**3GPP TSG RAN meeting #88e RP-20xxxx**

**Electronic Meeting, June 29 - July 3, 2020**

## Status Report to TSG

**Agenda item:** 9.9.5

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| **WI / SI Name** | Study on support of reduced capability NR devices |
| included in this status report | Study Item: Yes | Core part: No | Performance part:No | Testing part:No |
| **Acronym** | FS\_NR\_redcap |
| **Unique ID** | 860035 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | [RP-193238](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_86/Docs/RP-193238.zip) |
| **Target Completion Date****(indicate if changed)** | Study Item: 12/2020(was 06/2020) | Core part:  | Performance part:  | Testing part:  |
| **Overall Completion level** | Study Item: 20% | Core part:  | Performance Part:  | Testing part:  |

**Source:**

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| **Leading WG** | RAN1 |
| **Rapporteur** | **Name** | Johan BERGMAN |
| **Company** | Ericsson |
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## 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?** | Yes |

**Additional explanations/motivations for the time budget changes in the attached Excel table:**Since the start of the study item was postponed from February to May, the time budget needs to be updated.

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

## 2.1 RAN1

#### 2.1.1 Agreements

**RAN1#101-e**

103 contributions were submitted (for details see agenda item 8.3 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/TDoc_List_Meeting_RAN1%23101-e.xlsx)).

RAN1 carried out an initial online (GTW) session where it was agreed to start two email discussions:

* [101-e-NR-RedCap-Skeleton] on the skeleton for TR 38.875
* [101-e-NR-RedCap-01] focusing on high-level topics/evaluation assumptions necessary to facilitate next step’s more concrete analysis/evaluations

RAN1 carried out an email discussion [101-e-NR-RedCap-Skeleton] on the skeleton for TR 38.875:

* An initial TR skeleton was provided in [R1-2003288](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2003288.zip).
* An email discussion summary was provided in [R1-2004993](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2004993.zip).
* An updated TR skeleton was endorsed in [R1-2004962](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2004962.zip).

RAN1 carried out an email discussion [101-e-NR-RedCap-01] focusing on high-level topics/evaluation assumptions necessary to facilitate next step’s more concrete analysis/evaluations:

* An initial email discussion summary was provided in [R1-2004731](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2004731.zip) as input to a second online session.
* A final email discussion summary was provided in [R1-2005048](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2005048.zip) at the end of the email discussion.
* The resulting agreements are listed further down.

RAN1 carried out a post-meeting email discussion [101-e-NR-RedCap-Skeleton], again focusing on high-level topics/evaluation assumptions necessary to facilitate next step’s more concrete analysis/evaluations:

* The discussion focused on first the High priority proposals and then the Medium priority proposals according to the classification in the summary from the previous email discussion in [R1-2005048](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2005048.zip).
* An email discussion summary was provided in [R1-2005114](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/R1-2005114.zip) at the end of the email discussion.
* The resulting agreements are listed further down.

RAN1 made the following agreements related to use case requirements:

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| Agreements:* For safety related sensors, latency requirements apply to traffic initiated from RRC\_CONNECTED.
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RAN1 made the following agreements related to study of UE complexity reduction:

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| Agreements:* For FR1, study at least 20MHz maximum UE bandwidth at least for initial access
	+ Other bandwidths FFS
* For FR2, study 50MHz and 100 MHz maximum UE bandwidth at least for initial access
	+ Other bandwidths FFS

Agreements:* For FR1, study two antenna configurations for RedCap UEs, namely 1Rx/1Tx and 2Rx/1Tx.
* For FR2, study two antenna configurations for RedCap UEs, namely 1Rx/1Tx and 2Rx/1Tx.

Agreements:* Study HD-FDD operation Type A and Type B (as defined in LTE) in RAN1, where study of Type A is prioritized.

Agreements:* For UE complexity reduction through relaxed UE processing time, study a more relaxed UE processing time in terms of N1/N2 compared to capability #1.

Agreements:* Use the TR 36.888 methodology for UE cost/complexity evaluation as a starting point and determine what major updates are needed.
* Cost/complexity breakdowns can be separate for FR1 and FR2 if found beneficial.
* Include antenna parts at least in the cost/complexity breakdown for FR2.
* Potential benefits in terms of reduced device size can be mentioned where applicable in the TR (e.g. in the section on reduced number of antennas), but the SI will not aim to quantify such benefits.

Agreements:The reference NR device for evaluation of cost/complexity reduction supports the following:* All mandatory Rel-15 features (with or without capability signaling)
* Single RAT
* Operation in a single band at a time
* Maximum bandwidth:
	+ For FR1: 100 MHz for DL and UL
	+ For FR2: 200 MHz for DL and UL
* Antennas:
	+ For FR1 FDD: 2Rx/1Tx
	+ For FR1 TDD: 4Rx/1Tx
	+ For FR2: 2Rx/1Tx
* Power class: PC3
* Processing time: Capability 1
* Modulation:
	+ For FR1: support 256QAM for DL and 64QAM for UL
	+ For FR2: support 64QAM for DL and 64QAM for UL
* Access: Direct DL/UL access between UE and gNB

Note: The study will consider impacts on the cost/complexity reduction from support of multiple RF bands within FR1 or FR2. |

RAN1 made the following agreements related to study of UE power saving:

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| Agreements:* Study the impact of BD and CCE limits reduction on power saving and PDCCH blocking probability (quantitatively) and impacts on latency and scheduling flexibility (at least qualitatively).

Agreements:* Reuse the power consumption models and scaling factors for FR1 and FR2 provided in TR 38.840 (sections 8.1.1, 8.1.2, 8.1.3) as appropriate.
* For evaluation of UE power saving, for wearables, use the traffic models FTP model 3 and VoIP from TR 38.840 to characterize the wearables service types including IM, VoIP, heartbeat, etc. with proper modification of at least packet size and mean inter-arrival time. Values are FFS.
* For evaluation of UE power saving, for industrial wireless sensor use cases, use a traffic model based on the service performance requirements for the process monitoring use case in TS 22.104 Table 5.2-2. At least 64 bytes UL message (plus headers, e.g. MAC, RLC, etc.) transmitted periodically with a periodicity 100 ms should be considered (other values are encouraged).
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RAN1 made the following agreements related to study of coverage loss/recovery:

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| Agreements:* If/when coverage evaluations outside the CE SI are needed,
	+ The basic evaluation methodology is based on link-level simulation for FR1.
		- ­Step 1: Obtain the required SINR for the physical channels under target scenarios and service/reliability requirements.
		- ­Step 2: Obtain the baseline performance based on required SINR and link budget template.
		- ­Note: aspects related to identifying target performance and coverage bottlenecks based on target performance metric is to be handled separately
	+ The evaluation methodology for FR2 is the same as FR1.

Agreements:* If/when link-level coverage evaluations outside the CE SI are needed,
	+ The CE SI link-level simulation assumptions can be used as a starting point.
	+ For calibration purposes, the following settings can be used:

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| **Parameters** | **FR1 values** | **FR2 values** |
| Scenario and frequency | Urban:2.6 GHz (TDD) (primary choice)4 GHz (TDD) (secondary choice)Rural:700 MHz (FDD) | Indoor: 28 GHz (TDD) |
| Frame structure for TDD | For 2.6 GHz:DDDDDDDSUU (S: 6D:4G:4U)For 4 GHz:DDDSUDDSUU(S: 10D:2G:2U) | DDDSU(S: 10D:2G:2U) |
| Channel model | TDL-C | TDL-A |
| UE velocity | 3 km/h | 3 km/h |

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RAN1 made the following agreements related to study of performance impacts:

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| Agreements:* The evaluation of performance impacts includes at least peak data rate, latency and reliability (as needed for the use cases). Other performance metrics such as power consumption, spectral efficiency and PDCCH blocking probability may also be considered if appropriate for a specific technique.
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#### 2.1.2 Remaining Open issues

Identify and study potential UE complexity reduction features, including [RAN1, RAN2]:

* Reduced number of UE RX/TX antennas
* UE Bandwidth reduction
* Half-Duplex-FDD
* Relaxed UE processing time
* Relaxed UE processing capability

Study UE power saving and battery lifetime enhancement for reduced capability UEs in applicable use cases (e.g. delay tolerant) [RAN2, RAN1]:

* Reduced PDCCH monitoring by smaller numbers of blind decodes and CCE limits [RAN1].

Study functionality that will enable the performance degradation of such complexity reduction to be mitigated or limited, including [RAN1]:

* Coverage recovery to compensate for potential coverage reduction due to the device complexity reduction.

Support RAN2-led study objectives as needed (see section 2.2.2)

## 2.2 RAN2

#### 2.2.1 Agreements

#### 2.2.2 Remaining Open issues

Study UE power saving and battery lifetime enhancement for reduced capability UEs in applicable use cases (e.g. delay tolerant) [RAN2, RAN1]:

* Extended DRX for RRC Inactive and/or Idle [RAN2]
* RRM relaxation for stationary devices [RAN2]

Study standardization framework and principles for how to define and constrain such reduced capabilities – considering definition of a limited set of one or more device types and considering how to ensure those device types are only used for the intended use cases [RAN2, RAN1].

Study functionality that will allow devices with reduced capabilities to be explicitly identifiable to networks and network operators, and allow operators to restrict their access, if desired [RAN2, RAN1].

Support RAN1-led study objectives as needed (see section 2.1.2)

## 4. References

**RAN1#101-e**

103 contributions (for details see agenda item 8.3 in [Tdoc list](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_101-e/Docs/TDoc_List_Meeting_RAN1%23101-e.xlsx))