



**Reconfigurable Radio Systems (RRS);  
Radio Equipment (RE) information models and protocols  
for generalized software reconfiguration architecture;  
Part 3: generalized Unified Radio Application Interface (gURAI)**

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# Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Reconfigurable Radio Systems (RRS), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document is part 3 of a multi-part deliverable covering the Radio Equipment (RE) information models and protocols, as identified below:

- Part 1: "generalized Multiradio Interface (gMURI)";
- Part 2: "generalized Reconfigurable Radio Frequency Interface (gRRFI)";
- Part 3: "generalized Unified Radio Application Interface (gURAI)";**
- Part 4: "generalized Radio Programming Interface (gRPI)".

| Proposed national transposition dates  |                                 |
|--|---------------------------------|
| Date of latest announcement of this EN (doa):  | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 6 months after doa              |
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# 1 Scope

The scope of the present document is to define an information model and protocol for unified radio application interface for radio equipment reconfiguration except for reconfigurable mobile devices which are covered in [i.6] to [i.11]. The work is based on the Use Cases defined in ETSI TR 103 585 [i.1], on the system requirements defined in ETSI EN 303 641 [1] and on the radio reconfiguration related architecture for reconfigurable RE defined in ETSI EN 303 648 [i.2].

The present document will be based on ETSI EN 303 146-3 [i.10] and provide a generalized interface definition for the generalized Unified Radio Application Interface.

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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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[1] ETSI EN 303 641: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) reconfiguration requirements".

### 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 103 585: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) reconfiguration use cases".
- [i.2] ETSI EN 303 648: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) reconfiguration architecture".
- [i.3] IEEE 1900.4<sup>TM</sup>-2009: "IEEE Standard for Architectural Building Blocks Enabling Network-Device Distributed Decision Making for Optimized Radio Resource Usage in Heterogeneous Wireless Access Networks".
- [i.4] Recommendation ITU-T X.680: "Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation".
- [i.5] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of Radio Equipment and repealing Directive 1999/5/EC.
- [i.6] ETSI EN 302 969: "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Requirements for Mobile Devices".

- [i.7] ETSI EN 303 095: "Reconfigurable Radio Systems (RRS); Radio reconfiguration related architecture for Mobile Devices (MD)".
- [i.8] ETSI EN 303 146-1: "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 1: Multiradio Interface (MURI)".
- [i.9] ETSI EN 303 146-2: "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 2: Reconfigurable Radio Frequency Interface (RRFI)".
- [i.10] ETSI EN 303 146-3: "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 3: Unified Radio Application Interface (URAI)".
- [i.11] ETSI EN 303 146-4: "Reconfigurable Radio Systems (RRS); Mobile Device (MD) information models and protocols; Part 4: Radio Programming Interface (RPI)".
- [i.12] ETSI EN 303 681-1: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) information models and protocols for generalized software reconfiguration architecture; Part 1: generalized Multiradio Interface (gMURI)".
- [i.13] ETSI EN 303 681-2: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) information models and protocols for generalized software reconfiguration architecture; Part 3: generalized Unified Radio Application Interface (gURAI)".
- [i.14] ETSI EN 303 681-4: "Reconfigurable Radio Systems (RRS); Radio Equipment (RE) information models and protocols for generalized software reconfiguration architecture; Part 4: generalized Radio Programming Interface (gRPI)".

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the following terms 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 Radio Equipment. It can be reached by establishing a logical communication link (i.e. an association) between the reconfigurable Radio Equipment 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 303 648 [i.2].

**Communication Services Layer (CSL):** 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:** connection from one location to another through a given Radio Access Technology for the purpose of transmitting and receiving digital information

**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 Radio Equipment hardware working under ROS control and on which RAs are executed

NOTE: A Radio Computer typically includes programmable processors, hardware accelerators, peripherals, software, 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.

**Radio Equipment (RE):** *"an electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radiodetermination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radiodetermination"*.

NOTE: The definition above is as defined in the Radio Equipment Directive, Article 2(1)(1) [i.5].

**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.

**reconfigurable Radio Equipment:** Radio Equipment with radio communication capabilities providing support for radio reconfiguration

NOTE: Reconfigurable Radio Equipment includes Smartphones, Feature phones, Tablets, Laptops, Connected Vehicle communication platform, Network platform, IoT device, etc.

**Unified Radio Application (URA):** Radio Application which complies with the reconfigurable RE framework defined in the present document

## 3.2 Symbols

Void.

## 3.3 Abbreviations

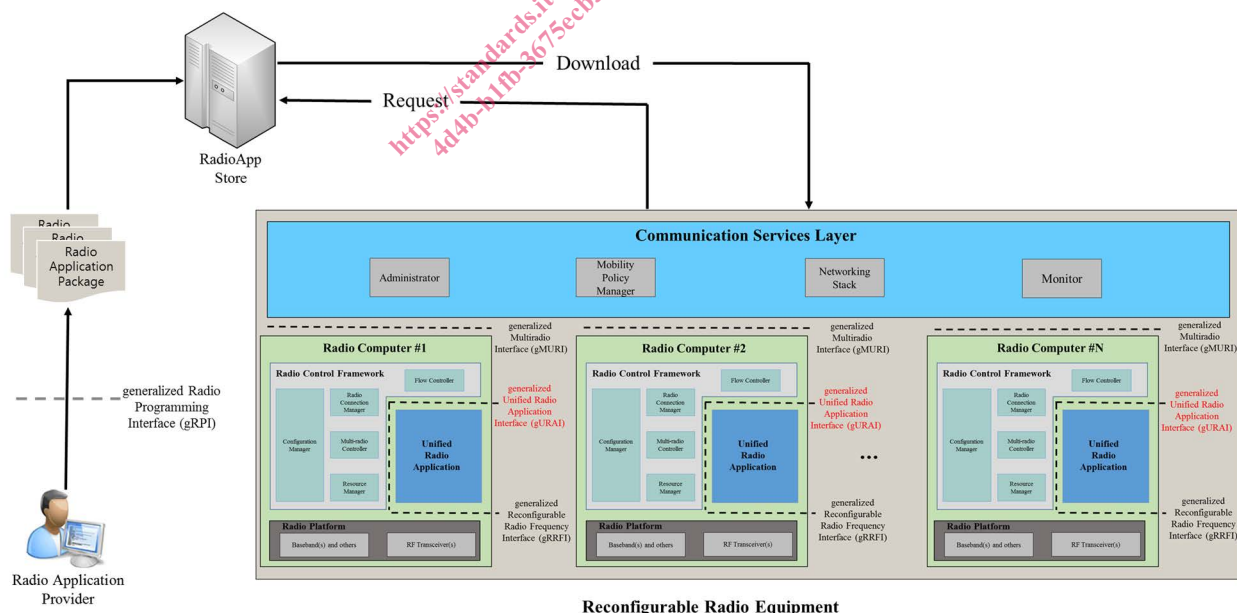
For the purposes of the present document, the following abbreviations apply:

|       |   |
|-------|---|
| ASN.1 | Abstract Syntax Notation One            |
| BLER  | BLOCK Error Rate                        |
| CM    | Configuration Manager                   |
| CSL   | Communication Services Layer            |
| FC    | Flow Controller                         |
| gMURI | generalized Multiradio Interface        |
| gRPI  | generalized Radio Programming Interface |

|       |  |
|-------|--|
| gRRFI | generalized Reconfigurable Radio Frequency Interface                           |
| gURAI | generalized Unified Radio Application Interface                                |
| ID    | IDentification   |
| IR    | Intermediate Representation  |
| ITU-T | International Telecommunication Union Telecommunication Standardization Sector |
| MPM   | Mobility Policy Manager  |
| MRC   | MultiRadio Controller  |
| OS    | Operating System   |
| RA    | Radio Application  |
| RAN   | Radio Access Network   |
| RAP   | Radio Application Package  |
| RAT   | Radio Access Technology  |
| RCF   | Radio Control Framework  |
| RCID  | Radio Computer IDentification  |
| RCM   | Radio Connection Manager   |
| RE    | Radio Equipment  |
| RF    | Radio Frequency  |
| RM    | Resource Manager   |
| ROS   | Radio Operating System   |
| RX    | Receiver   |
| SINR  | Signal to Interference plus Noise Ratio  |
| TX    | Transmitter  |
| UML   | Unified Modelling Language   |
| URA   | Unified Radio Applications   |

## 4 Introduction

A reconfigurable RE is capable of running multiple radios simultaneously, changing the set of radios by loading new Radio Application Packages (RAP) and setting their parameters. All Radio Applications (RAs) are called Unified Radio Applications (URAs) when they exhibit a common behaviour from the reconfigurable RE's point of view in ETSI EN 303 648 [i.2]. In order to run multiple URAs, the reconfigurable RE will include Communication Services Layer (CSL), Radio Control Frameworks (RCFs), Radio Platforms and 4 sets of interfaces for their interconnection.



**Figure 4.1: Four sets of interfaces for Reconfigurable RE**

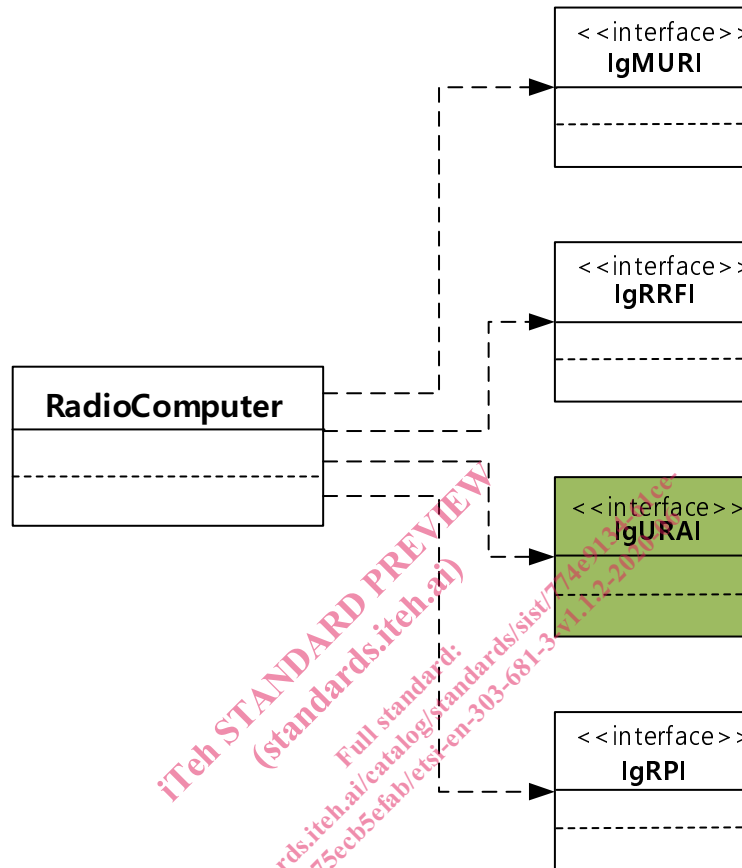
Figure 4.1 illustrates the Reconfigurable RE architecture with the 4 sets of interfaces, i.e.:

- gMURI for interfacing CSL and RCF (in ETSI EN 303 681-1 [i.12]).



- gRRFI for interfacing URA and RF Transceiver (in ETSI EN 303 681-2 [i.13]).
- gURAI for interfacing URA and RCF which is the scope of the present document.
- gRPI for allowing an independent and uniform production of RAs (in ETSI EN 303 681-4 [i.14]).

The present document defines gURAI.



**Figure 4.2: UML class diagram for Radio Computer interfaces**

Figure 4.2 illustrates UML class diagram for Radio Computer interfaces. The reconfigurable RE may be seen as a set of multiple Radio Computers where individual URAs are engineered as software entities in ETSI EN 303 648 [i.2].

The present document is organized as follows:

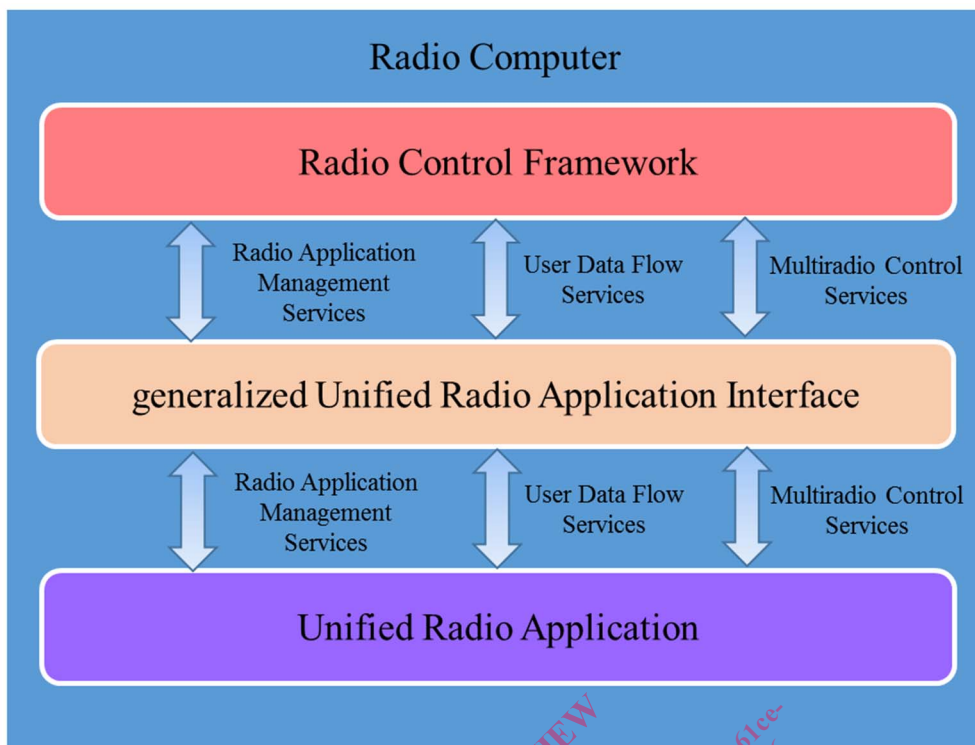
- clause 5 describes the system identification;
- clause 6 describes the notational tool for defining both information model classes and interface classes;
- clause 7 describes the information model for radio computer; and
- clause 8 describes the interface definition.

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

## 5 System Identification

### 5.1 Radio Computer Structure

Figure 5.1 illustrates how RCF and URA interact with each other using gURAI.



**Figure 5.1: Interconnection between RCF and URA using gURAI for Reconfigurable RE**

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

- **Radio Application Management Services**
  - These services are used by Radio Connection Manager (RCM) which is included in the RCF, to control URA functions such as reporting of discovered Peer Equipment's, creating/terminating association with Peer Equipment, starting/stopping communication with Peer Equipment, etc.
- **User Data Flow Services**
  - These services are used by Flow Controller (FC) which is included in the RCF, to transmit user data to URA, or used by URA to transmit received user data to FC. These services also include management of data flow, which is provided by FC.
- **Multiradio Control Services**
  - These services are used by Multiradio Controller (MRC) which is included in RCF, to manage spectral resource usage.

The RCF and URA are defined in ETSI EN 303 648 [i.2].

## 5.2 gURAI System Requirement Mapping

The Radio Computer components above described shall support the gURAI system requirements shown in table 5.1 and described in clause 6 of ETSI EN 303 641 [1].

**Table 5.1: Mapping of Radio Computer Components to the system requirements described in ETSI EN 303 641 [1]**

| Entity/Component/Unit    | System Requirements [1] | Comments   |
|--------------------------|-------------------------|--|
| Flow Controller          | R-FUNC-RAT-05           | The requirement is described in clause 6.1.5 of [1]. |
|                          | R-FUNC-RA-04            | The requirement is described in clause 6.2.4 of [1]. |
| Multiradio Controller    | R-FUNC-RAT-01           | The requirement is described in clause 6.1.1 of [1]. |
|                          | R-FUNC-RAT-02           | The requirement is described in clause 6.1.2 of [1]. |
|                          | R-FUNC-RAT-03           | The requirement is described in clause 6.1.3 of [1]. |
|                          | R-FUNC-RAT-06           | The requirement is described in clause 6.1.6 of [1]. |
|                          | R-FUNC-RER-03           | The requirement is described in clause 6.4.3 of [1]. |
| Radio Connection Manager | R-FUNC-RAT-04           | The requirement is described in clause 6.1.4 of [1]. |
|                          | R-FUNC-RAT-05           | The requirement is described in clause 6.1.5 of [1]. |
|                          | R-FUNC-RAT-06           | The requirement is described in clause 6.1.6 of [1]. |
|                          | R-FUNC-RA-03            | The requirement is described in clause 6.2.3 of [1]. |
|                          | R-FUNC-RER-03           | The requirement is described in clause 6.4.3 of [1]. |

## 6 Notational Tools

### 6.1 Notational Tool for Information Model Classes

In the present document, information model classes are used as defined in annex B.1 of IEEE 1900.4<sup>TM</sup>-2009 [i.3].

### 6.2 Notational Tool for Interface Classes

Table 6.1 shows a template for defining interface classes for gURAI. Each interface class for gURAI will be defined in clause 8.5 in accordance with the template shown in table 6.1.

**Table 6.1: Template for defining Interface Classes**

|  |  |  |
|--|--|--|
| <i>Class</i> <Class name>[( <i>abstract class</i> )] |  |  |
| <Description of the class>                           |  |  |
| OPERATIONS   |  |  |
| <Operation name>                                     | <i>Return type:</i><br><Operation return type> | <i>Value type:</i><br><Operation value type> |
| <Description of the operation>                       |  |  |

The template fields in table 6.1 are described below:

- <Class name> is the name of the Class as it appears in the corresponding model. Additional information is also included in case the class in question has been specified as an abstract one.
- OPERATIONS field describes the operations that have been defined in the class. More specifically:
  - <Operation name> identifies the name of an operation, as it is included in the class definition.
  - <Return type> identifies the type of return value at the corresponding operation. Details related to the ASN.1 module are specified in annex B.
  - <Value type> identifies the access levels for member functions: public, private, protected.