



## **Reconfigurable Radio Systems (RRS); Radio Interface Engine (RIE); Part 1: Technical requirements**

**STANDARD PREVIEW**  
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Full standard/standards/103/103-655-1-v1-1-2019-03  
<https://standards.iteh.ai/catalog/standards/sis/784-18c0-4186-a7a3-6ac813962186/etsi-ts-103-655-1-v1-1-2019-03>

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Reference

DTS/RRS-0149-1

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Keywords

mobile, modulation, radio, requirements, system

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# Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS).

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# Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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# Introduction

The radio interface engine comprises context information and communication needs to improve both depending on the demands. In ETSI TR 103 587 [i.1] several use cases are identified and described that are used as base for the requirements of the radio interface engine. The concept demands requirements for a future architecture of the radio interface engine. The requirements are split into two categories: the functional and the performance requirements. The functional requirements consist of three groups. These are the radio and hardware processing resources, the functions that are supporting the reconfiguration and the mobile device mobility and connectivity management.

The performance requirements comprise communication as well as context information indicators. Context information includes positioning performance indicators and is proposed in 3GPP R16 where positioning relevant KPIs are identified [i.2]. The context information performance KPIs steer the potential of the radio interface engine to improve and reach the communication performance requirements of the network.

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# 1 Scope

The present document specifies the system requirements for Reconfigurable Radio Systems operating in different environments and bands to apply the concept of the radio interface engine that is introduced in ETSI TR 103 587 [i.1] together with use cases comprising different key performance indicators in radio systems.

The documented key performance indicators are described and followed by the requirements on the wireless systems which are structured in the following requirement categories:

- Requirements for radio and hardware processing resources.
- Requirements for functions supporting the reconfiguration.
- Requirements for mobile device mobility and connectivity management.

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# 2 References

## 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TR 103 587: "Reconfigurable Radio Systems (RRS); Feasibility study of a Radio Interface Engine (RIE)".
- [i.2] 3GPP TR 22.872 (V16.1.0): "Study on positioning use cases (Release 16)", SA WG1.

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# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

Void.

## 3.2 Symbols

Void.

## 3.3 Abbreviations

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

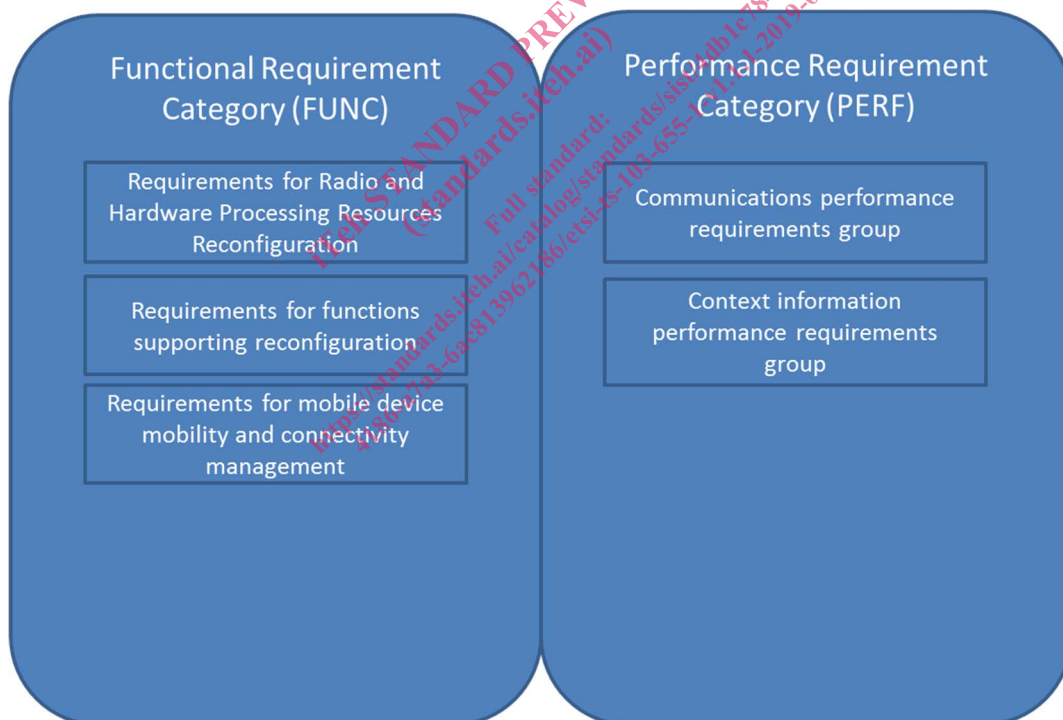
HPR	Hardware Processing Resources
QoS	Quality of Service
RR	Radio Resources
WD	Wireless Device

---

# 4 Requirement Organization and Methodology

## 4.1 Requirement Organization

The requirements are organized into two categories. Category one defines the function requirements and category two the performance requirements. Both categories are further split up into different groups. Figure 1 visualizes the categories and its enclosed groups.



**Figure 1: Requirements Operations**

## 4.2 Requirement Format

A letter code is defined to uniquely identify each requirement R<CAT><GROUP><XX>. It is constructed as follows:

- R-:standard requirement prefix.
- <CAT>:

Code	Category
FUNC	Functional aspects
PERF	Performance aspects

- <GROUP>: Requirement group identifier. A three letter code will be used for this identifier.
- <XX>: Requirement identifier within requirement group; range 01 → 99.

EXAMPLE: R-FUNC-RHR-01: Requirements-Function-Radio\_and\_Hardware\_Resources\_01.

## 4.3 Requirement Formulation

A requirement is formulated in such a way that it is uniquely defined. It is built as follows:

- Title: <Title Description>

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## 5 Working Assumptions

The working assumptions described below are based on ETSI TR 103 587 [i.1]. There a radio interface engine is defined to comprise the following use cases which all rely on context information, such as current and predictive location information of the wireless device:

- Decision making based on context information of either the mobile device or the base station identifying if a single or multiple links are best.
- User circumstance trigger context information management that adapts the communication KPIs.
- Considering context information to download and install a different PHY/MAC protocol of wireless devices.
- Tracking context information to decide where the processing unit shall be executed.
- Considering context information to adapt PHY and MAC to improve the location estimation of the WD iteratively further.

Relevant performance indicators are categorized in two groups:

- Communications performance indicators, such as data rate, latency, spectrum and power efficiency.
- Context information performance indicators, such as waveform, location accuracy, integrity of sensor data, and used spectrum for ranging, and outdated sensor data.



## 6 Functional System Requirements

### 6.1 Requirements for radio and hardware processing resources

#### 6.1.1 R-FUNC-RHR-01: Reconfiguration for each WD

The system shall support the reconfiguration of both the Hardware Processing Resources (HPRs) and the Radio Resources (RRs) for each supported Wireless Device (WD).

**Explanation:** The system should be able to perform resource reconfiguration of both the hardware processing resources and the radio resources for each supported WD. The radio resources assigned to each supported WD can be dynamically modified, which includes bandwidth, frequencies, power levels, spectrum masks, etc. Meanwhile, the percentage of hardware processing resources devoted to each supported WD should be dynamically modified. For example, sufficient HPR should be configured to a WD when a new channel is assigned to it.

#### 6.1.2 R-FUNC-RHR-02: Reconfiguration between WDs

The system shall support reconfiguration of both HPRs and RRs between different WDs.

**Explanation:** The system can reconfigure multiple WDs with flexibility in terms of the percentage of HPRs and RRs between different WDs according to the status of the network.

### 6.2 Requirements for functions supporting the reconfiguration

#### 6.2.1 R-FUNC-REC-01: Gathering and processing function

The system shall support a gathering and processing function to gather and process radio related metrics and parameters.

**Explanation:** After having gathered radio related metrics and parameters, the gathering and processing function may process them to make decisions on reconfiguration in order to optimize radio performance. The identification of the radio related metrics and parameters which can be used for reconfiguration purposes may vary according the specific use case. These are expected to include traffic variations, channel bandwidth, interference, transmit power and QoS.

#### 6.2.2 R-FUNC-REC-02: Support of trigger events for reconfiguration

The system shall support trigger events for reconfiguration.

**Explanation:** Trigger events are described by certain parameters (e.g. thresholds, hysteresis) in order to define the condition under which an event is happening. When one or more events occur, the system starts to evaluate the need for a possible reconfiguration.

#### 6.2.3 R-FUNC-REC-03: Support for reconfiguration function

The system shall support a reconfiguration function to make decisions for radio resource reconfiguration and inform RBSs to perform the reconfiguration e.g. triggered by events in clause 6.2.2.

**Explanation:** The reconfiguration function shall make radio resource reconfiguration decisions such as, reconfiguration time, reconfigured RATs, frequency bands allocation and adding/dropping carrier frequencies at RBSs.



## 6.2.4 R-FUNC-REC-04: Support for execution function

The system shall support the execution function in order to perform the reconfiguration.

**Explanation:** The system WDs should support mechanisms in order to be reconfigured according to the reconfiguration decision of the reconfiguration function.

**EXAMPLE:** An example is to exchange location estimates between WDs to improve the estimation process on the receiver itself.

## 6.2.5 R-FUNC-REC-05: Support of learning function

The system shall support a learning function to improve and optimize the reconfiguration decisions.

**Explanation:** For example, the learning capability may consist in monitoring the performance of the system after each reconfiguration and verifying whether the decisions meet or not the reconfiguration target. Another possibility is to learn about the causes that trigger a particular reconfiguration by memorizing the situation; if such causes happen again, the reconfiguration that should be performed is already known.

## 6.2.6 R-FUNC-REC-06: Support of information provisioning function

The system shall support an information provisioning function to provide updated network configuration information to the appropriate system devices.

**Explanation:** After a reconfiguration, the information related to the new network configuration and policies, are expected to be efficiently provided to the system devices (only the ones affected by the reconfiguration) in order to minimize the control plane overhead due to the reconfiguration.

## 6.3 Requirements for mobile device mobility and connectivity management

### 6.3.1 R-FUNC-MOB-01: Mobility management of the WDs

The system shall guarantee the mobility management of the WDs.

**Explanation:** Network reconfiguration (e.g. change of WD in currently used band or starting operations in a new band using a WD already deployed or a new WD) may imply the change of radio parameters, such as neighbour cells relation information (e.g. the neighbour cells IDs, the neighbour cells operating frequency, etc.) affecting the cell selection/reselection of WDs in idle mode. The mobility management is guaranteed by providing such updated information to the WDs.

### 6.3.2 R-FUNC-MOB-02: Connectivity management of the WDs

The system shall manage the connectivity of the WDs during the reconfiguration.

**Explanation:** When a WD is in connected mode and operating on radio resources that may be reconfigured, an appropriate decision has to be evaluated by the system in order to maintain the connectivity of the involved WDs. In the following, different examples of approaches are depicted according to the WDs capabilities:

In order to support connectivity of WDs that are only able to operate on WD "a" in band "x", sufficient radio resource in band "x" may be maintained for WD "a" in band "x". In order to support WDs capable of operating on WD "a" or WD "b" in band "x" and which are in connected mode on WD "a" in band "x", it may be evaluated if the connectivity currently provided to the WDs on WD "a" could be provided also on WD "b" performing handover from WD "a" to WD "b" before the reconfiguration from WD "a" to WD "b" on band "x".