**3GPP TSG RAN meeting #99 RP-23xxxx**

**Rotterdam, Netherlands, March 20-23, 2023**

## Status Report to TSG

**Agenda item:** 9.3.1.7

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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-223544](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Docs/RP-223544.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:  30%  (RAN#98e: 15%) | Performance Part: 0% (RAN#98e: 0%) | Testing part: | |

**Source:**

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| --- | --- | --- |
| **Leading WG** | | RAN1 |
| **Rapporteur** | **Name** | Johan BERGMAN |
| **Company** | Ericsson |
| **Email** | [johan.bergman@ericsson.com](mailto: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#112

To this meeting, 37 contributions were submitted (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/TDoc_List_Meeting_RAN1%23112.xlsx)). An updated work plan was provided by the rapporteur in [R1-2300177](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112/Docs/R1-2300177.zip).

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

* [112-R18-RedCap]

After the meeting, an updated RAN1 agreement summary was provided by the rapporteur in [R1-2301885](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112/Docs/R1-2301885.zip).

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

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| --- | --- |
| [R1-2301886](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301886.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301887](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301887.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301888](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301888.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301889](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301889.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  **Initial BWP**  Conclusion:  There is no consensus to continue discussion on “whether additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs is allowed to be configured by the SIB in the cell”.  **Number of PRBs**  Agreement:  For UE BB bandwidth reduction, for PUSCH, select the following option 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   For UE BB bandwidth reduction, for PDSCH (for both unicast and broadcast), select the following option 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   Note: No intention to change the RAN4 RF specifications about maximum transmission PRB number  **Paging bandwidth**  Agreement:  Update the agreement for PDSCH paging with the clarification as follows:   * 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). The scheduling of paging PDSCH is allowed to be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.   **RAR bandwidth and Msg3 transmission time**  Agreement:  For the earlier RAN1 agreement achieved in RAN1#111 as following,   |  | | --- | | 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 |   For the “FFS: value(s) of X”   * X = [0.5/0.25 or 1/0.5 or 2/1] ms for 15/30kHz SCS * Note: Single Value pair for X is to selected for SCSs   **MsgA bandwidth**  Agreement:  For UE BB complexity reduction, a UE is not expected to perform 2-step RACH with a MsgA PUSCH resource spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.  **Msg4 bandwidth**  Working assumption:   * For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.   + The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.   **Simultaneous reception**  Conclusion:  For UE BB complexity reduction, there is no need to relax the requirements on simultaneous reception of two broadcast PDSCH transmissions for SIB1/OSI/paging/RAR. |

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

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| --- | --- |
| [R1-2301886](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301886.zip) FL summary #1 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301887](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301887.zip) FL summary #2 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301888](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301888.zip) FL summary #3 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  [R1-2301889](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/R1-2301889.zip) FL summary #4 on Rel-18 RedCap UE complexity reduction Moderator (Ericsson)  Agreement:  Revise the earlier agreement by removing the square brackets like this:   * 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   Agreement:  For the relaxed constraint X in the following earlier RAN1 agreement, down-select between X = 3 and X = 3.2.   |  | | --- | | * 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 | |

#### 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

##### 2.2.1.1 RAN2#121

To this meeting, 46 contributions were submitted (for details see agenda item 8.19 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121/Docs/TDoc_List_Meeting_RAN2%23121.xlsx)). A work plan was provided by the rapporteur in [R2-2301696](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_121/Docs/R2-2301696.zip).

RAN2 carried out the following email discussions (with documents and agreements listed further down):

* [AT121][750] Organizational – eRedCap
* [AT121][751][eRedCap] LS to RAN3/SA2/CT1 on eDRX and SDT

RAN2 made the following agreements related to **enhanced eDRX in RRC\_INACTIVE**:

* The formula of PH/PTW for IDLE eDRX can be reused for enhanced INACTIVE eDRX, for eDRX cycles longer than 10.24s.
* RAN2 confirms the R17 agreements made at RAN2#114 for enhanced INACTIVE eDRX:
  + It is up to RAN to configure the length for PTW for RAN paging, the RAN PTW length can be different from the CN PTW length.
  + When RAN and CN paging coincide in the same PH, the actually used PTW starting location is the same for RAN and CN paging. FFS how to calculate the PTW starting location so that it is the same for RAN and CN PTW.
* PTW length value range of enhanced INACTIVE eDRX is same as IDLE eDRX, i.e. from 1.28s to 40.96s in the step of 1.28s.
* Long eDRX cycle (>10.24 s) value range of enhanced INACTIVE eDRX is same as IDLE eDRX from 20.48s to 10485.76s, i.e., hf2, hf4, hf8, hf16, hf32, hf64, hf128, hf256, hf512, hf1024
* Add the configuration of eDRX cycle (>10.24 s) and PTW length for enhanced INACTIVE eDRX in the RRCRelease message
* Introduce 1 bit indication in SIB1 whether UEs are allowed to use the enhanced INACTIVE eDRX cycle.
* FFS if/how to fallback for a UE which is configured with R18 eDRX but the gNB doesn’t indicate support for this.
* RAN2 confirms the enhanced INACTIVE eDRX can be applied to all R18 UEs. FFS if it can only be supported by UEs which support R17 eDRX.
* Indicate to [RAN3/SA2/CT1] that RAN2 intends to configure INACTIVE eDRX (beyond 10.24s) together with SDT (both MO and/or MT versions of SDT), and ask for feedback, if any.
  + RAN2 sent an LS to SA2, CT1 and RAN3 in [R2-2302082](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121/Docs/R2-2302082.zip) informing them that in Rel-18, RAN2 intends to allow configuring eDRX beyond 10.24 sec in RRC\_INACTIVE together with SDT features (including MO and/or MT versions of SDT).

RAN2 made the following agreements related to **further reduced UE complexity in FR1**:

* Introduce Msg3/MsgA PUSCH based early indication for Rel-18 eRedCap. FFS how to implement this in the spec (e.g., new LCIDs or not).
* We will wait for RAN1 progress to see if there is a need for a Msg1 early indication for eRedCap.
* The NR MIB “cellBarred” bit applies to all UEs (Normal UEs, Redcap UEs and eRedcap UEs).

#### 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

##### 2.3.1.1 RAN3#118

According to the TU allocation, the RAN3 work for this work item should start in April 2023. However, there has already been some progress triggered by LSs within the related NR\_REDCAP\_Ph2 work item.

In this meeting, RAN3 made the following agreements:

* It is up to gNB implementation when the gNB triggers the CN based MT communication handling request to CN.
* A Class-1 procedure is used to report to AMF when UE enters RRC\_INACTIVE with eDRX > 10.24s.

RAN3 received a follow-up LS from SA2 in [S2-2301858](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_154AHE_Electronic_2023-01/Docs/S2-2301858.zip) and sent a reply in [R3-230803](https://www.3gpp.org/ftp/tsg_ran/WG3_Iu/TSGR3_119/Inbox/R3-230803.zip) confirming that the triggering criteria for gNB sending a CN based MT communication handling request to CN is for eDRX cycle lengths larger than 10.24s.

#### 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

##### 2.4.1.1 RAN4#106

To this meeting, 17 contributions were submitted (for details see agenda item 9.30 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_106/Docs/TDoc_List_Meeting_RAN4%23106.xlsx)). A work plan was provided by the rapporteur in [R4-2302402](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_106/Docs/R4-2302402.zip).

In this meeting, RAN4 made the following agreements:

* It was agreed that there is no RRM impact from the UE peak data rate reduction objective for FR1.
* RAN4 discussed and identified the potential RRM impact of introducing eDRX with PTW requirements, and they were summarized in a way forward (WF) document [R4-2303259](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_106/Docs/R4-2303259.zip).
* RAN4 discussed the RF impact for the new type of RedCap UE and the agreements are agreed in WF [R4-2303565](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_106/Docs/R4-2303565.zip).

#### 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

See RAN2#121 and RAN3#118 agreements in sections 2.2.1.1 and 2.3.1.1 of this status report.

#### 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#112

37 contributions (for details see agenda item 9.6 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112/Docs/TDoc_List_Meeting_RAN1%23112.xlsx))

RAN2#121

46 contributions (for details see agenda item 8.19 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_121/Docs/TDoc_List_Meeting_RAN2%23121.xlsx))

RAN4#106

17 contributions (for details see agenda item 9.30 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_106/Docs/TDoc_List_Meeting_RAN4%23106.xlsx))