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**Reconfigurable Radio Systems (RRS);
Mobile Device Information Models and Protocols;
Part 1: Multiradio Interface (MURI)**

Reference

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Keywords

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS).

The present document is part 1 of a multi-part deliverable covering the Mobile Device Information Models and Protocols, as identified below:

Part 1:   "Multiradio Interface (MURI)";

Part 2:   "Reconfigurable Radio Frequency Interface (RRFI)";

Part 3:   "Unified Radio Application Interface (URAI)";

Part 4:   "Radio Programming Interface (RPI)".

National transposition dates	
Date of adoption of this EN:	17 November 2015
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Date of withdrawal of any conflicting National Standard (dow):	31 August 2016

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 present document defines an information model and protocol for multiradio interface for reconfigurable mobile devices. The work is be based on the Use Cases defined in ETSI TR 102 944 [i.1], on the system requirements defined in ETSI EN 302 969 [1] and on the radio reconfiguration related architecture for mobile devices defined in ETSI EN 303 095 [i.2].

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 reference document (including any amendments) applies.

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

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 necessary for the application of the present document.

[1] ETSI EN 302 969 (V1.2.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Requirements for Mobile Devices".

2.2 Informative 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 reference document (including any amendments) applies.

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 102 944: "Reconfigurable Radio Systems (RRS); Use Cases for Baseband Interfaces for Unified Radio Applications of Mobile Device".

[i.2] ETSI EN 303 095 (V1.2.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Architecture for Mobile Devices".

[i.3] ETSI TS 103 146-2: "Reconfigurable Radio Systems (RRS); Mobile Device Information Models and Protocols; Part 2: Reconfigurable Radio Frequency Interface (RRFI)".

[i.4] ETSI TR 102 839: "Reconfigurable Radio Systems (RRS); Multiradio Interface for Software Defined Radio (SDR) Mobile Device Architecture and Services".

[i.5] IEEE 1900.4-2009: "IEEE Standard for Architectural Building Blocks Enabling Network-Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks".

[i.6] Recommendation ITU-T X.680: "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".

3 Definitions and abbreviations

3.1 Definitions

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

association: logical communication link to a Radio Access Network or a peer equipment

NOTE 1: Typically, some control signalling is necessary to maintain the association. No user data transfer may occur with only an association present, but a data flow may be established into an association for this purpose.

NOTE 2: Peer equipment is any communication counterpart of a reconfigurable mobile device. It can be reached by establishing a logical communication link (i.e. an association) between the reconfigurable mobile device and peer equipment.

channel: designated part of the information transfer capability having specified characteristics, provided at the user network interface

NOTE: It is the over-the-air wireless propagation channel which is used to convey an information signal from transmitter to receiver. This definition is specified in ETSI EN 303 095 [i.2].

communication services layer: layer related to communication services supporting generic applications

NOTE: A communication services layer supports generic applications like Internet access. In the present document, it consists of Administrator, Mobility Policy Manager (MPM), Networking stack and Monitor.

link: connecting one location to another through a given Radio Access Technology for the purpose of transmitting and receiving digital information

NOTE: Each Link is conveyed over a given Channel.

Radio Application (RA): software which enforces the generation of the transmit RF signals or the decoding of the receive RF signals

NOTE 1: The Software is executed on a particular radio platform or an RVM as part of the radio platform.

NOTE 2: RAs might have different forms of representation. They are represented as:

- source codes including Radio Library calls of Radio Library native implementation and Radio HAL calls;

- IRs including Radio Library calls of Radio Library native implementation and radio HAL calls;

- executable codes for a particular radio platform.

radio computer: part of mobile device hardware working under ROS control and on which RAs are executed

NOTE: A Radio Computer typically includes programmable processors, hardware accelerators, peripherals, etc. RF part is considered to be part of peripherals.

Radio Control Framework (RCF): control framework which, as a part of the OS, extends OS capabilities in terms of radio resource management

NOTE: RCF is a control framework which consists of Configuration Manager (CM), Radio Connection Manager (RCM), Flow Controller (FC) and Multiradio Controller (MRC). The Resource Manager (RM) is typically part of OS.

reconfigurable mobile device: mobile device with radio communication capabilities providing support for radio reconfiguration

NOTE: Reconfigurable Mobile Devices include but are not limited to: Smartphones, Feature Phones, Tablets, and Laptops.

3.2 Abbreviations

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

ASN.1	Abstract Syntax Notation One
BLER	Block Error Rate
CM	Configuration Manager
CSL	Communication Services Layer
FC	Flow Controller
ID	IDentification
IR	Intermediate Representation
MD	Moblile Device
MDRC	Mobile Device Reconfiguration Class
MPM	Mobility Policy Manager
MRC	MultiRadio Controller
MURI	MUltiRadio Interface
OS	Operating System
RA	Radio Application
RAN	Radio Access Network
RAP	Radio Application Package
RAT	Radio Access Technology
RCF	Radio Control Framework
RCM	Radio Connection Manager
RF	Radio Frequency
RM	Resource Manager
ROS	Radio Operating System
RPI	Radio Programming Interface
RRFI	Reconfigurable Radio Frequency Interface
SINR	Signal to Interference plus Noise Ratio
TCP/IP	Transmission Control Protocol/Internet Protocol
UML	Unified Modeling Language
URA	Unified Radio Applications
URAI	Unified Radio Application Interface

4 Introduction

A reconfigurable MD is capable of running multiple radios simultaneously and of changing the set of radios by loading new Radio Application Package (RAP). All Radio Applications (RAs) are called Unified Radio Applications (URAs) when they exhibit a common behavior from the reconfigurable MD's point of view in ETSI EN 303 095 [i.2]. In order to run multiple URAs, the reconfigurable MD will include Communication Services Layer (CSL), Radio Control Framework (RCF), Radio Platform and 4 sets of interfaces for their interconnection.
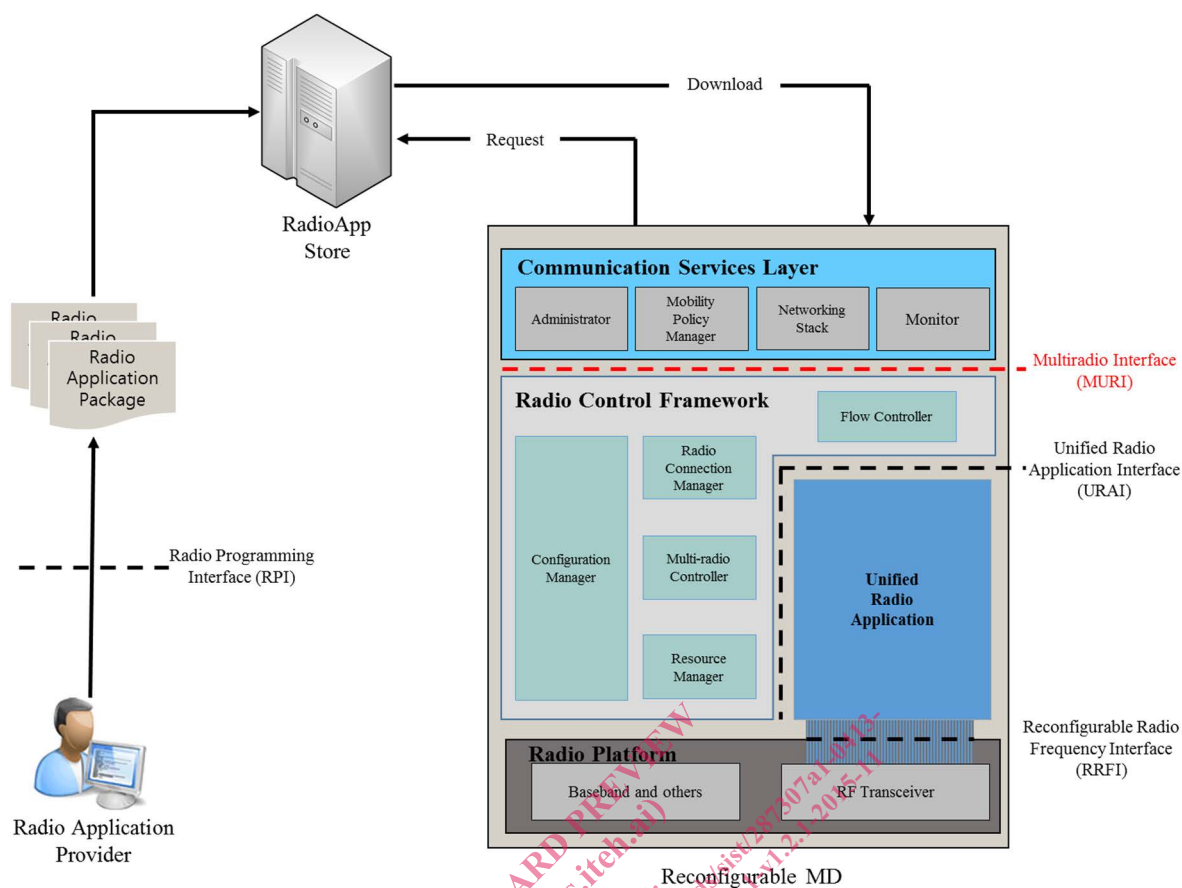
Figure 4.1: Four sets of interfaces for Reconfigurable MD

Figure 4.1 illustrates the Reconfigurable MD architecture with the 4 sets of interfaces, i.e.:

- MURI for interfacing CSL and RCF which is the scope of the present document;

- RRFI for interfacing URA and RF Transceiver in ETSI TS 103 146-2 [i.3];

- URAI for interfacing URA and RCF in ETSI TR 102 839 [i.4];

- RPI for allowing an independent and uniform production of RAs in ETSI TR 102 839 [i.4].
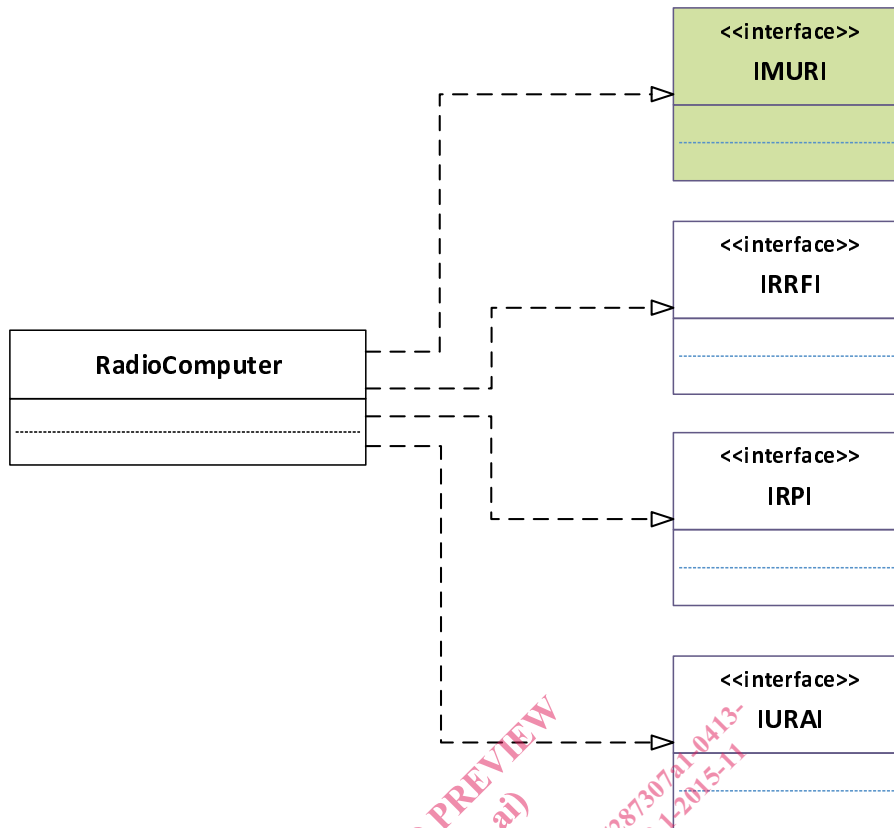
The present document defines MURI.

Figure 4.2: UML class diagram for Radio Computer interfaces

Figure 4.2 illustrates UML class diagram for Radio Computer interfaces. The reconfigurable MD may be seen as a Radio Computer where individual URAs are engineered as software entities in ETSI EN 303 095 [i.2].

The present document is organized as follows:

- clause 5 describes the system identification;

- clause 6 describes the notational tool for defining both information model classes and interface classes;

- clause 7 describes the information model for radio computer; and

- clause 8 describes the interface definition.

While UML is used for defining the information model and protocol related to MURI, other modeling languages could be used as well.

5 System Identification

5.1 Radio Computer Structure

Figure 5.1 illustrates how CSL and RCF interact with each other using MURI.
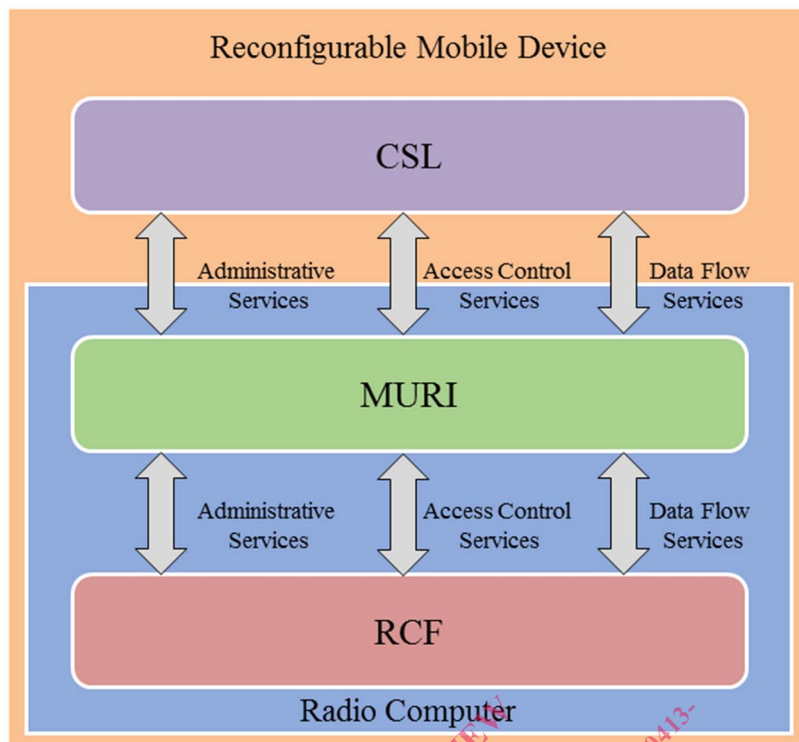
Figure 5.1: Interconnection between CSL and RCF using MURI for Reconfigurable MD

As shown in figure 5.1, MURI supports 3 kinds of services:

- **Administrative Services**

These services are used by some device configuration application i.e. Administrator which is included in the CSL, to (un)install a new URA into the Reconfigurable MD and create/delete an instance of the URA. Installation and loading may take place both at device start-up time to set up the network connection as well as during run-time, whenever reconfiguration of available URAs is needed. MURI does not make any assumption on how and when the mobile device will detect the need of the reconfiguration.

- **Access Control Services**

These services are used by the MPM to maintain the user policies and preferences related to the usage of different RATs and to make a selection between them. Modelling of such preferences and selection algorithms is not in the scope of the present document; however, the MURI specification covers the information exchange of RAT selection decisions between CSL and RCF. The preferences themselves may originate either locally from applications or end user settings as well as in a distributed manner from network operator or from a cognitive radio management framework.

- **Data Flow Services**

These services are used by the networking stack of the Reconfigurable MD, such as the TCP/IP stack. Therefore data flow services represent the set of (logical) link layer services, which are provided in a uniform manner regardless of which URAs are active.

The Communication Services Layer (CSL) and Radio Control Framework (RCF) are defined in ETSI EN 303 095 [i.2].

5.2   MURI System Requirement Mapping

The Radio Computer components above described shall support the MURI system requirements shown in table 5.1 and described in clauses 6.1 and 6.2 of ETSI EN 302 969 [1].

**Table 5.1: Mapping of Radio Computer Components to
the system requirements described in ETSI EN 302 969 [1]**

Entity/Component/Unit	System Requirements [1]	Comments
Administrator	R-FUNC-RAT–01	A reconfigurable MD should support parallel connections to more than one Radio Access Technology. The requirement is described in clause 6.1.1 of [1].
	R-FUNC-RA-01	Reconfigurable MDs shall support the execution of Radio Applications. The requirement is described in clause 6.2.1 of [1].
	R-FUNC-MDR-01	The configuration of a reconfigurable MD compliant to MDRC-2, MDRC-3 or MDRC-4 shall be realized with a Radio Application Package of which the user defined functional blocks, if any, are provided in platform-specific executable code. The requirement is described in clause 6.4.1 of [1].
	R-FUNC-MDR-02	The configuration of a reconfigurable MD compliant to MDRC-5, MDRC-6 or MDRC-7 shall be realized with a Radio Application Package of which the user defined functional blocks, if any, are provided either in a platform-independent source code or an Intermediate Representation (IR). The requirement is described in clause 6.4.2 of [1].
	R-FUNC-MDR-03	The radio configuration of a reconfigurable MD shall be realized with the activation of Radio Applications (RA) and, if necessary, changing parameters of the activated RAs. The requirement is described in clause 6.4.3 of [1].
Mobility Policy Manager	R-FUNC-RAT–01	A reconfigurable MD should support parallel connections to more than one Radio Access Technology. The requirement is described in clause 6.1.1 of [1].
	R-FUNC-RAT–04	If policies are applied to a reconfigurable MD, the link selection functionality in the reconfigurable MD shall meet the related conditions. The requirement is described in clause 6.1.4 of [1].
	R-FUNC-RA-03	Reconfigurable MDs should support concurrent execution of Radio Applications. The requirement is described in clause 6.2.3 of [1].
Networking Stack	R-FUNC-RAT–05	If a reconfigurable MD allows parallel connections to RATs (in alignment to R-FUNC-RAT–01), various independent data flows should be maintained simultaneously. The requirement is described in clause 6.1.5 of [1].
	R-FUNC-RA-04	Radio Applications should support the function of transferring receive (Rx)/transmit (Tx) data to/from the networking stack. The requirement is described in clause 6.2.4 of [1].
Configuration Manager	R-FUNC-RAT–01	A reconfigurable MD should support parallel connections to more than one Radio Access Technology. The requirement is described in clause 6.1.1 of [1].
	R-FUNC-RAT–02	If a reconfigurable MD allows parallel connections to RATs, (in alignment to R-FUNC-RAT-01), in-device coexistence functionalities shall be implemented. The requirement is described in clause 6.1.2 of [1].
	R-FUNC-RA-01	Reconfigurable MDs shall support the execution of Radio Applications. The requirement is described in clause 6.2.1 of [1].