in clause 9.2.4 for SR reporting or in clause 5.2.1.4 of [6, TS 38.214] for CSI reporting and having*  *- an UL symbol, as described in clause 11.1, or flexible symbol that is not SS/PBCH block symbol provided by startingSymbolIndex as a first symbol, and*  *- consecutive UL symbols, as described in clause 11.1, or flexible symbols that are not SS/PBCH block symbols, starting from the first symbol, equal to or larger than a number of symbols provided by nrofsymbols “*  **Given the support by majority companies, the FL suggestion is to reconsider the following proposal**  **FL1 High Priority Proposal 2-2:**   * For a HD-UE in paired spectrum and for a PUCCH transmission over slots   + A slot is not counted in the number of slots if a PUCCH transmission in the slot does not start or end at least or , respectively, from the last or first symbol in the set of symbols with SSB transmission | |
| Qualcomm | Y |  |
| vivo | Y |  |
| CMCC | Y |  |
| OPPO | Y |  |
| ZTE, Sanechips | Y |  |
| Spreadtrum | Y |  |
| Ericsson |  | We see still this as an optimization which typically should not be prioritized during the maintenance phase. The current specification is clear on how We see still this as an optimization which typically should not be prioritized during the maintenance phase. The current specification is clear on how is determined for FDD operation which includes HD-FDD. In case of collision with SSB for some repetition, RAN1 has already defined the handling to prioritize SSB. Such optimization can be justified if PUCCH performance for (HD-FDD) RedCap UE is identified as coveraged limited. However, so far, we have not seen that is the case and thus see no strong need for the proposal. |
| LGE | Y |  |
| Samsung | Y |  |
| Nordic | Y |  |
| Intel | Y |  |
| CATT | Y |  |

**FL1 High Priority Proposal 2-3:**

* For a HD-UE in paired spectrum and for PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 or with a configured grant
  + When *AvailableSlotCounting* is enabled
    - For K>1, a slot is not counted in the number of K slots if a PUSCH transmission in the slot does not start or end at least or , respectively, from the last or first symbol in the set of symbols with SSB transmission
    - For K=1, the HD-UE does not transmit PUSCH if PUSCH transmission in the slot does not start or end at least or , respectively, from the last or first symbol in the set of symbols with SSB transmission
  + When the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, the HD-UE does not transmit PUSCH in a slot if a PUSCH transmission in the slot does not start or end at least or , respectively, from the last or first symbol in the set of symbols with SSB transmission

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| **Company** | **Y/N** | **Comments** |
| vivo | Y | We support this proposal to align the UE behavior agreed in Cov\_enh. |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| ZTE, Sanechips | Y |  |
| Samsung | Y |  |
| Intel | Y |  |
| CATT | Y |  |
| Sharp | Y | Same comment as in Proposal 2-2. |
| Ericsson | Y | See also comments for Proposal 2-1. |
| CMCC | Y |  |
| OPPO | Y | This is inline with out proposal in contribution. (Note in our contribution, we mean PUSCH, not Msg3 only.)  Our TP attached:  **------------------------------ TP#2: TS 38.214 -----------------------------------** 6.1.2.1 Resource allocation in time domain \*\*\* Unchanged text is omitted \*\*\*  For paired spectrum and SUL band:  - The UE determines consecutive slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2.  - For the case of a reduced capability half-duplex UE, ~~and when~~ *~~AvailableSlotCounting~~* ~~is enabled,~~ the UE determines slots for a PUSCH transmission of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or for a PUSCH transmission of TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, based on the TDRA information field value in the DCI format 0\_1 or 0\_2. If *AvailableSlotCounting* is enabled, a ~~A~~ slot is not counted in the number of slots if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*. Otherwise, the slot is dropped but counted.  \*\*\* Unchanged text is omitted \*\*\*  We are also fine to include non sufficient gap of or , the change can be made in upport text of specification. |
| LGE | Y |  |

**FL1 High Priority Proposal 2-4:**

* For a HD-UE in paired spectrum and for PUSCH repetition type B transmission
  + Symbols that are not at least before the first symbol or not at least after the last symbol in the set of symbols with SSB transmission are considered as invalid symbols for PUSCH repetition type B transmission

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| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| ZTE, Sanechips |  | Since the collision handling rule for PUSCH repetition type B is not discussed in Cov\_enh, we suggest to reuse legacy rule, i.e., dropping PUSCH repetition type B transmission, to solve this collision. |
| Samsung | Y |  |
| Intel | Y |  |
| CATT | Y |  |
| Sharp | Y |  |
| Ericsson |  | Generally, PUSCH repetition type B should not be considered as important for (HD-FDD) RedCap UEs. It is mainly intended for low latency use cases where PUSCH can be segmented into repetitions around the slot boundary or set of invalid symbols. However, for the sake of spec consistency (if Proposal 2-3 on PUSCH repetition type A is agreed), we are okay to support it. |
| CMCC | Y |  |
| OPPO |  | Do we expect RedCap UE can support advanced feature like CA, URLLC? Type B repetition is more about URLLC. |
| LGE | Y |  |
| FL2 | According to the following specification text in 38.214, section 6.1.2.1, PUSCH repetition type B is supported for the HD-FDD RedCap UEs. Since the current tule is to consider the UL symbols overlapping with SSB as invalid symbols for PUSCH repetition type B, it would also make sense to include the switching gap for invalid symbol determination for spec consistency.  *For a reduced capability half-duplex UE in paired spectrum and for PUSCH repetition Type B transmission, symbols indicated by ssb-PositionsInBurst in SIB1 or ssb-PositionsInBurst in ServingCellConfigCommon for reception of SS/PBCH blocks are considered as invalid symbols for PUSCH repetition Type B transmission.*  **Therefore, the FL suggestion is to reconsider the following proposal**  **FL1 High Priority Proposal 2-4:**   * For a HD-UE in paired spectrum and for PUSCH repetition type B transmission   + Symbols that are not at least before the first symbol or not at least after the last symbol in the set of symbols with SSB transmission are considered as invalid symbols for PUSCH repetition type B transmission | |
| Qualcomm | Y |  |
| vivo | Y |  |
| CMCC | Y |  |
| OPPO |  | I guess the sub-clause for Type B in 38.214 you mentioned would be the intended place to include .  But this sub-clause does not mean we are ready to Support low capability HD-FDD with advanced Type B repetition.  Also, I see spec in other places like 17.2 38.213 does not well consider it.  Still we prefer to not optimize it, e.g not support HD and Type B same time, as this is CR stage. |
| ZTE, Sanechips | Y |  |
| Ericsson |  | Ok to support for spec consistency if Proposal 2-3 is agreed. |
| LGE | Y |  |
| Samsung | Y |  |
| Nordic | Y |  |
| Intel | Y |  |
| CATT | Y |  |
| OPPO2 |  | After check further with 17.2 38.213, I realized the proposal can simply work with it capatured in 6.1.2.1 of 38.214.  That is for 17.2 of 38.213, type B repetition related action is only in patial cancellation:  “- the HD-UE does not expect to cancel the transmission of the PUCCH or PUSCH in the set of symbols if the first symbol in the set occurs within relative to a last symbol of a CORESET where the HD-UE detects the DCI format; otherwise, the HD-UE cancels the PUCCH, or the PUSCH, or an actual repetition of the PUSCH [6, TS38.214], determined from clauses 9 and 9.2.5 or clause 6.1 of [6, TS38.214].  ”  Other parts in 17.2 of 213 will be not even applied, if we define overlapping within gap would be invalid symbol for type B repetition. They are for Type A repetition.  Since it can work that way, we are not against the proposal even the 2 features are not likely configured together. |

# 3 Issue #3: Collision handling between NCD-SSB and UL transmission

One more remaining issue discussed in [30] is how to handle the collision between NCD-SSB and UL transmission. It is proposed in [30] to handle the NCD-SSB in the same way as CD-SSB when an RRC-configured active DL BWP in connected mode contains the NCD-SSB.

**FL1 Medium Priority Proposal 3-1:**

* For collision handling between NCD-SSB and UL transmission, NCD-SSB is handled in the same way as CD-SSB

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| **Company** | **Y/N** | **Comments** |
| vivo | Y with comment | We think this proposal can be discussed together with **FL1 High Priority Proposal 1-1.** In addition, we think it is necessary to change specification since in current TS 38.213 section 17.2, the SSB refers to the “*ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*” while for NCD-SSB, it is configured by UE-dedicated RRC signaling *NonCellDefiningSSB*. |
| Nordic | Y | RAN1 spec talks about SSB only, and only SSB within BWP matters. This is in our opinion current specification. |
| DOCOMO | Y |  |
| Nokia, NSB | Y | Agree that they should be handled in the same way and this should refer to the SSB in the BWP |
| ZTE, Sanechips | Y with modification | Before UE acquiring the NCD-SSB configuration, the collision issue does not need to be considered. Therefore, we have the following modification.   * For collision handling between NCD-SSB and UL transmission after UE acquiring NCD-SSB configuration, NCD-SSB is handled in the same way as CD-SSB |
| Spreadtrum | Y with question | We are fine with this proposal.  But we have one further question for the SSB collision, if the CD-SSB and the NCD-SSB are both configured for the RedCap UE in a BWP (if we understand correctly, this does not preclude by the current spec, although the gNB should avoid this configuration), how the UE treat the SSBs? Only handling the collision between NCD-SSB and UL transmission, i.e., ignore CD-SSB, or handling the collision between NCD-SSB/CD-SSB and UL transmission? |
| Samsung | Y |  |
| Intel | Y | Since NCD-SSB on the RRC configured active DL BWP is important for measurements (FG 6-1), it is necessary for the prioritization of the NCD-SSB. As commented by vivo, the current spec refers to the “ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon”, which limits the interpretation of SSB to CD-SSB. Therefore, a clarification is needed.  The exact method to update the spec may be impacted by the conclusion on RAN2 incoming LS (R1-2203046) on introduction of an offset to transmit CD-SSB and NCD-SSB at different times |
| CATT | Y |  |
| Sharp | Y |  |
| Ericsson |  | It seems ok to treat them in the same way for collision handling. |
| CMCC | Y |  |
| OPPO | Y | May not need spec change. |
| Huawei, HiSilicon |  | Clarification is needed as vivo/Intel commented, which can also take the progress of offset discussion into account. Support of collision handling of NCD-SSB require additional description in UE feature as well. |
| LGE | Y | No differentiation b/w CD-SSB and NCD-SSB is needed, which we think complies with the current RAN1 spec. |
| FL2 | @Spreadtrum: Further clarification can be considered when both CD-SSB and NCD-SSB are configured in the active DL BWP, based on the conclusion on RAN2 incoming LS (R1-2203046) on introduction of an offset to transmit CD-SSB and NCD-SSB at different times.  The motivation of the proposal is to clarify the SSB definition in 38.214, section 17.2, where the “ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon” is used, which may be interpreted CD-SSB as commented by vivo and Intel.  Based on the received response, the following updated proposal based on the TP in [10] can be considered.  **FL2 Medium Priority Proposal 3-1:**   * Endorse the following text proposal to TS 38.213, clause 17.2  |  | | --- | | **17.2 Half-Duplex UE in paired spectrum**  ===================== Unchanged parts are omitted =====================  If a HD-UE would transmit a PUSCH, or PUCCH, or SRS based on a configuration by higher layers and the HD-UE is indicated presence of SS/PBCH blocks by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or by *NonCellDefiningSSB*, the HD-UE does not transmit  - PUSCH or PUCCH if a last symbol of the PUSCH or PUCCH transmission would not be at least [4, TS 38.211] prior to a first symbol of the next earliest SS/PBCH block  - PUSCH or PUCCH if a first symbol of the PUSCH or PUCCH transmission would not be at least [4, TS 38.211] after a last symbol of the previous latest SS/PBCH block  - SRS in symbols that would not be at least prior to a first symbol of the next earliest SS/PBCH block  - SRS in symbols that would not be at least after a last symbol of the previous latest SS/PBCH block  If a HD-UE would transmit a PRACH based on a detected DCI format, or PUSCH, or PUCCH, or SRS and the HD-UE is indicated presence of SS/PBCH blocks by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or by *NonCellDefiningSSB* in a set of symbols, the HD-UE does not transmit PUSCH or PUCCH or PRACH if a transmission would overlap with any symbol from the set of symbols and the HD-UE does not transmit SRS in the set of symbols.  If a HD-UE would transmit a PRACH or MsgA PUSCH triggered by higher layers in a set of symbols and would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS, or is indicated presence of SS/PBCH blocks by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or by *NonCellDefiningSSB* in symbols that include any symbol from the set of symbols, the HD-UE can select based on its implementation whether to either transmit the PRACH or the MsgA PUSCH or receive the PDSCH, or the CSI-RS, or the PL RS, or the PDCCH, or the SS/PBCH blocks.  If a HD-UE would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS based on a configuration by higher layers or is indicated presence of SS/PBCH blocks by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or by *NonCellDefiningSSB* in a set of symbols, and the HD-UE would transmit PRACH or MsgA PUSCH triggered by higher layers starting or ending at a symbol that is earlier or later than or , respectively, from the last or first symbol in the set of symbols, the HD-UE can select based on its implementation whether to either transmit the PRACH or the MsgA PUSCH or receive the PDSCH, or the CSI-RS, or the DL PRS, or the PDCCH, or the SS/PBCH blocks.  ===================== Unchanged parts are omitted ===================== | | |
| Qualcomm | Y |  |
| vivo | Y |  |
| CMCC | Y |  |
| OPPO | Y | Ok for adding NCD for subclause only had CD-SSB. |
| ZTE, Sanechips | Y |  |
| Spreadtrum | Y |  |
| Ericsson | Y |  |
| LGE | Y |  |
| Samsung | Y |  |
| Nordic | Y |  |
| Intel | Y |  |
| CATT | Y |  |

# References

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| --- | --- | --- | --- |
| [1] | [RP-220966](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_95e/Docs/RP-220966.zip) | Revised WID on support of reduced capability NR devices | Ericsson |
| [2] | [R1-2202535](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202535.zip) | RAN1 agreements for Rel-17 NR RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2203053](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203053.zip) | Remaining aspects of Bandwidth Reduction for RedCap UEs | Futurewei |
| [4] | [R1-2203109](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203109.zip) | Remaining issues on UE complexity reduction | Huawei, HiSilicon |
| [5] | [R1-2203114](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203114.zip) | Maintenance issues for UE complexity reduction for RedCap | Ericsson |
| [6] | [R1-2203115](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203115.zip) | Draft summary of WI on support of reduced capability (RedCap) NR devices | Ericsson |
| [7] | [R1-2203307](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203307.zip) | Remaining issues on aspects related to reduced maximum UE bandwidth | Spreadtrum Communications |
| [8] | [R1-2203438](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203438.zip) | Remaining issues on RedCap UE complexity reduction in Rel-17 | CATT |
| [9] | [R1-2203517](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203517.zip) | Remaining issues on reduced maximum UE bandwidth | Vivo, Guangdong Genius |
| [10] | [R1-2203518](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203518.zip) | Remaining issues on RedCap half-duplex operation | Vivo, Guangdong Genius |
| [11] | [R1-2203593](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203593.zip) | Discussion on UE complexity reduction for Rel-17 Redcap UE | ZTE, Sanechips |
| [12] | [R1-2203594](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203594.zip) | Remaining aspects for Rel-17 RedCap UE | ZTE, Sanechips |
| [13] | [R1-2203762](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203762.zip) | SIB reception for RedCap UE | Panasonic |
| [14] | [R1-2203787](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203787.zip) | Discussion on the remaining issues of complexity reduction | Xiaomi |
| [15] | [R1-2203788](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203788.zip) | Discussion on the other aspects for R17 RedCap | Xiaomi |
| [16] | [R1-2203866](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203866.zip) | Remaining issues on UE complexity reduction | Samsung |
| [17] | [R1-2203992](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203992.zip) | Other remaining issues for Reduced Capability NR Devices | OPPO |
| [18] | [R1-2204036](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204036.zip) | Remaining Issues in UE Complexity Reduction | Nokia, Nokia Shanghai Bell |
| [19] | [R1-2204037](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204037.zip) | Other Remaining Issues in RedCap Support | Nokia, Nokia Shanghai Bell |
| [20] | [R1-2204208](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204208.zip) | Reduced maximum UE bandwidth for Redcap | Apple |
| [21] | [R1-2204209](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204209.zip) | On other UE complexity reduction aspects of RedCap | Apple |
| [22] | [R1-2204277](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204277.zip) | Remaining issues on UE complexity reduction | CMCC |
| [23] | [R1-2204347](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204347.zip) | Maintenance on complexity reduction for RedCap | NTT DOCOMO, INC. |
| [24] | [R1-2204435](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204435.zip) | Remaining details on BWP operation for RedCap | NEC |
| [25] | [R1-2204619](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204619.zip) | Remaining aspects of UE complexity reduction for RedCap | LG Electronics |
| [26] | [R1-2204663](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204663.zip) | Remaining issues on UE complexity reduction for RedCap NR devices | Sharp |
| [27] | [R1-2204711](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204711.zip) | On RedCap UE complexity reduction | MediaTek Inc. |
| [28] | [R1-2204744](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204744.zip) | On remaining aspects related to reduced maximum UE BW | Nordic Semiconductor ASA |
| [29] | [R1-2204771](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204771.zip) | Remaining details on UE complexity reduction for Rel-17 RedCap | Intel Corporation |
| [30] | [R1-2204772](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204772.zip) | Remaining details on support of HD-FDD for Rel-17 RedCap | Intel Corporation |
| [31] | [R1-2204906](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204906.zip) | Remaining issues on RAN2 related issues | Huawei, HiSilicon |
| [32] | [R1-2204987](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204987.zip) | Remaining Issues on UE Complexity Reduction | Qualcomm Incorporated |