3GPP TSG-RAN WG1 Meeting #104bis-e Tdoc R1-21xxxxx

e-Meeting, 12th – 20th April, 2021

**Agenda Item: 8.6.1.3**

**Title: FL summary #2 on duplex operation for RedCap**

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

**Document for: Discussion, Decision**

# Introduction

This feature lead summary concerns the Rel-17 work item for support of reduced capability (RedCap) NR devices [1]. Earlier RAN1 agreements for this work item are summarized in [2].

This document summarizes contributions [3] – [29] and captures the following email discussion for the RedCap WI [29].

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| [104b-e-NR-RedCap-03] Email discussion on aspects related to duplex operation – Chao (Qualcomm)* 1st check point: 4/15
* 2nd check point: 4/19
* 3rd check point: 4/20
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The issues in this document are tagged and color coded like this:

1. High Priority
2. Medium Priority

# HD-FDD switching time

RAN1#104e made the following agreements related to switching time:

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| Agreements:* (Working assumption) 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
* Sending an LS to RAN4 to inform the above working assumption, and to ask for feedback if any
	+ The LS will not include the two FFS bullets

Draft LS in [R1-2102094](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Inbox/R1-2102094.zip) is approved. Final LS to be uploaded/updated depending on whether or not there are additional agreements for RedCap related to RAN4. Final LS in [R1-2102146](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Inbox/R1-2102146.zip) |

On the switching time, two contributions [8, 22] propose to confirm the working assumption on the HD-FDD switching time and one contribution [21] indicates the working assumption can be automatically confirmed upon positive feedback from RAN4.

One contribution [18] observes that a relaxed switching time (e.g. 65 usec) is beneficial for UE power saving. Also, it is discussed that the actual switching time required by HD-FDD should take into account both RF retuning gap and RTT required by the timing advance procedure.

One contribution [10] instead highlight that the description of UE behaviour in clause 4.3.2 in TS 38.211 is from a UE perspective and thus the timing of the UL symbols has included the timing advance. In [4, 27] it is suggested that gNB scheduler is responsible for creating sufficient gap to cover TA and transition time.

**High Priority Question 2-1: Should RTT required by the timing advance procedure be accounted in the HD-FDD operation of RedCap UE? What, if any, other potential RAN1 specification impacts are needed to address the possible TA misalignment between gNB and UE?**

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| **Company** | **Y/N** | **Comments** |
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## Open issue: whether to define the guard times in symbol units

This issue is discussed in the contributions [3, 4, 5, 6, 8, 10, 11, 12, 13, 18, 21, 22, 23, 28, 29].

* 8 contributions [3, 4, 6, 8, 10, 12, 22, 23] prefer not to specify guard time in symbol units
* 7 contributions [5, 11, 13, 18, 21, 28, 29] propose to use the symbol level switching time instead of the absolute time

Contribution [3] observes no clear benefits to define the guard time in symbol units.

Contribution [10] mentions that the timing offset between DL and UL frames $T\_{TA}$ has granularity finer than symbol duration and defining the guard time in symbol units is therefore not needed as the end of guard time cannot be guaranteed to align with the symbol boundary.

The justifications for the symbol level switching time are

* [11]: Support of the guard period in symbol units is beneficial for lower latency
* [18]: Guard symbols can be configured for DL to UL switching to accommodate TA and RF retuning gap.
* [21]: Definition the guard time in symbol units simplifies the descriptions on the collision handling cases for HD-FDD type A in the spec
* [28, 29]: The switching time of 13 usec can be covered by 1 OFDM symbol duration (including extended CP) for 15, 30, 60 kHz SCSs in FR1

**High Priority Proposal 2-2:**

**For HD-FDD switching time, a guard period of N symbols can be configured for UE Rx-to-Tx switching. FFS the value of N.**

**High Priority Question 2-2: Can Proposal 2-2 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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## Open issue: switching position

The other issue is whether/how to define the guard time positions. Some contributions [5, 6, 8, 10, 11, 12, 18, 20, 29] have expressed views on the switching position for HD-FDD.

* [5, 8] supports reusing the LTE definition for Type A HD-FDD, i.e. “not receiving the last part of a downlink subframe immediately preceding an uplink subframe from the same UE”
* [12, 29] express their views that the switching position for Rx-to-Tx is after the end of the last received downlink symbol and the switching position for Tx-to-Rx is after the end of the last transmitted uplink symobl.
* [6, 10] indicate that there is no need to explictly specify the DL/UL switching position as the collision handling principles determine whether DL or UL symbols are prioritized in various cases.
* [11] suggests specifying the switching position based on a defined rule, e.g. the starting symbol based on the BWP with the largest SCS, the smallest SCS or the reference BWP
* [18] proposes the switching position configuration can be left to NW, in a hybrid way similar to TDD. NW can explicitly configure the switching positions by SI or RRC (e.g. guard symbols in a semi-static slot format). Or, NW does not configure the swithcing positions and UE determines the switching position based on the DCI and semi-static scheduling on DL/UL (SPS, CG, SSB, PRACH, etc.)
* [20] suggests applying the switching position based on the channel priority, e.g. the switching gap is applied in the channel with the lower priority. If the two channels have the same L1 priority, it is preferable to share the switching portion between the two channels.

**High Priority Proposal 2-3:**

**For HD-FDD, for the case UL/DL slot pattern (if any) not configured, the switching position is not explicitly specified. It is up to UE to determine the DL/UL switching position based on the prioritized channels/signals.**

**High Priority Question 2-3: Can Proposal 2-3 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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# Collision Handling

RAN1#104e made the following agreements related to collision handling for HD-FDD:

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| Agreements:* For HD-FDD, for cases (if any) where collision handling needs to be specified, then the existing collision handling principles in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum are used as a starting point if deemed applicable.

Agreements:* For HD-FDD operation for RedCap UEs, collisions may be addressed or alleviated with proper scheduling. The following cases of potential collisions can be further studied to see if any change to the current specs is necessary:
	+ Case 1: Dynamically scheduled DL reception vs. semi-statically configured UL transmission
		- e.g., dynamic PDSCH or CSI-RS collides with configured SRS, PUCCH, or CG PUSCH
	+ Case 2: Semi-statically configured DL reception vs. dynamically scheduled UL transmission
		- e.g., PDCCH or SPS PDSCH collides with dynamic PUSCH or PUCCH
	+ Case 3: Semi-statically configured DL reception vs. semi-statically configured UL transmission
	+ Case 4: Dynamically scheduled DL reception vs. dynamic scheduled UL transmission
	+ Case 5: Configured SSB vs. dynamically scheduled or configured UL transmission
		- e.g., PUSCH, PUCCH, PRACH, SRS
	+ Case 8: Dynamic or semi-static DL vs. valid RO
	+ Case 9: Collision due to direction switching
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Many contributions [3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29] express views on how UE should handle the seven potential collision cases identified in the last RAN1 meeting.

Many contributions noted that although in general collision may be avoided by the scheduler, DL/UL collision may not be avoidable in some scenarios and would be handled by UE.

Contribution [11] suggests a general method to handle the collision. For example, three options are proposed including scheduling restriction, defining a prioritization rule, and providing a TDD-like configuration.

Contribution [20] proposes to define a set of priority rules between different types of DL and UL channels and the channel collision can be solved through comparing different L1 priorities of two channels.

## Case 1: Dynamically scheduled DL reception vs. semi-statically configured UL transmission

Many contributions [5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 21, 22, 24, 25, 26, 28, 29] express views that the dynamic scheduled DL should be prioritized over the semi-statically configured UL transmission.

Contributions [5, 6, 7, 10, 14, 16, 17, 18, 19, 26, 28, 29] propose to reuse the existing rule of Rel-15/16 for Case 1, i.e. configured UL is (partially) cancelled if timeline allows. In the contribution [14] it was proposed to further study whether the timeline can be extended by including the Tx/Rx switching time.

Contributions [16, 21] indicate that it should be treated as error case if the first symbol of UL transmission occurs within Tproc,2 relative to a last symbol of the PDCCH.

Contribution [24] proposes to further study the case of DL scheduling collision UL CG resources.

Contribution [3] highlights that the dynamic scheduling is flexible to avoid collision with semi-static UL transmission.

**High Priority Proposal 3-1:**

**For Case 1 (dynamically scheduled DL reception vs. semi-statically configured UL transmission), reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum.**

* **FFS whether the timeline is extended to include the RX/TX switching time for HD-FDD**

**High Priority Question 3-1: Can Proposal 3-1 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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## Case 2: Semi-statically configured DL reception vs. dynamically scheduled UL transmission

Many contributions [5, 6, 7, 8, 10, 12, 14, 15, 16, 17, 18, 19, 21, 22, 25, 26, 28, 29] express views that the dynamic scheduled UL should be prioritized over the semi-statically configured DL reception. The existing collision handling principles in Rel-15/16 NR for operation on a single carrier/single cell in unpaired spectrum can be reused for case 2.

Contribution [3, 9, 24] mentioned that the collision between semi-statically configured DL reception and dynamically configured UL transmission is avoidable via proper gNB scheduler implementation.

Moreover, it was clarified in the contributions [6, 16] that the semi-statically configured DL reception may include also a CSI-RS and a DL PRS; the dynamically scheduled UL transmission may include also SRS or PRACH preamble transmission triggered by PDCCH order.

Based on above, the following proposal can be considered.

**High Priority Proposal 3-2:**

**For Case 2 (semi-statically configured DL reception vs. dynamically scheduled UL transmission), reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier/single cell in unpaired spectrum**

* **The semi-statically configured DL reception may include PDCCH, SPS PDSCH, CSI-RS or PRS**
* **The dynamically scheduled UL transmission may include PUSCH, PUCCH, SRS or PRACH triggered by PDCCH order**

**High Priority Question 3-2: Can Proposal 3-2 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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## Case 3: Semi-statically configured DL reception vs. semi-statically configured UL transmission

Many contributions [5, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 22, 24, 25, 26] express views that the overlapped semi-static DL reception and semi-static UL transmission can be avoided by gNB scheduler, however, contributions [3, 6] mention it may not be avoidable in some scenarios.

In the contribution [6], it was discussed that the semi-static configuration should be further separated as semi-static configuration with cell-specific higher layer parameters and semi-static configuration with dedicated parameters. Since FD-FDD and HD-FDD UEs may co-exist in the same cell, there is a big impact for FD-FDD UE when relying on NW’s configuration to avoid the collision between semi-static DL reception and UL transmission configured by cell-specific higher layer parameters.

In the contribution [21], it was proposed to further discuss and down select between the following two alternatives

* Alt.1 (LTE approach): No DL reception during the guard period (=Tsw) before the start of the first UL transmission
* Alt.2 (NR approach): No UL transmission during the guard period (=Tsw) after the end of the last DL reception

Similarly, contribution [29] proposed that a UE behavior should be defined in this case for which channel/signal should take precedence over the other channel/signal.

**High Priority Question 3-3: For Case 3, is it sufficient to assume the collision is avoidable via proper gNB implementation and UE does not expect to be configured with overlapped semi-static DL reception and semi-static UL transmission occasions? What, if any, needs to be specified?**

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| **Company** | **Y/N** | **Comments** |
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## Case 4: Dynamically scheduled DL reception vs. dynamic scheduled UL transmission

Many contributions [3, 5, 6, 7, 8, 10, 12, 14, 15, 16, 17, 18, 19, 22, 24, 25, 26, 27, 28, 29] express views that gNB should be able to handle the case of dynamic scheduled DL reception collides with dynamic scheduled UL transmission, and UE will not expect the collision.

Contribution [9] mentioned that when dynamically scheduled UL/DL transmission collide, the earlier scheduled transmission should take effect and the latter should be dropped.

In the contribution [21], it was proposed to further discuss and down select between the following two alternatives

* Alt.1 (LTE approach): No DL reception during the guard period (=Tsw) before the start of the first UL transmission
* Alt.2 (NR approach): No UL transmission during the guard period (=Tsw) after the end of the last DL reception

**High Priority Question 3-4: For Case 4, is it sufficient to assume the collision is avoidable via proper gNB implementation and UE does not expect to be dynamically scheduled with overlapped DL reception and UL transmission occasions? What, if any, needs to be specified?**

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| **Company** | **Y/N** | **Comments** |
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## Case 5: Configured SSB vs. dynamically scheduled or configured UL transmission

Many contributions [5, 6, 9, 10, 12, 15, 17, 18, 21, 22, 24, 26, 27] express views that the existing TDD rule can be reused so that dynamically scheduled or configured UL transmission should be cancelled when colliding with SSB. Also, contribution [10] indicated that the existing rule may be extended to address the direction switching case by including overlapping with the time intervals that are used for DL-to-UL or UL-to-DL switching.

Contribution [8] mentioned that it is up to gNB implementation to avoid collision.

Contribution [7, 14, 19] discussed that if UE does not need to receive SSB then dynamically scheduled or configured UL transmission may not be cancelled since gNB can transmit and receive simultaneously on paired spectrum.

In the contribution [16], it was noted that UE-autonomous prioritization between SSB reception and UL transmission increases detection complexity at the gNB receiver and therefore as a baseline it can be considered as an error case.

Contribution [25] suggested to come back to this issue after the handling for case 2 and 3. Basically, two possibilities can be considered.

* Alt.1: Follow the handling of case 2 and 3 by considering SSB to be semi-statically configured DL reception
* Alt.2: Folow the principle of Rel-15/16

Contribution [29] noted that it should not be an issue for the dynamically scheduled UL transmission since it is fully controlled by gNB, but whether to transmit semi-statically configured UL transmission need further study.

**High Priority Proposal 3-5:**

**For Case 5, down-select between the following two options:**

* **Option 1: Follow the handling of case 2 and 3 by considering SSB to be semi-statically configured DL reception**
* **Option 2: Reuse the existing collision handling principles in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum**

**High Priority Question 3-5: Can Proposal 3-5 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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## Case 8: Dynamic or semi-static DL vs. valid RO

Many contributions [5, 10, 12, 15, 18, 21, 24, 26, 29] express views that the existing TDD rule can be reused so that the UE will not receive any DL symbols overlapping with the set of symbols corresponding to a valid RO plus Ngap symbols before the valid RO. Also, contribution [10] indicates that the existing rule may be extended to address the direction switching case by including overlapping with the time intervals that are used for DL-to-UL or UL-to-DL switching.

Contribution [6, vivo] highlights that for Case 8 of dynamic or semi-static DL vs. valid RO, there are contradictions among the existing collision handling principles of Rel-15/16, and proposes to come back to this issue after a common understanding is made.

Contribution [7, 14] mentioned that UE may be allowed to receive the DL signals/signals when colliding with valid RO, for example, when RedCap UE is not in initial access procedure. Similarly, in the contribution [19] it was discussed that prioritization of valid RO over DL reception may result in no DL slots that can be scheduled for RedCap UE when PRACH is configured in all the subframes. Three approaches are thus proposed for further study.

Contribution [16] proposed to consider it as error case if a dynamically scheduled or configured DL reception overlaps with a valid RO since gNB has full control on the scheduling.

Contribution [9, MTK] proposed that dynamic or semi-static DL vs. valid RO could be treated as Case 3 despite R15, while in the contribution [17] it was proposed to follow Case 1 by considering valid PRACH occasion to be semi-statically configured UL transmission.

Contribution [25] suggested to come back to this issue after the handling for case 1 and 3. Basically, two possibilities can be considered.

* Alt.1: Follow the handling of case 1 and 3 by considering RO to be semi-statically configured UL transmission
* Alt.2: Folow the principle of Rel-15/16

**High Priority Proposal 3-6:**

**For Case 8, down-select between the following two options:**

* **Option 1: Follow the handling of case 1 and 3 by considering valid RO to be semi-statically configured UL transmission**
* **Option 2: Reuse the existing collision handling principles (valid RO prioritized over dynamic or semi-static DL) in Rel-15/16 NR for operation on a single carrier /single cell in unpaired spectrum**

**High Priority Question 3-6: Can Proposal 3-6 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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## Case 9: Collision due to direction switching

Many contributions [5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 19, 25, 26, 29] express their views on the collision due to direction switching (i.e. Case 9).

Several contributions [5, 8] mention it is up to gNB implementation and no issue is identified for Case 9.

Contributions [9, 16] note that any such collision should be treated as part of previous cases and a separate rule is not needed for Case 9.

Contribution [10] observes that if this case concerns the back-to-back UL/DL scenario (without gap or with a gap shorter than the Tx/Rx switching time) then it can be avoided for cases 1, 2, 3 and 4 through proper gNB implementation but not for case 5 and 8.

Contribution [6] proposes to FFS collision handling due to direction switching b/w cell specific configured DL reception and cell specific configured UL transmission and observes that other cases can be handled by gNB implementation.

Several contributions [7, 12, 14, 18, 25, 26] propose to have explicit specification for UE behaviour, e.g. a HD-FDD UE is not required to perform transmission or reception during the switching time.

In the contributions [15, 19] it was discussed that the direction switching time should occur in the duration of operation with lower priority and switching gap(s) need to be created before and/or after the high priority direction.

**High Priority Question 3-7: What, if any, other potential RAN1 specification impacts (beyond possible specification for other cases) do you expect for handling collision due to direction switching (i.e. Case 9)?**

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| **Company** | **Y/N** | **Comments** |
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## Other potential case

In [12] it was proposed that the rule for handling the collision between L1-RSRP measurement and dynamic or semi-static UL transmission should be addressed. For example, L1-RSRP measurement can be prioritized and UE is not required to perform UL transmission during the window of L1-RSRP measurement.

**Medium Priority Question 3-8: Companies are welcome to provide views for this potential collision case, e.g., whether it has been covered by the identified 7 cases or not.**

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| **Company** | **Y/N** | **Comments** |
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# Semi-static UL/DL configuration

Contributions [15, 16, 18, 24] propose to support semi-static TDD-like slot configuration for HD-FDD Type-A UE; while contributions [21, 27, 28] propose not to configure the semi-static TDD-like slot formats for HD-FDD.

In the contributions [16, 18], it was mentioned that with the semi-static configuration of UL/DL pattern UE power consumption can be reduced. Also, [16] mentioned that the semi-static UL/DL configuration can be used to reduce the overhead of Type1 HARQ-ACK codebook size and simplify the collision handling procedures.

Based on above, the following proposal can be considered.

**High Priority Proposal 4-1:**

**FFS the need for NW to optionally configure semi-static TDD-like slot formats for HD-FDD UE.**

**High Priority Question 4-1: Can Proposal 4-1 be agreed? If not, please explain why?**

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| **Company** | **Y/N** | **Comments** |
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# Other aspects (for information)

**UE capability signalling**

A few contributions [3, 4, 17] express views on the UE capability of HD-FDD.

* Contributions [3, 17] note that no specification impact in initial access/random access procedure is expected from HD-FDD Type-A UE and the UE capability signaling of HD-FDD can be reported to the network after initial access through UE capability framework
* Contribution [4] mentions that it is required for the network to know the UE capability signaling of HD-FDD in the earlier stage of initial access, e.g. to avoid zero gap between HARQ-ACK and the previous DL transmission

**FD-FDD fallback to HD-FDD**

A few contributions [17, 18] express views on enabling FD-FDD fall back operation to HD-FDD

* [17]: Support a signaling mechanism to enable HD-FDD operation for a FD-FDD capable RedCap UE
* [18]: A RedCap UE capable of full-duplex operation can fall back to Type-A HD-FDD for power saving in RRC connected state subject to the performance requirements for latency and throughput

**HARQ-ACK bundling support**

Contribution [8] proposes that HARQ-ACK bundling is not considered for HD-FDD in Rel-17

**Medium Priority Question 5-1: Companies are welcome to provide views for the above issues. If there is any new issue to be addressed for half duplex FDD operation, please also indicate here.**

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| **Company** | **Y/N** | **Comments** |
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# References

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| --- | --- | --- | --- |
| [1] | [RP-210918](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Docs/RP-210918.zip) | Revised WID on support of reduced capability NR devices | Nokia, Ericsson |
| [2] | [R1-2102220](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2102220.zip) | RAN1 agreements for Rel-17 NR RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2102356](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102356.zip) | Discussion on duplex operation for RedCap | Huawei, HiSilicon |
| [4] | [R1-2102404](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102404.zip) | On half-duplex operation | OPPO |
| [5] | [R1-2102462](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102462.zip) | Discussion on aspects related to duplex operation | Spreadtrum Communications |
| [6] | [R1-2102531](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102531.zip) | Discussion on RedCap half-duplex operation | vivo, Guangdong Genius |
| [7] | [R1-2102640](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102640.zip) | Discussion on HD-FDD operation | CATT |
| [8] | [R1-2102651](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102651.zip) | UE complexity reduction aspects related to duplex operation | Nokia, Nokia Shanghai Bell |
| [9] | [R1-2102701](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102701.zip) | On half duplex operation for RedCap UEs | MediaTek Inc. |
| [10] | [R1-2102724](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102724.zip) | Duplex operation for RedCap | Ericsson |
| [11] | [R1-2102735](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102735.zip) | Discussion on aspects related to duplex operation | Asia Pacific Telecom, FGI |
| [12] | [R1-2102856](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102856.zip) | HD-FDD for reduced capability NR devices | ZTE |
| [13] | [R1-2102874](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102874.zip) | Discussion on aspects related to duplex operation | Potevio Company Limited |
| [14] | [R1-2102891](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102891.zip) | Discussion on collision handling of HD-FDD operation | CMCC |
| [15] | [R1-2102990](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102990.zip) | Discussion on Half-duplex FDD operation of Redcap UE | Xiaomi |
| [16] | [R1-2103040](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103040.zip) | On HD-FDD support for RedCap devices | Intel Corporation |
| [17] | [R1-2103114](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103114.zip) | On aspects related to half-duplex operation | Apple |
| [18] | [R1-2103176](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103176.zip) | Type-A HD-FDD for RedCap UE | Qualcomm Incorporated |
| [19] | [R1-2103248](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103248.zip) | HD-FDD Operation for RedCap UEs | Samsung |
| [20] | [R1-2103309](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103309.zip) | Half-duplex FDD operation for Redcap UEs | Sony |
| [21] | [R1-2103354](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103354.zip) | Aspects related to the duplex operation of RedCap | LG Electronics |
| [22] | [R1-2103423](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103423.zip) | Duplex operation for RedCap UEs | InterDigital, Inc. |
| [23] | [R1-2103478](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103478.zip) | Discussion on the duplex operation of redcap UEs | Sharp |
| [24] | [R1-2103536](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103536.zip) | Half duplex operation for RedCap | Lenovo, Motorola Mobility |
| [25] | [R1-2103542](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103542.zip) | Aspects related to duplex operation | Panasonic Corporation |
| [26] | [R1-2103585](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103585.zip) | Discussion on duplex operation for RedCap | NTT DOCOMO, INC. |
| [27] | [R1-2103652](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103652.zip) | On aspects related to duplex operation | Nordic Semiconductor ASA |
| [28] | [R1-2103666](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103666.zip) | Discussion on aspects related to duplex operation | ASUSTeK |
| [29] | [R1-2103699](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103699.zip) | Discussion on duplex operation for RedCap UE | WILUS Inc. |