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

e-Meeting, 9th – 20th May 2022

**Agenda Item: 8.6.2**

**Title: FL summary #1 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
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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]
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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 FL1.

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

|  |  |  |
| --- | --- | --- |
| **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 |
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| Samsung | Seunghoon Choi | Seunghoon.choi@samsung.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 |  |

**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.  |

# 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 $N\_{Tx-Rx}⋅T\_{c} $before the first symbol or not at least $N\_{Rx-Tx}⋅T\_{c}$ 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.  |

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 $N\_{PUCCH}^{repeat}$ slots
	+ A slot is not counted in the number of $N\_{PUCCH}^{repeat}$ slots if a PUCCH transmission in the slot does not start or end 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 SSB transmission

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| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| ZTE, Sanechips | Y |  |
| Samsung | Y |  |
| Intel | 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 $N\_{Rx-Tx}⋅T\_{c}$ or $N\_{Tx-Rx}⋅T\_{c}$, 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 $N\_{Rx-Tx}⋅T\_{c}$ or $N\_{Tx-Rx}⋅T\_{c}$, 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 $N\_{Rx-Tx}⋅T\_{c}$ or $N\_{Tx-Rx}⋅T\_{c}$, 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 |  |

**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 $N\_{Tx-Rx}⋅T\_{c} $before the first symbol or not at least $N\_{Rx-Tx}⋅T\_{c}$ 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 |  |

# 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  |

# 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 |