3GPP TSG-RAN WG1 Meeting #108-e R1-22xxxxx

e-Meeting, February 21st – March 3rd 2022

**Agenda Item: 8.6.1.2**

**Title: FL summary #1 on other aspects of UE complexity reduction 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].

This document summarizes contributions [3] – [19] submitted to agenda item 8.6.1.2 and relevant parts of contribution [20] submitted to other agenda items and captures this email discussion on other aspects of UE complexity reduction for RedCap:

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| [108-e-R17-RedCap-02] Email discussion for maintenance on other aspects of UE complexity reduction – Chao (Qualcomm)* 1st check point: February 25
* Final check point: March 3
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# HD-FDD

## Issue #1: SSB overlapping with semi-statically configured UL

For collision handling between SSB and semi-statically configured UL transmission, it is noted in contributions [13, 14] that the current specification in clause 17.2 of TS 38.213 only covers the non-overlapping case of “back-to-back” without sufficient gap, and the collision handling for the overlapping case is missing. The following TP is proposed in [13, 14] to implement the agreement for the overlapping case.

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| ===================== Unchanged parts are omitted=====================If a HD-UE would transmit a PUSCH, or PUCCH, or PRACH, or SRS ~~based on a detected DCI format~~ and the HD-UE is indicated presence of SS/PBCH blocks 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.===================== Unchanged parts are omitted ===================== |

**FL1 High Priority Proposal 2.1-1**

* Endorse the above text proposal to TS 38.213, clause 17.2

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| **Company** | **Y/N** | **Comments** |
| Nordic | Y |  |
| Intel | Y | We support the FL proposal. |
| Qualcomm | Y |  |
| vivo | Y |  |
| Nokia, NSB | Y |  |
| CATT | Y |  |
| Spreadtrum  | Y  |  |
| DOCOMO | Y |  |
| Sharp | Y |  |
| Xiaomi | Y |  |
| ZTE, Sanechips | Y |  |
| China Telecom | Y |  |
| LGE | Y (with modification) | We support the text proposal with the modifications as suggested below.===================== Unchanged parts are omitted=====================If a HD-UE would transmit a PUSCH, or PUCCH, or PRACH, or SRS ~~based on a detected DCI format~~ 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* 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.===================== Unchanged parts are omitted ===================== |
| Panasonic | Y |  |
| Samsung | Y |  |
| CMCC |  | Since SSB vs valid RO case is up to UE implementation, here PRACH configured by higher layers should be precluded. We suggest following modification. ===================== Unchanged parts are omitted=====================If a HD-UE would transmit a PRACH based on a detected DCI format, or PUSCH, or PUCCH, ~~or PRACH~~, or SRS ~~based on a detected DCI format~~ and the HD-UE is indicated presence of SS/PBCH blocks 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.===================== Unchanged parts are omitted ===================== |
| Ericsson | Y |  |
| OPPO | Y |  |
| Apple  | Y |  |
| IDCC | Y |  |
| FL2 | LGE’s proposal is one way to go, but it is much preferrable to combine the dynamically scheduled UL and semi-statically configured UL into one paragraph for simple specification. Also, the moderator agrees with CMCC’s comment that PRACH configured by higher layers should be precluded since it has been described in the next paragraph in clause 17.2, 38.213, copied below for your reference.

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| ===================== text from Clause 17.2, TS 38.213=====================If a HD-UE would transmit a PRACH or MsgA PUSCH 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* 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* in a set of symbols, and the HD-UE would transmit PRACH or MsgA PUSCH starting or ending at a symbol that is earlier or later than $N\_{Rx-Tx}⋅T\_{c}$ or $N\_{Tx-Rx}⋅T\_{c}$, 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 |

**There is one question from moderator if we consider the following TP proposed by CMCC:*** Is it necessary to change the highlight “PRACH” in the above cited text to “PRACH triggered by higher layers” if it is understood it is for collision handling between SSB and valid RO.

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| ===================== Unchanged parts are omitted=====================If a HD-UE would transmit a PRACH based on a detected DCI format, or PUSCH, or PUCCH, ~~or PRACH~~, or SRS ~~based on a detected DCI format~~ and the HD-UE is indicated presence of SS/PBCH blocks 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. ===================== Unchanged parts are omitted ===================== |

Moderator would like to invite companies to provide views whether the TP proposed by CMCC can be acceptable or not. |
| Qualcomm | Y | We are fine with the proposal of CMCC  |
| vivo | Y | We are fine with latest TP (FL2) |
| CATT | Y | (1) We think CMCC’s TP is fine. We recall that:DCI triggered PRACH is categorized as ‘dynamic UL’, which will be dropped when overlapped with SSB.PRACH triggered by higher layers (e.g. SR), w.r.t. valid RO, is up to UE implementation when overlapped with SSB.(2) We think FL’s suggestion is also fine and even necessary. ‘Up to UE implementation’ case should only apply to higher layer triggered PRACH. |

## Issue #2: Collision handling between SSB and Msg3 (re)transmission and PUCCH for Msg4/MsgB

For Case 5 of SSB overlapping with UL transmission, the remaining issue is how to handle the collision between SSB and Msg3 (re)transmission and PUCCH for Msg4/MsgB. The following FL proposal was discussed in the last RAN1 meeting but no consensus was achieved.

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| **Updated FL3 High Priority Proposal 5.1-1:*** For Case 5 of SSB overlapping with Msg3 (re)transmission ~~and~~ or PUCCH for Msg4, reuse the existing collision handling principles of Rel-15/16 for NR TDD that SSB is prioritized over Msg3 and PUCCH for Msg4
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Based on the received response, companies’ positions have not changed as compared to last RAN1 meeting.

* 12 companies [03, 06, 07, 08, 09, 10, 12, 13, 15, 16, 18, 19] prefer to reuse the same handling as for other dynamically scheduled UL transmission and prioritize the SSB.
* 3 companies [04, 11, 14] have a preference to prioritize Msg3 or PUCCH for Msg4/MsgB over SSB
* Contribution [06, 11, 20] propose other approach, e.g., leaving it to UE implementation for a compromise

The potential impacts on random access procedure and coexistence with legacy FDD UEs are further analysed and discussed in contributions [04, 06, 07, 09, 12, 13, 15, 16]. Companies’ views are quite divergent. It is viewed in contributions [07, 09, 12, 15, 16] that no critical issues are observed for prioritizing SSB over Msg3 or PUCCH for Msg4/MsgB. However, contribution [04] indicates that the RACH performance will be seriously degraded if Msg3 or PUCCH for Msg4/MsgB is dropped in the overlapped resources.

Since majority does not view any critical issue for prioritizing SSB over Msg3 or PUCCH for Msg4/MsgB, unified solution is desirable considering specification impact [03, 12, 16]. No optimization would be necessary in the maintenance phase while the other option (i.e., drop SSB) may have better scheduling flexibility [08]. Therefore, the moderator suggestion is to reuse the same handling as for other dynamically scheduled UL transmission. If it is not acceptable, then leaving it to UE implementation could be considered for a compromise.

**FL1 High Priority Proposal 2.2-1:**

* 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

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| **Company** | **Y/N** | **Comments** |
| ZTE, Sanechips |  | **Prioritizing SSB or msg3/PUCCH for msg4**If we consider gNB scheduling to avoid the collision of SSB vs msg3/PUCCH for msg4, then actually we do not need to define the priority, since the collision would not happen and we only need to agree gNB scheduling is used to avoid this kind of collision.However, gNB scheduling would have impacts on the NR FDD UE and FD-FDD RedCap UE. More specifically, all the msg3 scheduling for FDD-RedCap UE and HD-FDD RedCap UE would be delayed if msg1 identification is configured, since HD-FDD RedCap UE is not identified. If msg1 identification is not configured, besides FDD-RedCap UE and HD-FDD RedCap UE, NR FDD UE also would be delayed due to the scheduling without identification. For the case that the collision is possible to happen, defining priority for SSB or msg3/PUCCH for msg4 is needed. Prioritizing SSB means the msg3/PUCCH for msg4 would be dropped by the UE(gNB does not know the dropping since gNB does not identify which UE is HD-FDD RedCap UE) when the collision happens. The following issues need to be considered.**From the NW side, prioritizing SSB would cause gNB detection problem**Since the msg3 is dropped and msg3 dropping is not known by gNB, the gNB detection performance by combining msg3 initial transmission and retransmission would be worse. Therefore, the gNB detection problem would be caused if SSB is prioritized and msg3 for HD-FDD RedCap UE is dropped.**From the UE side, prioritizing SSB would cause larger access delay for the UE**The HD-FDD RedCap UE access delay would be larger since the msg3/PUCCH for msg4 is dropped. If msg3/PUCCH for msg4 is prioritized, the access delay is similar as legacy.**Other aspects:*** **Spec impacts:**

according to the agreement from CE

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| AgreementAll slots are considered as available slots for Msg3 repetition for both FD-FDD UEs and HD-FDD RedCap UEs. |

If the overlapped slots are not available for transmission, the dropping rule of msg3 or PUCCH for msg4 should be captured in CE if SSB is prioritized. In this case, the spec impacts also would be increased. However, prioritizing msg3 would not have this kind of spec impacts. * **Regarding receiving SSB:**

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| * “From RAN2 perspective, if a RedCap UE in idle/inactive mode is configured with a separate initial BWP associated with no SSB (CD or NCD) for RACH, it is up to UE implementation to perform new RSRP measurement in a DL BWP associated with CD-SSB before Msg1/A retransmission.”
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RAN2 actually agree that UE implementation can be used for receiving SSB for measurement when RACH procedure on separate initial BWP is configured. Therefore, prioritizing SSB or msg3/PUCCH for msg4 would not impact the SSB receiving for measurement.* **Msg2/msg4 VS SSB need to be handled if SSB is prioritized:**

According to RAN1 agreement:

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| 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.
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Based on this agreement, I will generally think the RACH procedure is prioritized over SSB, which ensures the UE access. Assume SSB is prioritized over msg3/PUCCH for msg4 for measurement, does this mean when SSB overlaps with msg2 and msg4(in separate initial DL BWP), the UE also need to prioritize the SSB and drop the msg2 and msg4 for measurement? In this case, the collision case for SSB overlapping with msg2/msg4 may also need to be handled . **UE implementation**If we consider leave collision of SSB vs msg3/PUCCH for msg4 to UE implementation and UE can choose to prioritize SSB or msg3/PUCCH for msg4, some similar issues can not be avoided.In this case, gNB does not need to avoid the collision by scheduling. However, gNB detection problem still exist, since the gNB can not know the UE behaviour exactly. Also, if the UE choose to prioritize the SSB, access latency and more serious NW congestion also would be caused.Additionally, spec impacts also are caused in CE. That is, if All slots are considered as available slots for Msg3 repetition for both FD-FDD UEs and HD-FDD RedCap UEs, whether to drop msg3 transmission or not is up to the HD-FDD RedCap UE, which should be captured in the spec.Similarly, SSB overlapping with msg2 and msg4 also need to be considered if UE implementation is adopted for collision of SSB vs msg3/PUCCH for msg4. If msg3/PUCCH for msg4 is prioritized, all the above mentioned issues are gone. It is also beneficial for the NW and the UE side. Sorry for the long text, I hope the detailed analysis can reach to all of you and we are clear about all the pros and cons before jump to to conclusion.  |
| Nordic  | Support |   |
| Intel | Y | We support the FL proposal. |
| Qualcomm | Y | Support the FL proposal |
| vivo | Y |  |
| Nokia, NSB | Y | We support the FL proposal. |
| CATT |  | Although FL proposal seems to be a simpler choice and may be acceptable, we want to make it clear that: (1) It is a little strange that a HD-FDD RedCap UE is able to perform the whole random access procedure in a separate initial DL BWP without any SSB (agreed in AI 8.6.1.1), but we still prioritize SSB than Msg3 when it appears…(2) If SSB is prioritized, and considering the following CE agreement:

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| AgreementAll slots are considered as available slots for Msg3 repetition for both FD-FDD UEs and HD-FDD RedCap UEs. |

Additional work is needed to further clarify that for HD-FDD and Msg3 case, SSB will lead to PUSCH dropping in *Step 2* of Rel-17 available slot counting mechanism (CE topic), rather than available slot determination in original *Step 1*. |
| Spreadtrum | Y | From the perspective of complexity, we prefer to support FL proposal. Also, we are open to the issues mentioned by ZTE, if companies think those issues are critical, we can consider other solutions (e.g., Msg 3 PUSCH (or PUCCH for Msg 4) is prioritized). |
| DOCOMO | Y | We don’t see any critical issues for having a unified solution with other dynamically scheduled UL transmission. Regarding the spec impact, we don’t think additional work is necessary for this case, since HD-FDD collision handling is done per symbol basis, not per slot basis, similar to TDD case. |
| Sharp | Y |  |
| Xiaomi | Y |  |
| China Telecom |  | We do not want any impact on CE WI. The comments from ZTE can be further considered and checked.  |
| LGE | Y | Regarding the additional spec impact, similar to DOCOMO, we also don’t think additional work is needed to conform to the CE agreements. |
| Panasonic |  | Seeing the majority view, we accept the FL proposal.  |
| Samsung | Y | Support the FL proposal and would like to share our view further about ZTE explanation.**NW impacts**First of all, the gNB scheduling for the collision avoidance is not a new one because there may be Rel-15 HD-FDD UEs in the cell regardless of the discussion for HD-FDD RedCap UE. In addition, the gNB implementation when the collision is allowed is already existing one because potential missing UL transmissions should be anyway handled in NW side due to UE PDCCH decoding failure or gNB PUCCH mis-detection.**Spec impacts**Regarding the discussion for available slot in CE, we understand it can be related to the discussion (at least for PUSCH) in Issue #7 and then we don’t see a need to have further spec. impact due to SSB prioritization over msg 3/PUCCH for msg4.It is not clear whether SSB overlapping with msg2/msg4 is a really issue because they seems a collision between two different DL signals which may be up to gNB scheduling. |
| CMCC |  | From the perspective of having unified solution, we prefer to support FL proposal. We are also open to discuss the issues mentioned by ZTE. |
| Ericsson |  | Given the comments from ZTE and others, it may be worthwhile to continue the discussion a bit further to understand the potential problems and solutions a bit better. |
| OPPO | Y | There is not major issue to use the handling of dynamical UL. This have least spec change. |
| Huawei, HiSilicon |  | Support the FL proposal. Also open to discuss the issue raised by ZTE. |
| Apple  |  | We support FL proposal to go with preference of majority companies. On the issue raised by ZTE, we share view from Samsung. Since 4G LTE, some implementation-based approach e.g., DTX detection supposed to be implemented already at gNB side to avoid the noise pollution. Even for FD-FDD UE, the deep fading may happen and implement supposed to handle this already.  |
| IDCC | Y |  |
| FL2 | On the issues raised by ZTE, they can be categorized into the following* Performance impact (e.g., gNB DTX detection, RACH latency and coexistence with FD-UE)
* Additional spec impact (e.g., available slot in CE agreement)
* RAN2 LS for RA in a separate initial DL BWP without any SSB
* SSB overlaps with msg2/msg4 in separate initial DL BWP without any SSB

The first performance impact has been discussed a lot. As summarized for contributions, the majority does not view any critical performance issue for prioritizing the SSB, and only one company has a different view. In moderator view, further discussion on performance impact could not help to make progress if just to repeat the same argument.Regarding additional spec impact related to CE agreement, moderator shares the same view as companies (DOCOMO, LGE, Samsung) that there is no need to have further spec. impact due to SSB prioritization over msg 3/PUCCH for msg4 since dropping msg3 repetition in the available slots with SSB transmission will be straightforward when following the agreed collision rules. The third and fourth issues are related to the configuration of a separate initial DL BWP without CD-SSB. In moderator view, it will be discussed in AI 8.6.1.1. According to the RAN2 LS, it is up to UE implementation to perform RSRP measurement in a DL BWP with CD-SSB before Msg1/A transmission. Therefore, from UE perspective, the collision b/w SSB and Msg3/A may also happen even for the case of the separate initial DL BWP for RACH not including any SSB. Similarly, SSB overlapping with msg2/4 may happen also for FD-FDD UEs. But as commented by Samsung, this can be handled by gNB scheduling. At least in moderator view, there is no change compared to previous discussion. Probably one thing that can be further clarified is UE behaviour for collision handling when a separate initial DL BWP without any SSB is configured, for which we can wait for the outcome of AI 8.6.1.1. **FL2 High Priority Proposal 2.2-1:*** 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 at least for the case of a separate initial DL BWP without CD-SSB not configured for RedCap UEs
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| ZTE, Sanechips | N | According to the last round discussion, compared with prioritizing msg3/PUCCH for msg4, the following observation maybe for sure can be achieved for prioritizing SSB1. Performance degradation for CE. Msg3 repetition with RV is supported in CE. Dropping the msg3, e.g., with RV0, would cause worse decoding performance.
2. Increased PDCCH missing (DTX detection) probability. msg3 dropping by HD-FDD UE would make gNB misunderstand that the PDCCH is missing. This would increase the probability of PDCCH missing compared with legacy.
3. Larger access delay for the UE. The maximum delay for prioritizing SSB(compared with prioritizing msg3/PUCCH for msg4) is far more than a few slots,since corresponding retransmission, PDCCH transmission and 4-step fallback from 2-step RACH may cause a large delay.
4. Impacts on the system efficiency. Due to the larger access delay, the retransmitted gNB scheduling, resource wasting and PDCCH blocking would be caused.

After discussion, the following is also reaching to us: For the impacts on legacy UE, this may be avoided by gNB implementation which may bring complexity for gNB. For the additional spec impact for CE, even msg3 dropping related may need to be clear for CE, this could be captured in the future, instead of further impacts compared with current spec. Based on above observation, prioritizing msg3/PUCCH for msg4 is obviously better. Other issues need to be confirmed:1. Whether the collision rule for 4-step RACH is alsp appled for 2-step RACH
2. Whether all the RACH procedure(after msg1), including msg2/msg3/msg4 and PUCCH for msg4, have the unified solution

Regarding the Proposal 2.2-1,We are not sure whether the sentence should be ‘at least for the case of a separate initial DL BWP without CD-SSB ~~not~~ configured for RedCap UEs’ When the separate initial DL BWP is only configured for RACH, it is also agreed that UE does not expect SSB, it is strange to prioritize SSB. |
| Qualcomm | Y | In our view, msg3/PUCCH transmission of UE needs to meet the UL timing error limit specified by RAN4 (e.g. Clause 7.1.2, TS 38.133). If the UL timing requirements cannot be satisfied, msg3/PUCCH transmission of the UE may interfere with other UE’s UL signals/channels. Therefore, we think the proposal of FL is reasonable. |
| FL3 | I would like to clarify the FL proposal to address ZTE’s question. In moderator view, if a separate DL-BWP without CD-SSB is not configured (i.e., shared initial DL BWP), then there is SSB in the shared initial DL BWP and collision rule is needed to address potential overlapping between SSB and Msg3 or PUCCH for Msg4.If a separate DL-BWP without CD-SSB is configured, then according to RAN2 LS, it is up to UE implementation to perform RSRP measurement in a DL BWP associated with CD-SSB before Msg1/MsgA transmission. Therefore, even there is no SSB in the separate DL-BWP, there is still potential collision with Msg3 or PUCCH for Msg4/B due to the switching. This is my understanding for ZTE’s comment for the RAN2 LS and the issue of SSB overlapping with Msg2/Msg4. That is the reason why an additional condition is added to the updated FL proposal. In moderator view, this will be discussed in AI 8.6.1.1, and based on the outcome we can revisit or update the proposal for the case of the separate initial DL BWP without CD-SSB for RedCap UEs.At least in moderator view, there is no critical performance issue for the case of shared initial DL BWP due to SSB prioritization over msg 3/PUCCH for msg4. Moderator would like to invite companies to provide their views on the performance issues raised by ZTE. |
| Huawei, HiSilicon |  | We’d like to understand more about FL understanding. Our reading of RAN2 LS is talking about Msg1/A reTx for which the UE should either have decoded Msg2 or without receiving Msg2. It should not be interpreted as a UE can discard potential gNB feedback in RAR to randomly perform new RSRP measurement whenever it wants. |
| vivo | Fine with the modifications | We are generally fine to go step by step, although it has been very clear that the FL1 proposal has unanimous support except one company.We would like to make some modification to the FL2 proposal to make it clearer what is agreed and what is FFS. Updated **FL2 High Priority Proposal 2.2-1:*** 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 at least for the case when ~~a~~ separate initial DL BWP is not configured, or when a sepreate initial DL BWP is configured with CD-SSB. ~~without CD-SSB not configured for RedCap Ues~~
	+ FFS for the case when a seperate initial DL BWP is configured wihtout CD-SSB
 |
| CATT | FFS | (1) We have a different view on the collision case when separate initial DL BWP is configured without CD-SSB.RAN2 LS says ‘it is up to UE implementation to perform RSRP measurement in a DL BWP associated with CD-SSB before Msg1/MsgA transmission’, this is true. But once UE transmits Msg1, before finishing RACH procedure, we do not think UE should switch outside the separate initial DL BWP to receive SSB. There should be no BWP switching/retuning during the RACH procedure. RAN2 only agree that, between two independent RACH procedure (i.e. Msg1 fails, retransmission of Msg1 happens), it is up to UE to measure CD-SSB outside the BWP.In short, we think it is more reasonable to apply SSB-related dropping rules only if SSB exists in the current BWP. (2) Frankly speaking, I feel that most companies do not get the point of impact on available slot counting in CE topic. Let me explain a bit more since I attend both topics:- For current HD-FDD operation of available slot counting, UE determines available slot based on **RRC configuration** (*ssb-PositionsInBurst*) in Step 1, and transmits PUSCH on available slots in Step 2. Any dropping due to dynamic signaling would happen in Step 2, but no more postpone. Clearly, SSB will not lead to dropping in Step 2 in current mechanism.- For HD-FDD operation of Msg3, *if prioritizing SSB than Msg3*, and combining the following agreement from CE topic:

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| AgreementAll slots are considered as available slots for Msg3 repetition for both FD-FDD UEs and HD-FDD RedCap UEs. |

We will have the following consequence. The HD-UE determines available slot regardless SSB configuration, but still have to drop overlapping Msg3 in Step 2. Therefore, SSB will lead to dropping in Step 2 in this case. This is something new, because RRC configuration (*ssb-PositionsInBurst*) causes dropping in Step 2.That’s why we think prioritizing SSB than Msg3 will have additional spec impact on CE topic on the mechanism of available slot counting, as shown above. This is not related to Issue #7. On the contrary, if we prioritize Msg3, HD-FDD UE is just the same with FD-FDD UE, so no additional impact.I hope everyone aware of this before making decision.  |

## Issue #3: Whether to support other cases of the “back-to-back” non-overlapping UL/DL without sufficient gap

In the RAN1#106b-e and 107-e meeting, the following were agreed for the “back-to-back” non-overlapping UL/DL without sufficient gap. The remaining issues is whether to allow other cases of the “back-to-back non-overlapping UL/DL without sufficient gap, e.g., between dedicated configured DL and dedicated configured UL, between dynamically scheduled DL and RRC configured UL, or between RRC configured DL and dynamically scheduled UL.

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| Agreements:* (Working Assumption) The “back-to-back” non-overlapping UL/DL without sufficient gap between RRC configured UL and DL may happen, i.e., are allowed for HD-FDD UEs.
	+ RRC configured DL/UL includes at least cell specific higher layer parameters configured DL/UL
	+ Discuss further whether to specify a clear UE behavior, or leave it to UE implementation to ensure that the switching time is satisfied
	+ Note: This does not mean a HD-FDD UE is required to support the back-to-back UL/DL switching without sufficient gap

Agreement: * For the case of the “back-to-back” non-overlapping UL/DL without sufficient gap between cell specific configured DL and cell-specific configured UL, e.g., SSB or PDCCH in CSS vs. valid RO, it is up to UE implementation to ensure that the switching time is satisfied

Agreement: * The “back-to-back” non-overlapping UL/DL without sufficient gap between cell-specific configured DL and dedicated configured UL may happen, i.e., allowed for HD-FDD UEs
	+ E.g., SSB vs. CG PUSCH, PUCCH or SRS
	+ Configured UL transmission is cancelled (as in the overlapping case)
* The “back-to-back” non-overlapping UL/DL without sufficient gap between dedicated configured DL and cell-specific configured UL may happen, i.e., allowed for HD-FDD UEs
	+ E.g., PDCCH in USS, SPS PDSCH, CSI-RS or DL PRS vs. valid RO
	+ Leave it to UE implementation to cancel either DL reception or UL transmission to ensure sufficient switching time
 |

In contribution [16], it is proposed that all the other cases of the “back-to-back” non-overlapping UL/DL without sufficient gap are not allowed since it is easier for gNB to avoid collision when performing dedicated configuration or dynamic scheduling. Contributions [04, 19] have a different view that the scenarios involved with dynamic DL/UL should be allowed and the corresponding collision handling principles as in the overlapping cases can be applied.

According to [21], the motivation for supporting the “back-to-back” non-overlapping UL/DL without sufficient gap is to efficiently support coexistence with FD-FDD UEs and relax network configuration restriction, there is no strong need to extend to other subcases which would be managed by proper gNB implementation. Considering no optimization would be necessary in the maintenance phase, the following FL proposal can be considered to conclude the discussion.

**FL1 Medium Priority Proposed Conclusion 2.3-1**

* All the other cases of the “back-to-back” non-overlapping UL/DL without sufficient gap are not allowed

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| **Company** | **Y/N** | **Comments** |
| Nordic  | N |  |
| Intel | Y | We support the FL proposal.  |
| Qualcomm |  | If a cell allows HD-FDD RedCap UE to access, at least the “back-to-back” non-overlapping UL/DL without sufficient gap are not allowed in RRC connected mode. |
| Vivo | Y |  |
| CATT | Y | In last meeting we should aware that gNB can easily avoid such cases, if at least one of the channel is ‘UE dedicated configured’ or ‘dynamically scheduled’ |
| DOCOMO | Y |  |
| Xiaomi | Y |  |
| ZTE, Sanechips | Y | Similar view with CATT. Additionally,a clarification is needed, that is, if ‘partial cancellation’ is supported, does it also use the same solution to ensure sufficient gap? |
| China Telecom | Y | We are fine with FL proposal. |
| LGE | Y | Not a strong preference, but we are fine with the FL proposal. |
| Samsung | Y | We believe it was already discussed in RAN1#107-e and so we understand the consensus was to remove other cases from the FL proposal 5.3-1. |
| CMCC | Y |  |
| OPPO | No | We wondering How to define the “without sufficient gap”. Our understanding is not conclusion in meeting say it is Ntx-rx or Nrx-tx. We need clarify that before we introduce other cases.We see no problem to not specific those cases are not allowed. |
| Huawei, HiSilicon |  | If the sufficient gap by the gNB implementation for the non-overlapping cases involved with dynamic DL/UL can be assumed, then follow this logic, the overlapping cases involved with dynamic DL/UL does not need to be discussed because the gNB can also avoid the dynamic scheduled DL/UL to be overlapped with configured UL/DL.Therefore, we still think the other cases of the “back-to-back” non-overlapping cases involved with dynamic DL/UL without sufficient gap should be allowed.  |
| Apple  | Y | The other cases can be avoided by gNB implementation since it is UE-specific and no impact on the legacy UEs or system performance loss.  |
| IDCC | Y |  |
| FL2 | Based on received response, majority supports the FL proposal and only 3 companies have different view and prefer to specify other cases involved with dynamic DL/UL.Since the WID requests the minimum specification impact for supporting HD-FDD, a new rule is introduced to HD-FDD only when it is necessarily needed. Therefore, we need to know whether there is any critical issue if we do not support other cases of the “back-to-back” non-overlapping cases without sufficient gap involved with dynamic DL/UL. At viewed by moderator, TDD has similar issues for collision with switching gap, but no such rules are defined for dynamic UL/DL.If we cannot agree this issue is essential, the moderator suggestion is to re-consider the following FL proposal. **FL1 Medium Priority Proposed Conclusion 2.3-1*** All the other cases of the “back-to-back” non-overlapping UL/DL without sufficient gap are not allowed
 |
| Qualcomm | Y |  |
| Huawei,HiSilicon | Can be Ok |  |
| vivo | Y |  |
| CATT | Y |  |

## Issue #4: PRACH overlapping with dynamically scheduled PDSCH or CSI-RS

Contribution [06] indicates that the text related to PRACH for collision handling between semi-statically configured UL and dynamically scheduled PDSCH or CSI-RS should be deleted since RAN1 has agreed that whether to transmit PRACH is up to UE implementation, which is already captured in another paragraph in TS 38.213, clause 17.2.

The corresponding TP proposed by [06] is as follows.

|  |
| --- |
| ===================== Unchanged parts are omitted=====================If a HD-UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH in a set of symbols and the UE detects a DCI format indicating to the HD-UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols, then - 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 $T\_{proc,2 }$ 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]~~, or the PRACH transmission in the set of symbols~~.- the HD-UE does not expect to cancel the transmission of SRS in symbols from the subset of symbols that occur within $T\_{proc,2}$ relative to a last symbol of a CORESET where the HD-UE detects the DCI format. The HD-UE cancels the SRS transmission in remaining symbols from the subset of symbols. $T\_{proc,2}$ is the PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming $d\_{2,1}=1$ and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15 kHz or larger; otherwise $μ\_{r}=0$.===================== Unchanged parts are omitted ===================== |

**FL1 High Priority Proposal 2.4-1**

* Endorse the above text proposal to TS 38.213, clause 17.2

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Intel | Y | We support the TP since PRACH is not included in Case 1 overlapping |
| Qualcomm | Y |  |
| vivo | Y | Following correction is also needed to remove the PRACH part. ================== Unchanged parts are omitted===================If a HD-UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH in a set of symbols and the UE detects a DCI format indicating to the HD-UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols, then - 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 $T\_{proc,2 }$ 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]~~, or the PRACH transmission in the set of symbols~~.- the HD-UE does not expect to cancel the transmission of SRS in symbols from the subset of symbols that occur within $T\_{proc,2}$ relative to a last symbol of a CORESET where the HD-UE detects the DCI format. The HD-UE cancels the SRS transmission in remaining symbols from the subset of symbols. $T\_{proc,2}$ is the PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming $d\_{2,1}=1$ and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the SRS, PUCCH, PUSCH ~~or~~ $μ\_{r}$~~, where~~ $μ\_{r}$ ~~corresponds to the SCS configuration of the PRACH if it is 15 kHz or larger; otherwise~~ $μ\_{r}=0$.================ Unchanged parts are omitted ================== |
| Nokia, NSB | Y |  |
| CATT | Y | Also fine with vivo’s additional update. |
| Spreadtrum | Y | Additional update from vivo is reasonable. |
| DOCOMO | Y | Also support the update from vivo |
| Sharp | Y | Also fine with vivo’s update. |
| Xiaomi | Y | Also support vivo’s update |
| ZTE, Sanechips | Y | We are fine with vivo’ updated TP. |
| China Telecom | Y | We are fine with vivo’s update. |
| LGE | Y | Also fine with the correction from vivo. |
| Panasonic | Y | We also support vivo’s update. |
| Samsung | Y | Also, OK with vivo’s update. |
| CMCC | Y | We are fine with vivo’s update. |
| Intel2 | Y | We also support vivo’s update. |
| Ericsson | Y | Also fine with Vivo’s update. |
| OPPO | Y |  |
| Huawei, HiSilicon | Y | Also fine with Vivo’s update. |
| Apple | Y | Support vivo’s additional update as well.  |
| IDCC | Y |  |
| FL2 | Based on the received response, the TP is updated as follows (same as vivo’s update). **FL2 High Priority Proposal 2.4-1** * Endorse the following text proposal to TS 38.213, clause 17.2

|  |
| --- |
| ===================== Unchanged parts are omitted=====================If a HD-UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH in a set of symbols and the UE detects a DCI format indicating to the HD-UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols, then - 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 $T\_{proc,2 }$ 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]~~, or the PRACH transmission in the set of symbols~~.- the HD-UE does not expect to cancel the transmission of SRS in symbols from the subset of symbols that occur within $T\_{proc,2}$ relative to a last symbol of a CORESET where the HD-UE detects the DCI format. The HD-UE cancels the SRS transmission in remaining symbols from the subset of symbols. $T\_{proc,2}$ is the PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming $d\_{2,1}=1$ and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the SRS, PUCCH, PUSCH ~~or~~ $μ\_{r}$~~, where~~ $μ\_{r}$ ~~corresponds to the SCS configuration of the PRACH if it is 15 kHz or larger; otherwise~~ $μ\_{r}=0$.===================== Unchanged parts are omitted ===================== |

 |
| Qualcomm | Y |  |
| Huawei,HiSilicon | Y |  |
| vivo |  | This TP has been agreed online session today.  |
| CATT |  | Already agreed |

## Issue #5: Partial UL cancelation

It is noted in contributions [04, 06] that the current specification in the clause 17.2 of TS 38.213 does not consider whether HD-FDD UE supports partial cancellation or not. Considering partial cancellation is an optional capability introduced in Rel-16, it can be supported by HD-FDD RedCap UE as an optional capability too. Therefore, contributions [04, 06] suggest RAN1 to reach consensus on whether HD-FDD RedCap UE can optionally support partial cancellation. The corresponding TP proposed by [06] is as follows.

|  |
| --- |
| ===================== Unchanged parts are omitted=====================If a HD-UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH in a set of symbols and the UE detects a DCI format indicating to the HD-UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols, then - If the HD-UE does not indicate the capability of [partialCancellation], 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 $T\_{proc,2 }$ 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], or the PRACH transmission in the set of symbols.- If the HD-UE indicates the capability of [partialCancellation], the HD-UE does not expect to cancel the transmission of the PUCCH or PUSCH in symbols from the set of symbols that occur within $T\_{proc,2}$ relative to a last symbol of a CORESET where the HD-UE detects the DCI format. The HD-UE cancels the PUCCH, or the PUSCH, or an actual repetition of the PUSCH [6, TS 38.214], determined from clauses 9 and 9.2.5 or clause 6.1 of [6, TS 38.214]. - the HD-UE does not expect to cancel the transmission of SRS in symbols from the subset of symbols that occur within $T\_{proc,2}$ relative to a last symbol of a CORESET where the HD-UE detects the DCI format. The HD-UE cancels the SRS transmission in remaining symbols from the subset of symbols.  $T\_{proc,2}$ is the PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming $d\_{2,1}=1$ and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15 kHz or larger; otherwise $μ\_{r}=0$.===================== Unchanged parts are omitted ===================== |

**FL1 High Priority Proposal 2.5-1**

* Endorse the above text proposal to TS 38.213, clause 17.2

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Intel | N | We prefer to not support capability [partialCancellation] for HD-UE. Otherwise, it results in a tricky handling “back-to-back” non-overlapping UL/DL without sufficient gap after handling [partialCancellation], and may need further discussions. |
| Qualcomm | Y |  |
| vivo | N | We prefer not to support partial cancellation for RedCap UEs |
| Nokia, NSB |  | We have slight preference not to support partialCancellation to simplify collision handling due to the gap |
| CATT | Y | By default a RedCap UE can optionally support optional features from normal UE. Considering that partialCancellation is already supported in TDD for normal UE, it should be fine to apply in HD-FDD case for RedCap UE.If this is not agreeable, instead, we may draw a conclusion that HD-FDD RedCap UE does not support partialCancellation, and inform this conclusion to AI 8.16.8.  |
| DOCOMO | N | We agree that RedCap UE can optionally support optional features by default. However, if partial cancellation is supported for HD-FDD UE, further discussion is necessary for the case of “back-to-back” non-overlapping UL/DL without sufficient gap, as pointed out by Intel. Also, there would be no strong motivation to introduce partial cancellation for RedCap UEs. Considering the maintenance phase, we don’t think this issue is essential and prefer not to support partial cancellation for HD-FDD UE.By the way, if partial cancellation is supported for HD-FDD UE, it should be discussed whether existing capability FG 22-9 can be reused for HD-FDD UE since it was defined for TDD case in Rel-16. If not, it has RAN2 signalling impact, which must be concluded as soon as possible. |
| ZTE, Sanechips |  | If ‘partialCancellation’ is supported, the HD-FDD RedCap UE may not drop the whole transmission of PRACH/PUCCH/PUSCH when collision happens, and can transmit the non-overlapping part of PRACH/PUCCH/PUSCH especially when transmission with repetitions is supported for the above UL channels. So, there are some benefits for supporting partialCancellation. Before we discuss the TP, we may need to consider the following two options:Option1: RedCap UE does not support partialCancellationOption 2: Only HD-FDD RedCap UE does not support partialCancellation |
| LGE | N | We prefer the RedCap UEs not to support partialCancellation. As the opinion on whether to support the partialCancellation is quite divided, and given this is a maintenance phase, we will have to quickly conclude on this first. |
| Panasonic | N | Our preference is not to support it as it requires further discussion. |
| Samsung | Y | There is no clear reason to exclude it from HD-FDD RedCap UE. Similar to other UE features, it can be optionally supported by HD-FDD RedCap UEs. |
| CMCC |  | We are open to further discuss this since both supporting or not supporting partialCancellation lead to other problems. As our comment to Proposal 2.6-1, if partialCancellation is not supported for RedCap, the definition of available slots for PUCCH needs to be reconsidered. |
| Ericsson |  | We tend to agree that ZTE’s two options should be considered before spending too much time on HD-FDD handling for partialCancellation. |
| OPPO | N | partialCancellation will introduce another different capability which is not needed for low capability UE. |
| Huawei, HiSilicon |  | We prefer the RedCap UEs including the FD-FDD and HD-FDD not to support partialCancellation. |
| Apple | N | Our preference is that HD-FDD Redcap device does not support partial cancelation to reduce the complexity/cost and minimize the spec impacts.  |
| IDCC |  | We also think that partial cancellation may not be needed for RedCap UEs. We may discuss ZTE’s options to move forward. |
| FL2 | Based on the received response, 4 companies support [partialCancellation] capability for HD-FDD UE, but 10 companies prefer not to support [partialCancellation] for HD-FDD UE or RedCap UEs since it requires further discussion for some collision handling cases and potential RAN2 signalling impact, and such optimization seems unnecessary during maintenance phase. For the two options proposed by ZTE, as understood by moderator there is no partial UL cancelation defined for FD-FDD UEs. Therefore, it may be okay to conclude RedCap UEs including the FD-FDD and HD-FDD are not required to support partialCancellation. With this conclusion, no TP is needed for TS 38.213.**FL2 High Priority Proposed Conclusion 2.5-1*** RedCap UEs are not required to support [partialCancellation] capability in Rel-17
 |
| Qualcomm | Y |  |
| Huawei, HiSilicon |  | The proposal would be simply read as optional support, therefore issue still exists. |
| vivo | Modification needed | Similar to Huawei’s comment, we think the current proposal does not address the issue, as [partialCancellation] is an optional feature, saying UE is not required to support an optional feature is always true but does not provide much information.We think the intention was to say RedCap UE does support [partialCancellation] from specification point of view, suggest the following modification**Updated FL2 High Priority Proposed Conclusion 2.5-1*** From specification point of view, RedCap UEs ~~are not required to~~ do not support [partialCancellation] capability in Rel-17
 |
| CATT | Y | OK for progress. This should be informed to AI 8.16.6 once agreed. |

## Issue #6: Available slots for PUCCH repetition

In contributions [13, 17], it is indicated that the HD-FDD UE behaviour on determining the available slots for PUCCH repetition is unclear, thereby proposing that HD-FDD UE determines a slot as an available slot for PUCCH repetitions when a PUCCH repetition does not overlap with a symbol with synchronization signal block (SSB) transmission indicated by *ssb-PositionsInBurst.* The corresponding TP proposed for TS 38.213 by [13] is as follows.

|  |
| --- |
| 9.2.6 PUCCH repetition procedure\*\*\* Unchanged text is omitted \*\*\*For paired spectrum or supplementary uplink band, the UE, except when it is a half-duplex UE, determines the $N\_{PUCCH}^{repeat}$ slots for a PUCCH transmission as the $N\_{PUCCH}^{repeat}$ 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\*\*\* Unchanged text is omitted \*\*\*17.2 Half-Duplex UE in paired spectrum\*\*\* Unchanged text is omitted \*\*\*A HD-UE determines the $N\_{PUCCH}^{repeat}$ 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, where a repetition of the PUCCH transmission does not include a symbol indicated as a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.\*\*\* Unchanged text is omitted \*\*\* |

Contribution [08] expresses a similar view that the following conclusion at RAN1#106-e meeting can be also applied to HD-FDD case to have a unified solution with TDD.

|  |
| --- |
| **Conclusion**It is clarified that a PUCCH repetition in case  (including the first PUCCH repetition) is postponed to the next available slot if the PUCCH repetition collides with SSB symbols or symbols indicated as DL by*tdd-UL-DL-ConfigurationCommon*or*tdd-UL-DL-ConfigurationDedicated***.*** There is no consensus in RAN1 for whether or not the above case issupported in Rel-15 for the first PUCCH repetition when the PUCCH is triggered by DCI.
 |

**FL1 High Priority Proposal 2.6-1**

* HD-FDD UE determines a slot as an available slot for PUCCH repetitions when a PUCCH repetition does not overlap with a symbol with synchronization signal block (SSB) transmission indicated by *ssb-PositionsInBurst*

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Intel | Y | We support the FL proposal  |
| Qualcomm |  | It is unclear to us if PUCCH repetitions are supported in a separate initial UL BWP of RedCap UE without SSB. If the proposal is for RRC connected mode only, we support the FL proposal when SSB is present in the dedicated DL BWP of RedCap UE. |
| Vivo | Y |  |
| Nokia, NSB | Y |  |
| CATT | Y |  |
| Spreadtrum | Y |  |
| DOCOMO | Y | Our understanding is that PUCCH repetition is supported for RRC connected mode only |
| Sharp |  | We would like to first clarify the meaning of ‘overlap with a symbol with SSB’.In previous agreements, we support the case that “back-to-back” non-overlapping UL/DL without sufficient gap between SSB and configured PUCCH may happen. And it was agreed that this case would be treated as the overlapping case, i.e., the configured UL transmission is cancelled. Therefore, we would like to ask FL whether the proposal 2.6-1 includes the case of “back-to-back” non-overlapping UL/DL without sufficient gap for configured UL PUCCH or not. |
| ZTE, Sanechips | N | From our understanding, is only for RRC connected mode. When the PUCCH is overlapped with SSB, according to the agreement, SSB is prioritized.Based on this proposal, the HD-FDD RedCap UE need to firstly switch to SSB for receiving. After SSB reception, the UE need to switch back to PUCCH transmission. Moreover, the sufficient switching gap before and after SSB should be provided, i.e., 2 gaps are needed for switching, which is quite complicated for the UE.Additionally, if the optional partialCancellation is not supported or enabled, if the PUCCH is dropped due to the collision handling rule, the whole PUCCH transmission is canceled and no any postponement is needed. |
| LGE | Y | We would be fine with the FL proposal in that it is same handling as in TDD.Regarding the question from Sharp, it is our view that the “back-to-back” non-overlapping UL/DL without sufficient gap should be regarded as the overlapping case throughout the spec for consistency. |
| Panasonic | Y |  |
| Samsung |  | We share Sharp’s question about the case of “back-to-back” non-overlapping UL/DL without sufficient gap for configured UL PUCCH and then it should be addressed. |
| CMCC |  | If partialCancellation is not supported for RedCap, we wonder whether it needs to define available slots since the whole PUCCH transmission is canceled. |
| Intel2 | Y | Our understanding is that back-to-back” non-overlapping UL/DL without sufficient gap is handled differently from overlap between UL and a SSB. For all UL (PUSCH and PUCCH), * the available slot is determined by checking the overlap between the UL and a SSB. If a slot is not available, the PUSCH or PUCCH repetition can be delayed to a next available slot.
* After the determination of available slot, UE can further check if a PUSCH or PUCCH repeition can be transmitted by checking back-to-back” non-overlapping UL/DL without sufficient gap. If it cannot be transmitted, the PUSCH or PUCCH repeition is dropped without delaying.
 |
| Ericsson | Y | Perhaps it is good to clarify that this only concerns connected mode (since different UE behaviour for FD-FDD and HD-FDD could be problematic in idle/inactive mode where gNB may not be aware whether the UE is an FD-FDD or HD-FDD UE). |
| OPPO |  | We share similar questions by Sharp.Further, we also this it is unclear how to interpreted the “sufficient gap” in the agreements. |
| Huawei, HiSilicon | Y |  |
| Apple  | Y |  |
| IDCC | Y |  |
| FL2 | The moderator shares the same view as majority that the proposal concerns only RRC connected mode since PUCCH repetition is supported only for RRC connected mode based on the existing specification.For Sharp’s question about the case of “back-to-back” non-overlapping UL/DL without sufficient gap, the moderator agrees it should be addressed. From the received response, there are two different views or options.* Option 1: The slot where PUCCH repetition is back-to-back to SSB but without sufficient gap is not counted as the available slots
	+ Proposed by Sharp, LGE
* Option 2: The slot where PUCCH repetition is back-to-back to SSB but without sufficient gap can be counted as the available slots but the transmission of PUCCH repetition in the slot is dropped
	+ Propsed by Intel

In moderator view, both options are aligned with the RAN1#107-e agreement to cancel configured UL for the case of non-overlapping with SSB but without sufficient gap. Moderator supports more company to provide their views on the two options.**@OPPO**, as discussed in section 2.8, it is clarified by many companies that the gap time is same as the UL/DL switching time, i.e., *NRX-TX Tc* and *NTX-RX Tc* in TS 38.211, Table 4.3.2-3. Do you view any issue with this clarification?**@CMCC,** as understood by moderator,there is no dependency between the definition of the available slots for PUCCH repetition and partialCancellation capability. According to the current specification, it is possible for TDD UE to drop a PUCCH or PUSCH repetition in the available slots according to Rel-15/16 drop rules. This can be also reused for HD-FDD UEs.**FL2 High Priority Proposal 2.6-1*** For PUCCH repetition in RRC connected state, down-select between the following two options during RAN1#108-e:
	+ Option 1: HD-FDD UE determines a slot as an available slot for PUCCH repetitions when a PUCCH repetition starts or ends at least $N\_{Rx-Tx}⋅T\_{c}$ or $N\_{Tx-Rx}⋅T\_{c}$, respectively, from the last or first symbol in the set of symbols with synchronization signal block (SSB) transmission indicated by *ssb-PositionsInBurst*
	+ Option 2: HD-FDD UE determines a slot as an available slot for PUCCH repetitions when a PUCCH repetition does not overlap with a symbol with synchronization signal block (SSB) transmission indicated by *ssb-PositionsInBurst*
 |
| Qualcomm | Y | We support Option 1  |
| vivo |  | We are fine to further discuss, but have following comments to the proposals.1. In option 2, how to handle the case when PUCCH repetition collides with Rx/Tx swtiching gap is not clear and would need to be clarified. We expect partial PUCCH transmission will not be considered, but still there could be differnt interpretations.
	1. Interpretation 1: The case where a PUCCH repetition collides with Rx/Tx switching time around SSB is error case, i.e. should be avoided by gNB scheduling or configuration
	2. Interpretation 2: The case where a PUCCH repetition collides with Rx/Tx switching time around SSB is valid case and UE drops the collidng PUCCh repetition

There could be even hybrid interpretation where dynamic sceduled PUCCH repetition follows interpretation 1 and higher layer configured PUCCH repetition follows interpretation 2? Clarification for option 2 would be necessary before downselection, while option 1, the expected UE behavior is clear. 1. Since the collision also happens for NCD-SSB, and it is not clear yet the existing parameter ssb-PositionsInBurst will be directly reused for NCD-SSB and whether additional parameters will be introduced, e.g. periodicity, time offset etc, it would be safer to delete ” indicated by ssb-PositionsInBurst” in both options for now.
 |
| CATT | Y | Option 1 seems reasonable.  |

## Issue #7: Omitting condition of DL/UL collision for HD-FDD

Contribution [17] indicates the omitting condition of DL/UL collision handling for HD-FDD, which is specified in Clause 17.2 in TS 38.213, has not yet been reflected in the TS 38.214. The corresponding TP proposed by [17] is as below.

|  |
| --- |
| ======TP to TS 38.214 V17.0.0 ======5.1.2.1 Resource allocation in time domain< unchanged text omitted>A PDSCH reception in a slot of a multi-slot PDSCH reception is omitted according to the conditions in Clause 11.1 and Clause 17.2 of [6, TS38.213].< unchanged text omitted>6.1.2.1 Resource allocation in time domain< unchanged text omitted>For PUSCH repetition Type A and TB processing over multiple slots, a PUSCH transmission in a slot of a multi-slot PUSCH transmission is omitted according to the conditions in Clause 9, Clause 11.1, ~~and~~ Clause 11.2A and Clause 17.2 of [6, TS 38.213]. < unchanged text omitted>For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 9, Clause 11.1, ~~and~~ Clause 11.2A and Clause 17.2 of [6, TS 38.213]. The UE shall repeat the TB across actual repetitions. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2, where *N*=1. For PUSCH repetition Type B, when a UE receives a DCI that schedules aperiodic CSI report(s) or activates semi-persistent CSI report(s) on PUSCH with no transport block by a ‘*CSI request’* field on a DCI, the number of nominal repetitions is always assumed to be 1, regardless of the value of *numberOfRepetitions*. When the UE is scheduled to transmit a PUSCH repetition Type B with no transport block and with aperiodic or semi-persistent CSI report(s) by a ‘*CSI request’* field on a DCI, the first nominal repetition is expected to be the same as the first actual repetition. For PUSCH repetition Type B carrying semi-persistent CSI report(s) without a corresponding PDCCH after being activated on PUSCH by a ‘*CSI request’* field on a DCI, if the first nominal repetition is not the same as the first actual repetition, the first nominal repetition is omitted; otherwise, the first nominal repetition is omitted according to the conditions in Clause 9, Clause 11.1, ~~and~~ Clause 11.2A and Clause 17.2 of [6, TS 38.213].< unchanged text omitted>6.1.2.3.1 Transport Block repetition for uplink transmissions of PUSCH repetition Type A with a configured grant< unchanged text omitted>A Type 1 or Type 2 PUSCH transmission with a configured grant in a slot is omitted according to the conditions in Clause 9, Clause 11.1, ~~and~~ Clause 11.2A and Clause 17.2 of [6, TS 38.213]. < unchanged text omitted> |

**FL1 High Priority Proposal 2.7-1**

* Endorse the above text proposal to TS 38.214

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Intel | Y | We support the FL proposal. |
| Vivo | Y |  |
| Nokia, NSB | Y |  |
| CATT | Y |  |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Sharp | Y |  |
| ZTE, Sanechips | Y |  |
| China Telecom | Y |  |
| LGE | Y | Fine with the proposal. |
| Samsung | Y |  |
| CMCC | Y |  |
| Ericsson | Y |  |
| OPPO | Y |  |
| Huawei, HiSilicon | Y |  |
| Apple  | Y |  |
| IDCC | Y |  |

## Issue #8: Collision with switching gap

Contributions [05, 13] raise concern on the following text in the clause 17.2 of TS 38.213.

In [13], it is commented that since the logic between the first condition (red) and the second condition (yellow) is essentially ‘OR’, UE will always drop any PUSCH or PUCCH if the PUSCH or PUCCH is not overlapped with the SSB. It is proposed to fix the problem by adding a logic ‘AND’ to the two conditions.

|  |
| --- |
| 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*, the HD-UE does not transmit - PUSCH or PUCCH if a last symbol of the PUSCH or PUCCH transmission would not be at least $N\_{Tx-Rx}⋅T\_{c}$ [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 $N\_{Rx-Tx}⋅T\_{c}$ [4, TS 38.211] after a last symbol of the previous latest SS/PBCH block - SRS in symbols that would not be at least $N\_{Tx-Rx}⋅T\_{c}$ prior to a first symbol of the next earliest SS/PBCH block- SRS in symbols that would not be at least $N\_{Rx-Tx}⋅T\_{c}$ after a last symbol of the previous latest SS/PBCH block |

Contribution [05] points out that *NRX-TX Tc* and *NTX-RX Tc* are not the sufficient gap intended for HD-FDD UEs since there is no agreement on how the gap is defined. It is proposed in [05] to remove the gap of *NRX-TX Tc and NTX-RX Tc*restriction in section 17.2 of TS 38.213 or RAN1 to discuss and conclude the Ngap values for HD-FDD UL/DL processing.

**FL1 High Priority Question 2.8-1**

* Companies are invited to provide views on the above quoted text and any changes needed for correction

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | N | maybe rephrasing to positive wording could help?UE does transmit - PUSCH or PUCCH if a last symbol of the PUSCH or PUCCH transmission would be at least $N\_{Tx-Rx}⋅T\_{c}$ [4, TS 38.211] prior to a first symbol of the next earliest SS/PBCH block- … |
| Intel |  | As discussed in our contribution R1-2201703, our understanding is the logic between the first condition (red) and the second condition (yellow) is ‘OR’, which results in any PUSCH/PUCCH will be dropped. We would like to hear other companies views on the understanding of the current spec especially the logic of the red/yellow conditions.  |
| vivo | N | We are actually not sure about the problem with existing text. Since we have “prior to a first symbol of the next earliest SS/PBCH block” in the 1st bullet, and “after a last symbol of the previous latest SS/PBCH block” in the 2nd bullet, so the they should mean the red and yellow parts, respectively, as in the figure below (modified figure based on Intel’s) |
| CATT | N | (1) Regarding the interpretation of text, we have the same understanding with vivo.(2) Regarding the gap time, we have the following agreement in RAN1#106bis-e, and agree to reuse the existing switching times:

|  |
| --- |
| **Agreement*** For HD-FDD switching time, reuse existing switching times for UE not capable of full duplex in TS 38.211, Table 4.3.2-3.

Note: With this agreement, no need to confirm below Working Assumption(From RAN1#104e)Working Assumption (FromRAN1#104e )* For HD-FDD switching time, reuse existing switching times for UE not capable of full duplex in TS 38.211, Table 4.3.2-3.
	+ ~~FFS: whether to define the guard times in symbol units~~
	+ ~~FFS: the switching positions~~
 |

So *NRX-TX Tc* and *NTX-RX Tc* should be fine. |
| DOCOMO |  | We have the same understanding as vivo and CATT |
| Sharp | N | We share same view with vivo. |
| Xiaomi |  | We have the same understanding with vivo and CATT |
| ZTE, Sanechips | N | Similar view with vivo.  |
| China Telecom |  | We share the same understanding with vivo and CATT. |
| LGE |  | We tend to think the current wording does not cause any confusion.In Intel’s figure, to check the condition, the region in red after the SSB should be looking at the next SSB which is not drawn in the figure. We are not sure why this region should be in red without the following SSB being without sufficient gap. |
| Samsung | N | We don’t see a need of any change because we have a same understanding with vivo and CATT regarding the text and also regarding the gap. |
| CMCC |  | We have the same understanding as vivo and CATT |
| Intel2 |  | Thanks for all discussions especially the revised figure from vivo. We now understand how to interpret the specification. We agree the specification text is correct.  |
| Ericsson | N |  |
| OPPO | N |  |
| Huawei, HiSilicon | N | In our view, there is no misunderstanding for the current description because the SSB is restricted to the “next earliest” or “previous latest”.  |
| IDCC | N | Same view as Vivo. |
| FL2 | According to the discussion, it is now clear that the current specification text would not cause any misinterpretation on dropping PUSCH, PUCCH or SRS that is not overlapped with SSB. Regarding the gap, it is also clarified by many companies that the gap time is same as the UL/DL switching time, i.e., *NRX-TX Tc* and *NTX-RX Tc* in TS 38.211, Table 4.3.2-3. Therefore, the moderator suggestion is to conclude there is no need of any change for issue #8 and close the discussion. |
| Qualcomm | Y |  |
| vivo | Y |  |
| CATT | Y |  |

## Issue #9: Processing order for collision handling and intra-UE multiplexing/prioritization

For TDD, it is specified in TS 38.213 that DL-UL collision handling is applied after intra-UE multiplexing/prioritization. It is proposed in [08] that the same principle can be applied to HD-FDD case to have a unified solution with TDD.

**FL1 High Priority Proposal 2.9-1**

* DL-UL collision handling for HD-FDD operation is applied after intra-UE multiplexing/prioritization

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Intel | Y |  |
| vivo | Y |  |
| Nokia, NSB | Y |  |
| CATT | Y |  |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Sharp | Y |  |
| Xiaomi | Y |  |
| ZTE, Sanechips | Y |  |
| China Telecom | Y |  |
| LGE | Y |  |
| Panasonic | Y |  |
| Samsung | Y |  |
| CMCC | Y |  |
| Ericsson | Y |  |
| OPPO | Y | We would like to discuss if some specification change needed. |
| Huawei, HiSilicon | Y |  |
| Apple  | Y |  |
| IDCC | Y |  |
| FL2 | All the responses support the FL proposal. In terms of potential spec change, the moderator thinks the following TP to Clause 9 of TS 38.213 may be needed.**FL2 High Priority Proposal 2.9-1*** DL-UL collision handling for HD-FDD operation is applied after intra-UE multiplexing/prioritization, and endorse the following TP to Clause 9 of TS 38.213

|  |
| --- |
| ===================== Unchanged parts are omitted=====================In the remaining of this clause, a UE multiplexes UCIs with same priority index in a PUCCH or a PUSCH before considering limitations for UE transmission as described in clause 11.1, ~~and~~ clause 11.1.1 and clause 17.2. A PUCCH or a PUSCH is assumed to have a same priority index as a priority index of UCIs a UE multiplexes in the PUCCH or the PUSCH.===================== Unchanged parts are omitted ===================== |

 |
| Qualcomm | Y |  |
| vivo | Y |  |
| CATT | Y |  |

# On PDCCH blocking rate reduction

Contribution [09] proposes to consider configuration of separate PDCCH SS set for RedCap UEs to reduce PDCCH blocking if separated initial DL BWP for RedCap UEs is not configured. The potential spec impact is very limited, as the legacy SS set configuration can be reused for the dedicated search space set. The configuration of a dedicated search space set can be provided to UE in the same way as dedicated initial DL BWP.

Contribution [07] expresses a different view that PDCCH blocking is not expected to be an issue for RedCap UE and existing solutions can be used to mitigate PDCCH blocking if needed and therefore no new solution is needed specifically for PDCCH blocking.

Considering this has been discussed many times in the previous RAN1 meetings and companies’ position has not changed, the following moderator proposal can be considered to conclude the discussion.

**FL1 Medium Priority Proposed Conclusion 3-1:**

* There is no consensus in RAN1 for whether or not a dedicated search space set configuration is supported in Rel-17 for RedCap UEs in case of shared initial DL BWP

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic | Y |  |
| Intel | Y |  |
| Qualcomm | Y |  |
| vivo | Y |  |
| Nokia, NSB | Y |  |
| CATT | Y |  |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Sharp | Y |  |
| Xiaomi | Y |  |
| ZTE, Sanechips | N | From our understanding, separate search space set configuration, e.g., RAR or paging, can also be used for offloading, avoid UE power consumption due to unnecessary paging detection and SIB receiving. More details can be found in the tdoc R1-2201892. It also can be further discussed in AI 8.6.1.1. |
| China Telecom | Y |  |
| LGE | Y |  |
| Panasonic | Y |  |
| CMCC | Y |  |
| Ericsson | Y |  |
| Samsung  | N | The motivation of dedicated SS set is same as dedicated initial DL BWP, which can be used for RAR or paging reception for RedCap UEs. The dedicated search space set is necessary in case of shared initial DL BWP. We are OK to discuss it in AI 8.6.1.1. |
| Huawei, HiSilicon | Y |  |
| IDCC | Y |  |
| FL2 | Since a few companies comment to prefer to discuss it in AI 8.6.1.1, the moderator suggestion is not to further discuss it in this section.  |
| Qualcomm | Y |  |
| CATT | Y |  |

# 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] | [R1-2112506](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112506.zip) | RAN1 agreements for Rel-17 NR RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2201100](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201100.zip) | Remaining issues on RedCap half-duplex operation | vivo, Guangdong Genius |
| [4] | [R1-2201137](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201137.zip) | HD-FDD for reduced capability NR devices | ZTE, Sanechips |
| [5] | [R1-2201278](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201278.zip) | Other remaining issues for Reduced Capability NR Devices | OPPO |
| [6] | [R1-2201368](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201368.zip) | Remaining issues on other aspects related to complexity reduction | CATT |
| [7] | [R1-2201405](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201405.zip) | Other Aspects | Nokia, Nokia Shanghai Bell |
| [8] | [R1-2201483](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201483.zip) | Remaining issues on other aspects for RedCap | NTT DOCOMO, INC. |
| [9] | [R1-2201525](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201525.zip) | Other aspects for complexity reduction for RedCap Ues | Samsung |
| [10] | [R1-2201550](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201550.zip) | Discussion on other aspects for RedCap | Spreadtrum Communications |
| [11] | [R1-2201591](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201591.zip) | Other aspects for RedCap UE complexity reduction | Panasonic Corporation |
| [12] | [R1-2201669](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201669.zip) | Other UE complexity reduction aspects for RedCap | Ericsson |
| [13] | [R1-2201703](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201703.zip) | On other aspects of complexity reduction for RedCap Ues | Intel Corporation |
| [14] | [R1-2201776](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201776.zip) | Other UE complexity reduction aspects for RedCap | Apple |
| [15] | [R1-2201862](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201862.zip) | Remaining issues of collision handling of HD-FDD operation | CMCC |
| [16] | [R1-2201956](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2201956.zip) | Discussion on the remaining issues of HD-FDD | Xiaomi |
| [17] | [R1-2202193](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202193.zip) | Discussion on duplex operation for RedCap UEs | Sharp |
| [18] | [R1-2202345](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202345.zip) | Other aspects related to the UE complexity reduction for RedCap | LG Electronics |
| [19] | [R1-2202418](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202418.zip) | Remaining issues on HD-FDD for RedCap UEs | Huawei, HiSilicon |
| [20] | [R1-2202146](file:///D%3A%5CDocuments%5C3GPP%20documents%5CRAN1%5CTSGR1_108-e%5CDocs%5CR1-2202146.zip) | Remaining Issues on UE Complexity Reduction | Qualcomm Incorporated |
| [21] | [R1-2112601](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_107-e/Docs/R1-2112601.zip) | FL summary #3 on other aspects for RedCap | Qualcomm Incorporated |