**3GPP TSG RAN meeting #98-e RP-22xxxx**

**Electronic Meeting, December 12-16, 2022**

## Status Report to TSG

**Agenda item:** 9.3.1.7

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| --- | --- |
| **WI / SI Name** | Enhanced support of reduced capability NR devices |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_redcap\_enh |
| **Unique ID** | 970080 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | [RP-222675](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_97e/Docs/RP-222675.zip) |
| **Target Completion Date****(indicate if changed)** | Study Item:  | Core part:12/2023 | Performance part:06/2024 | Testing part: |
| **Overall Completion level** | Study Item:  | Core part: 15% | Performance Part:0% | Testing part: |

**Source:**

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| **Leading WG** | RAN1 |
| **Rapporteur** | **Name** | Johan BERGMAN |
| **Company** | Ericsson |
| **Email** | johan.bergman@ericsson.com |

## 1 Work plan related evaluation

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| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

## 2. Detailed progress in RAN WGs since last TSG meeting

## 2.1 RAN1

#### 2.1.1 Agreements

##### 2.1.1.1 RAN1#110bis-e

To this meeting, 36 contributions were submitted (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/TDoc_List_Meeting_RAN1%23110-bis-e.xlsx)). An initial work plan was provided by the rapporteur in [R1-2208361](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208361.zip).

RAN1 carried out the following email discussion (with documents and agreements listed further down):

* [110bis-e-R18-RedCap-01]

After the meeting, a RAN1 agreement summary was provided by the rapporteur in [R1-2210637](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210637.zip).

RAN1#110bis-e made the following agreement related to **UE BB bandwidth reduction**:

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| [R1-2210248](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210248.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210249](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210249.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210250](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210250.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210251](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210251.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)**Initial BWP**Agreement:For a cell supporting both Rel-17 and Rel-18 RedCap UEs,* The Rel-18 RedCap UEs can share the same separate initial DL/UL BWP as the Rel-17 RedCap UEs.
* FFS: whether to support an additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs

**Number of PRBs**Agreement: (replaced by later agreement)For UE BB bandwidth reduction, for PUSCH, down-select between the following options for the maximum number of PRBs that the UE can transmit:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

For UE BB bandwidth reduction, for PDSCH (at least for unicast), down-select between the following options for the maximum number of PRBs that the UE can [receive/process]:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

Same option will be selected for both PDSCH (at least for unicast) and PUSCHAgreement: (replaced by later agreement)Replace the agreement on the maximum number of PRBs supported by UE with the following:For UE BB bandwidth reduction, for PUSCH, down-select between the following options for the maximum number of PRBs that the UE can transmit per slot or per hop, if applicable:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

For UE BB bandwidth reduction, for PDSCH (at least for unicast), down-select between the following options for the maximum number of PRBs that the UE can process per slot:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

Same option will be selected for both PDSCH (at least for unicast) and PUSCH.**SIB1 bandwidth**Agreement: (replaced by later agreement)For UE BB bandwidth reduction, for SIB1 (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of SIB1 to be within 5 MHz
* Option 2: Allow the scheduling of SIB1 to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous

Agreement:Replace the agreement on SIB1(PDSCH) for UE BB bandwidth reduction with the following:For UE BB bandwidth reduction, for SIB1 (PDSCH),* Allow the scheduling of SIB1 to be larger than 5 MHz (as in legacy operation)
* FFS: UE post-FFT buffering “assumption” (replaced by later agreement)

**OSI bandwidth**Agreement: (replaced by later agreement)For UE BB bandwidth reduction, for broadcast OSI (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of OSI PDSCH to be within 5 MHz
* Option 2: Allow the scheduling of OSI PDSCH to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous

Agreement:Replace the agreement on broadcast OSI (PDSCH) for UE BB bandwidth reduction with the following:For UE BB bandwidth reduction, for broadcast OSI (PDSCH),* Allow the scheduling of broadcast OSI (PDSCH) to be larger than 5 MHz (as in legacy operation)

 **Paging bandwidth**Agreement: (replaced by later agreement)For UE BB bandwidth reduction, for paging channel (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of paging channel to be within 5 MHz
* Option 2: Allow the scheduling of paging channel to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous

**RAR bandwidth**Agreement: (replaced by later agreement)For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of RAR PDSCH to be within 5 MHz
* Option 2: Allow the scheduling of RAR PDSCH to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous

 **PUSCH bandwidth**Agreement:For UE BB bandwidth reduction, a UE is not expected to receive an UL grant in a DCI with a PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.Agreement:* For UE BB bandwidth reduction, a UE is not expected to be configured with a CG grant with a PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.

Agreement: (replaced by later agreement)* For UE BB bandwidth reduction, it is FFS whether a UE can be expected to receive an UL grant in a RAR with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.
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RAN1#110bis-e made the following agreement related to **UE peak data rate reduction**:

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| [R1-2210248](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210248.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210249](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210249.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210250](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210250.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2210251](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210251.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)Agreement:* UE peak data rate reduction is supported at least as an add-on to UE BB bandwidth reduction,
	+ The constraint *vLayers*·*Qm*·*f* ≥ 4 is relaxed to *vLayers*·*Qm*·*f* ≥ X.
	+ FFS: the value of X
* If UE peak data rate reduction is supported as a standalone feature,
	+ The constraint *vLayers*·*Qm*·*f* ≥ 4 is relaxed to *vLayers*·*Qm*·*f* ≥ Y.
	+ FFS: the value of Y
	+ Note: Whether this option is supported will be decided in RAN plenary.
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##### 2.1.1.2 RAN1#111

To this meeting, 34 contributions were submitted (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/TDoc_List_Meeting_RAN1%23111.xlsx)).

RAN1 carried out the following email discussion (with documents and agreements listed further down):

* [111-R18-RedCap]

After the meeting, an updated RAN1 agreement summary was provided by the rapporteur in [R1-2212982](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212982.zip).

RAN1#111 made the following agreement related to **UE BB bandwidth reduction**:

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| [R1-2212533](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212533.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212534](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212534.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212535](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212535.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212536](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212536.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)**Number of PRBs**Agreement:For UE BB bandwidth reduction, for PUSCH, down-select between the following options for the maximum number of PRBs that the UE can transmit per slot or per hop, if applicable:* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

For UE BB bandwidth reduction, for PDSCH (for both unicast and broadcast), down-select between the following options for the maximum number of PRBs that the UE can process per slot:* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

Same option will be selected for both PDSCH and PUSCH.**UE post-FFT buffer size**Conclusion:For UE BB complexity reduction, for broadcast and unicast PDSCH, RAN1 does not assume that the UE post-FFT buffer size per slot is smaller than 20 MHz.**Unicast PDSCH bandwidth**Agreement:* For UE BB complexity reduction, a UE is able to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
* The number of PRB scheduled in DCI is not larger than the maximum number of PRB agreed in previous agreement from 110b-e

**SIB1/OSI**Conclusion:For UE BB complexity reduction, broadcast of separate SIB1/OSI (PDSCH) to Rel-18 RedCap UEs is not supported.**Paging bandwidth**Agreement:From RAN1 perspective, for UE BB complexity reduction, for paging channel (PDSCH) to Rel-18 RedCap UEs, allow the scheduling of paging channel to be larger than 5 MHz (as in legacy operation). **RAR bandwidth**Agreement:For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, the scheduling of RAR PDSCH is allowed to be larger than the maximum number of unicast PRBs that the UE can process per slot.* When the scheduling of RAR PDSCH is within the maximum number of unicast PRBs that the UE can process per slot, the legacy time between RAR reception and Msg3 transmission (not smaller than NT,1 + NT,2 + 0.5 ms) is applied.
* When the scheduling of RAR PDSCH is larger than the maximum number of unicast PRBs that the UE can process per slot,
	+ The UE receives the RAR and correspondingly transmits Msg3 if the TDRA for Msg3 in UL grant in RAR indicates that the time between RAR reception and Msg3 transmission is NOT smaller than NT,1 + NT,2 + 0.5 + X ms.
		- FFS: value(s) of X
	+ Otherwise, the UE behavior is up to the UE implementation.
* Note: it does not mean early indication is needed
* Note: it will not be used as example for unicast PDSCH

**Msg3 bandwidth**Agreement:For UE BB complexity reduction, a UE is not expected to receive an UL grant in a RAR or in a DCI scrambled with TC-RNTI with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable. |

RAN1#111 made the following agreement related to **UE peak data rate reduction**:

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| [R1-2212533](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212533.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212534](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212534.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212535](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212535.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)[R1-2212536](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2212536.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)Agreement:* The minimum DL peak rate target (for FD-FDD) is [10] Mbps based on peak data rate calculation according to 38.306.
* The same value for X is used for DL and UL
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#### 2.1.2 Remaining Open issues

RAN1 aspects for the following objectives:

* Further reduced UE complexity in FR1
	+ UE BB bandwidth reduction
	+ UE peak data rate reduction

## 2.2 RAN2

#### 2.2.1 Agreements

The RAN2 work for this work item starts in February 2023.

There has already been some progress in the related NR\_REDCAP\_Ph2 work item, see Section 3.1.1 of this status report.

#### 2.2.2 Remaining Open issues

RAN2 aspects for the following objectives:

* Enhanced eDRX in RRC\_INACTIVE (>10.24s)
* Further reduced UE complexity in FR1
	+ UE BB bandwidth reduction
	+ UE peak data rate reduction

## 2.3 RAN3

#### 2.3.1 Agreements

The RAN3 work for this work item starts in April 2023.

There has already been some progress in the related NR\_REDCAP\_Ph2 work item, see Section 3.1.1 of this status report.

#### 2.3.2 Remaining Open issues

RAN3 aspects for the following objectives:

* Enhanced eDRX in RRC\_INACTIVE (>10.24s)

## 2.4 RAN4

#### 2.4.1 Agreements

The RAN4 work for this work item starts in February 2023.

#### 2.4.2 Remaining Open issues

RAN4 aspects (including necessary performance requirements, measurement accuracy requirements and test cases) for the following objectives:

* Enhanced eDRX in RRC\_INACTIVE (>10.24s)
* Further reduced UE complexity in FR1
	+ UE BB bandwidth reduction
	+ UE peak data rate reduction

## 3. Detailed progress in SA/CT WGs since last TSG meeting

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

In the work with the related NR\_REDCAP\_Ph2 work item, SA2 sent an LS to RAN2 and RAN3 on long eDRX support for RRC\_INACTIVE in [S2-2209958](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_153E_Electronic_2022-10/Docs/S2-2209958.zip), and RAN3 sent a reply in [R3-226776](https://www.3gpp.org/ftp/TSG_RAN/WG3_Iu/TSGR3_118/Docs/R3-226776.zip).

#### 3.1.2 Remaining Open issues with cross-TSG impacts

The WI objective on enhanced eDRX in RRC\_INACTIVE requires SA2, CT1 and CT4 involvement.

## 4. References

RAN1#110bis-e

36 contributions (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/TDoc_List_Meeting_RAN1%23110-bis-e.xlsx))

RAN1#111

34 contributions (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/TDoc_List_Meeting_RAN1%23111.xlsx))