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Reconfigurable Radio Systems (RRS);
System requirements for Reconfigurable Radio Systems operating in IMT-Bands and GSM-Bands for intra-operator scenarios

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Contents

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Foreword

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

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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1 Scope

The scope of the present document is to define the system requirements for Reconfigurable Radio Systems operating in GSM and IMT bands for intra-operator scenarios. These requirements are derived from the use cases described in ETSI TR 103 063 [i.1]. The present document considers the system requirements only for intra-operator scenarios for which the spectrum resources are assigned to and managed by a single operator.

Requirement categories are:

- Requirements for Radio and Hardware Processing Resources Reconfiguration.
- Requirements for functions supporting reconfiguration.
- Requirements for mobile device mobility and connectivity management.

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.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

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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 103 063: "Reconfigurable Radio Systems (RRS); Use Cases for Reconfigurable Radio Systems operating in IMT bands and GSM bands for intra-operator scenarios".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

cognitive radio system: radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained

Reconfigurable Radio Systems (RRS): generic term for radio systems encompassing Software Defined and/or Cognitive Radio Systems

software defined radio: radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard

use case: description of a system from a user's perspective

NOTE 1: Use cases treat a system as a black box, and the interactions with the system, including system responses, are perceived as from outside the system. Use cases typically avoid technical jargon, preferring instead the language of the end user or domain expert.

NOTE 2: Use cases should not be confused with the features/requirements of the system under consideration. A use case may be related to one or more features/requirements, a feature/requirement may be related to one or more use cases.

NOTE 3: A brief use case consists of a few sentences summarizing the use case.

3.2 Abbreviations

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

DSP	Digital Signal Processor
FPGA	Field Programmable Gate Array
HPR	Hardware Processing Resource
IMT	International Mobile Telecommunications
MD	Mobile Device
QoS	Quality of Service
RAT	Radio Access Technology
RBS	Reconfigurable Base Station
RF	Radio Frequency

4 Requirement Organization and Format

4.1 Requirement Organization

The present document is structured such that a level 2 section is dedicated to the requirements associated with a single category. The overall structure is shown in figure 4.1.

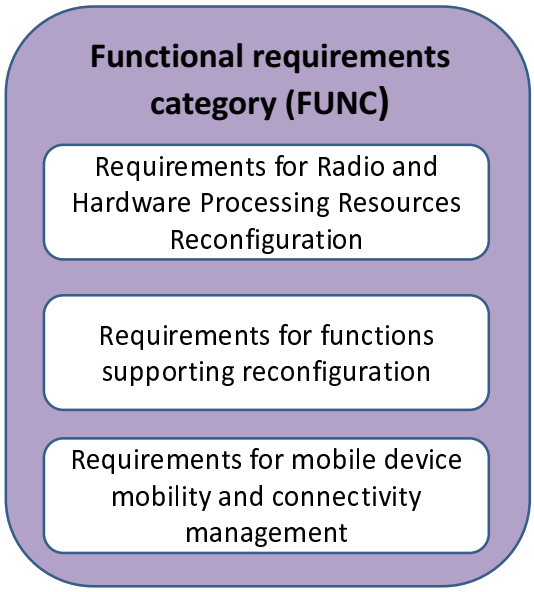

Figure 4.1: Overall requirements structure

4.2 Requirement Format

A letter code system is defined which makes a unique identification of each requirement R-<CAT>-<GROUP>-<XX>.

It should be constructed as follows:

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

Code	Category
FUNC	Functional aspects
PERF	Performance aspects

- <GROUP>: Requirement group identifier. A letter code will be used for this identifier. The three first letters will give the identifier of the group.
- <XX>: Requirement identifier within requirement group; range 01 => 99.

EXAMPLE: R-FUNC-QOS-01.

5 Working assumptions

ETSI TR 103 063 [i.1] describes how Reconfigurable Radio Systems can be exploited in IMT bands and GSM bands (i.e. licensed spectrums allocated to IMT and GSM systems) to increase the efficiency of the radio resource management in the intra-operator scenarios for which the spectrum resources are assigned to and managed by a single operator. The list of Use Cases described in ETSI TR 103 063 [i.1] is reported hereafter:

- Radio Resource optimization.
- Spectrum refarming.
- Upgrading a pre-existing RAT and deploying a new RAT to a pre-existing network.
- Addition of multiple standards modes.
- LTE pico/femto cell reconfiguration.

- Cognition Enabler.

It has to be noted that each Use Case does not necessarily require fulfilling all the system requirements but only the ones related to the specific Scenarios. Furthermore the requirements related to MD has to be intended as a means to fully benefit from the depicted RRS operations in which even non-reconfigurable multi-mode MDs can be fully supported.

6 Functional Requirements

6.1 Radio and Hardware Processing Resources Reconfiguration Requirements

6.1.1 R-FUNC-RHR-01: Reconfiguration for each RAT

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

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

NOTE: HPR indicates the hardware of the reconfigurable node (e.g. constituted by DSPs and FPGAs) that is used to run the software that implements the specific RATs functionalities (e.g. Base Band operations). The RF part is supposed to be separate and managed by specific modules (e.g. Radio Units (RUs)) able to support more RATs at the same time with sufficient power capacity in order to respect the RF requirements of any single RAT [i.1].

6.1.2 R-FUNC-RHR-02: Reconfiguration between RATs

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

Explanation: The system can re-configure multiple RATs with flexibility in terms of the percentage of HPRs and RRs between different RATs according to the status of the network.

6.2 Requirements for functions supporting 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 certain 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, QoS, etc.

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, etc.) 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 devices (e.g. RBS, MDs, etc.) should support mechanisms in order to be reconfigured according to the reconfiguration decision of the reconfiguration function.

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 MDs mobility and connectivity management requirements

6.3.1 R-FUNC-MOB-01: Mobility management of the MDs

The system shall guarantee the mobility management of the MDs.

Explanation: Network reconfiguration (e.g. change of RAT in currently used band or starting operations in a new band using a RAT already deployed or a new RAT) 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 MDs in idle mode. The mobility management is guaranteed by providing such updated information to the MDs.

6.3.2 R-FUNC-MOB-02: Connectivity management of the MDs

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

Explanations: When a MD is in connected mode on a RAT 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 MDs.

In the following, different examples of approaches are depicted according to the MDs capabilities:

- In order to support connectivity of MDs that are only able to operate on RAT "a" in band "x", sufficient radio resource in band "x" may be maintained for RAT "a" in band "x".

- In order to support MDs capable of operating on RAT "a" or RAT "b" in band "x" and which are in connected mode on RAT "a" in band "x", it may be evaluated if the connectivity currently provided to the MDs on RAT "a" could be provided also on RAT "b" performing handover from RAT "a" to RAT "b" before the reconfiguration from RAT "a" to RAT "b" on band "x".

- In order to support MDs capable of operating only on RAT "a" in band "x" and band "y" and which are in connected mode on RAT "a" in band "x", the MDs may be handed over to band "y" before the reconfiguration of the radio resources that refer to band "x".

History

Document history		
V1.1.1	November 2016	Publication