3GPP TSG-RAN WG1 Meeting #101-e Tdoc R1-20xxxxx

e-Meeting, May 25th – June 5th, 2020

**Agenda Item: 8.3**

**Title: TR skeleton for Study on support of reduced capability NR devices**

**Source: Rapporteur (Ericsson)**

**Document for: Discussion**

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| 3GPP TR 38.875 Vx.y.z (yyyy-mm) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Study on support of reduced capability NR devices  (Release 17) | |
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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

This document captures the findings from the study item “Study on support of reduced capability NR devices” [2].

The study includes identification and study of potential UE complexity reduction techniques and UE power saving and battery lifetime enhancements for reduced capability UEs in applicable use cases, functionality that will enable the performance degradation of such complexity reduction to be mitigated or limited, principles for how to define and constrain such reduced capabilities, and functionality that will allow devices with reduced capabilities to be explicitly identifiable to networks and networks operators and allow operators to restrict their access if desired.

The scope of the study includes support for all FR1/FR2 bands for FDD and TDD and coexistence with Rel-15/16 UEs. This study focuses on SA mode and single connectivity. The scope of the study does not include LPWA use cases.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP RP-193238: "New SID on support of reduced capability NR devices".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

<ABBREVIATION> <Expansion>

# 4 Introduction

The usage scenarios that have been identified for 5G are *enhanced mobile broadband* (eMBB), *massive machine-type communication* (mMTC), and *Ultra-Reliable and Low Latency communication* (URLLC). Yet another identified area is *time sensitive communication* (TSC). In particular, mMTC, URLLC and TSC are associated with novel IoT use cases that are targeted in vertical industries. It is envisaged that eMBB, mMTC, URLLC and TSC use cases may all need to be supported in the same network.

In the 3GPP study on “*self-evaluation towards IMT-2020 submission*” it was confirmed that NB-IoT and LTE-M fulfil the IMT-2020 requirements for mMTC and can be certified as 5G technologies. For URLLC support, URLLC features were introduced in Release 15 for both LTE and NR, and NR URLLC is further enhanced in Release 16 within the enhanced URLLC (eURLLC) and Industrial IoT work items. Rel-16 also introduced support for Time-Sensitive Networking (TSN) and 5G integration for TSC use cases.

1. One important objective of 5G is to enable connected industries. 5G connectivity can serve as catalyst for next wave of industrial transformation and digitalization, which improve flexibility, enhance productivity and efficiency, reduce maintenance cost, and improve operational safety. Devices in such environment include e.g. pressure sensors, humidity sensors, thermometers, motion sensors, accelerometers, actuators, etc. It is desirable to connect these sensors and actuators to 5G radio access and core networks. The massive industrial wireless sensor network (IWSN) use cases and requirements described in TR 22.804, TS 22.104, TR 22.832 and TS 22.261 include not only URLLC services with very high requirements, but also relatively low-end services with the requirement of small device form factors, and/or being completely wireless with a battery life of several years. The requirements for these services are higher than LPWA (i.e. LTE-M/NB-IoT) but lower than URLCC and eMBB.
2. Similar to connected industries, 5G connectivity can serve as catalyst for the next wave smart city innovations. As an example, TS 22.804 describes smart city use case and requirements for that. The smart city vertical 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.
3. Finally, wearables use case includes smart watches, rings, eHealth related devices, and medical monitoring devices etc. One characteristic for the use case is that the device is small in size.

The intention is to study a UE feature and parameter list with lower end capabilities, relative to Release 16 eMBB and URLLC NR to serve the three use cases mentioned above.

# 5 Requirements

# 6 Evaluation methodology

## 6.1 Evaluation methodology for UE complexity reduction

## 6.2 Evaluation methodology for UE power saving

## 6.3 Evaluation methodology for coverage recovery

## 6.4 Evaluation methodology for performance impacts

# 7 UE complexity reduction features

## 7.1 Introduction to UE complexity reduction features

## 7.2 Reduced number of UE Rx/Tx antennas

### 7.2.1 Description of feature

### 7.2.2 Analysis of UE complexity reduction

### 7.2.3 Analysis of performance impacts

### 7.2.4 Analysis of coexistence with legacy UEs

### 7.2.5 Analysis of specification impacts

## 7.3 UE bandwidth reduction

### 7.3.1 Description of feature

### 7.3.2 Analysis of UE complexity reduction

### 7.3.3 Analysis of performance impacts

### 7.3.4 Analysis of coexistence with legacy UEs

### 7.3.5 Analysis of specification impacts

## 7.4 Half-duplex FDD operation

### 7.4.1 Description of feature

### 7.4.2 Analysis of UE complexity reduction

### 7.4.3 Analysis of performance impacts

### 7.4.4 Analysis of coexistence with legacy UEs

### 7.4.5 Analysis of specification impacts

## 7.5 Relaxed UE processing time

### 7.5.1 Description of feature

### 7.5.2 Analysis of UE complexity reduction

### 7.5.3 Analysis of performance impacts

### 7.5.4 Analysis of coexistence with legacy UEs

### 7.5.5 Analysis of specification impacts

## 7.6 Relaxed UE processing capability

### 7.6.1 Description of feature

### 7.6.2 Analysis of UE complexity reduction

### 7.6.3 Analysis of performance impacts

### 7.6.4 Analysis of coexistence with legacy UEs

### 7.6.5 Analysis of specification impacts

## 7.7 Combinations of UE complexity reduction features

### 7.7.1 Description of feature combinations

### 7.7.2 Analysis of UE complexity reduction

### 7.7.3 Analysis of performance impacts

### 7.7.4 Analysis of coexistence with legacy UEs

### 7.7.5 Analysis of specification impacts

# 8 UE power saving and battery lifetime enhancement

## 8.1 Introduction to UE power saving and battery lifetime enhancement

## 8.2 Reduced PDCCH monitoring

### 8.2.1 Description of feature

### 8.2.2 Analysis of UE power saving

### 8.2.3 Analysis of performance impacts

### 8.2.4 Analysis of coexistence with legacy UEs

### 8.2.5 Analysis of specification impacts

## 8.3 Extended DRX for RRC Inactive and/or Idle

## 8.4 RRM relaxation for stationary devices

# 9 Coverage recovery features

## 9.1 Introduction to coverage recovery features

## 9.2 Coverage recovery feature X

### 9.2.1 Description of feature

### 9.2.2 Analysis of coverage recovery

### 9.2.3 Analysis of performance impacts

### 9.2.4 Analysis of coexistence with legacy UEs

### 9.2.5 Analysis of specification impacts

# 10 Definition and constraining of reduced capabilities

# 11 UE identification and access restrictions

# 12 Conclusions

Annex <A>:  
<Title>

# A.1 <Heading>

Annex <Y>:  
Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

<Publication>: "<Title>".

Annex <Z>:  
Change history

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| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
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