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

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

**Source: Ericsson**

**Title: Revised WID on Enhanced support of reduced capability NR devices**

**Document for: Approval**

**Agenda Item: 9.3.1.7**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

# Title: Enhanced support of reduced capability NR devices

## Acronym: NR\_redcap\_enh

## Unique identifier: 970080

|  |  |
| --- | --- |
| **This WID includes a Core part** | **X** |
| **This WID includes a Performance part** | **X** |

Potential target Release: Rel-18

## 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others (specify) |
| **Yes** |  | X | X | X |  |
| **No** | X |  |  |  | X |
| **Don't know** |  |  |  |  |  |

## 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This work item is a

|  |  |
| --- | --- |
| X | Feature |
|  | Building Block |
|  | *Work Task* |
|  | Study Item |

### 2.2 Parent Work Item

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| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work Items (if any) |
| Unique ID | Title | Nature of relationship |
| 860035 | Study on support of reduced capability NR devices |  |
| 860036 | Study on NR coverage enhancements |  |
| 860047 | UE power saving enhancements for NR |  |
| 900061 | NR coverage enhancements |  |
| 900062 | Support of reduced capability NR devices |  |
| 940086 | Study on further NR RedCap UE complexity reduction |  |

## 3 Justification

One 5G aim is to accelerate industrial transformation and digitalization, which improve flexibility, enhance productivity and efficiency, reduce maintenance, and improve operational safety. Industrial sensors play an important role for realizing such a vision. Not only widely used in industrial automation and digitalization use cases, industrial sensors are also widely used in the general environmental monitoring use cases such as monitoring of critical infrastructure (e.g., buildings, bridges, water dams, etc.) or monitoring for natural disasters (e.g., wild fire, flood, tsunami, earthquake, etc.).

Another emerging new class of new 5G use cases is the smart city vertical, which covers data collection and processing to more efficiently monitor and control city resources, and to provide services to city residents. Especially, the deployment of surveillance cameras is an essential part of the smart city but also of factories and industries.

Furthermore, there have been increasing interests in wearables use cases such as smart watches, eHealth related devices, and medical monitoring devices. These use cases call for different design considerations and have different requirements in terms of form factor, UE complexity and energy efficiency, compared to eMBB devices.

The support of industrial sensors, video surveillance, and wearables were the motivations behind Rel-17 RedCap. Through the Rel-17 NR RedCap work item, 3GPP has established a framework for enabling reduced capability NR devices suitable for a range of use cases, including the industrial sensors, video surveillance, and wearables use cases, with requirements on low UE complexity and sometimes also on low UE power consumption.

To further expand the market for RedCap use cases with relatively low cost, low energy consumption, and low data rate requirements, e.g., industrial wireless sensor network use cases, some further complexity reduction enhancements should be considered.

Rel-18 RedCap should provide NR support for low-tier devices between existing LPWA UEs and the capabilities of Rel-17 RedCap UEs. The supported peak data rate for Rel-18 RedCap targets to 10Mbps. Rel-18 RedCap should not overlap with existing LPWA solutions.

The enhancements should be introduced while maintaining the integrity of the RedCap ecosystem and maximizing the benefit of economies of scale. The WI targets enhancements applicable to the RedCap framework defined in Rel-17, including principles of network awareness of device capabilities.

Techniques for further UE complexity reduction have been studied in the study item documented in TR 38.865.

## 4 Objective

### 4.1 Objective of Core part WI

The objective is to specify support for the following enhancements:

**Power saving/energy efficiency enhancements**

* Enhanced eDRX in RRC\_INACTIVE (>10.24s) [RAN2, RAN3, RAN4]
	+ Note that this objective requires SA2, CT1 and CT4 involvement

**Complexity/cost reduction**

* Further reduced UE complexity in FR1 [RAN1, RAN2, RAN4]
	+ UE BB bandwidth reduction
		- 5 MHz BB bandwidth only for PDSCH (for both unicast and broadcast) and PUSCH, with 20 MHz RF bandwidth for UL and DL
		- The other physical channels and signals are still allowed to use a BWP up to the 20 MHz maximum UE RF+BB bandwidth.
	+ UE peak data rate reduction
		- Relaxation of the constraint (*vLayers*·*Qm*·*f* ≥ 4) for peak data rate reduction
		- The relaxed constraint is, e.g., 1 (instead of 4).
		- The parameters (*vLayers*, *Qm*, *f*) can be as in Rel-17 RedCap.
	+ Both 15 kHz SCS and 30 kHz SCS are supported.
	+ Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction.
	+ The existing UE capability framework is used, and changes to capability signalling are specified only if necessary. By default, all UE capabilities applicable to a Rel-17 RedCap UE are applicable unless otherwise specified.

Notes:

* The work defined as part of this WI is not to overlap with LPWA use cases.
* Coexistence with non-RedCap UEs and Rel-17 RedCap UEs should be ensured.
* This WI considers all applicable duplex modes unless otherwise specified.

Check in RAN#98-e regarding:

* Whether UE peak data rate reduction for UE is limited only with UE BB bandwidth reduction or standalone
* Whether or not/how a separate early indication can be supported
* Other restrictions of the WI (e.g., connectivity restrictions, band, etc.)

### 4.2 Objective of Performance part WI

Specify necessary performance requirements, measurement accuracy requirements and test cases related to the above-mentioned enhancements and core requirements [RAN4].

### 4.3 RAN time budget request

**additional comments to the time budget request in the attached Excel table: -**

## 5 Expected Output and Time scale

|  |
| --- |
| **New specifications** *{One line per specification. Create/delete lines as needed}* |
| Proposed Spec no. or series | Type (see note 1)  | Title | For info at TSG#  | For approval at TSG# | Remarks |
|  |  |  |  |  |  |

|  |
| --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| 38.202  | NR; Services provided by the physical layer | RAN#101 | Core part |
| 38.211 | NR; Physical channels and modulation | RAN#101 | Core part |
| 38.212 | NR; Multiplexing and channel coding | RAN#101 | Core part |
| 38.213 | NR; Physical layer procedures for control | RAN#101 | Core part |
| 38.214 | NR; Physical layer procedures for data | RAN#101 | Core part |
| 38.300  | NR; NR and NG-RAN Overall description; Stage-2  | RAN#102 | Core part |
| 38.304  | NR; User Equipment (UE) procedures in idle mode and in RRC Inactive state | RAN#102 | Core part |
| 38.306 | NR; User Equipment (UE) radio access capabilities | RAN#102 | Core part |
| 38.321 | NR; Medium Access Control (MAC) protocol specification | RAN#102 | Core part |
| 38.331 | NR; Radio Resource Control (RRC) protocol specification | RAN#102 | Core part |
| 38.413 | NG-RAN; NG Application Protocol (NGAP) | RAN#102 | Core part |
| 38.101-1  | NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone  | RAN#102 | Core part |
| 38.133  | NR; Requirements for support of radio resource management | RAN#102 | Core part |
| 38.101-4 | NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements | RAN#104 | Perf. part |
| 38.104 | NR; Base Station (BS) radio transmission and reception | RAN#104 | Perf. part |
| 38.133  | NR; Requirements for support of radio resource management | RAN#104 | Perf. part |
| 38.141-1  | NR; Base Station (BS) conformance testing Part 1: Conducted conformance testing  | RAN#104 | Perf. part |
| 38.141-2  | NR; Base Station (BS) conformance testing Part 2: Radiated conformance testing | RAN#104 | Perf. part |

## 6 Work item Rapporteur(s)

Johan Bergman, Ericsson, johan.bergman@ericsson.com

## 7 Work item leadership

Primary: RAN WG1

Secondary: RAN WG2, RAN WG4, RAN WG3

## 8 Aspects that involve other WGs

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

## 9 Supporting Individual Members

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| Supporting IM name |
| Ericsson |
| FUTUREWEI |
| CATT |
| Sony |
| Panasonic |
| Thales |
| Sharp |
| NTT DOCOMO |
| Sierra Wireless |
| Spreadtrum Communications |
| KDDI |
| NEC |
| MediaTek Inc. |
| Huawei |
| HiSilicon |
| Nokia |
| Nokia Shanghai Bell |
| OPPO |
| III |
| Intel |
| FirstNet |
| New H3C |
| Samsung |
| CMCC |
| ZTE |
| Sanechips |
| LG Electronics |
| Vivo |