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Reconfigurable Radio Systems (RRS);
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Part 1: Multiradio Interface (MURI)

Reference

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Foreword

This Technical Specification (TS) 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 Applications Interface (URAI)";

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

1 Scope

The present document defines an information model and protocol for multiradio interface for mobile device reconfiguration. The work will be based on the Use Cases defined in TR 103 062 [i.1], TR 102 839 [i.2] and TR 102 944 [i.3], on the system requirements defined in TS 102 969 [1] and on the radio reconfiguration related architecture for mobile devices defined in TS 103 095 [2].

2 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 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.

2.1 Normative references

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

[1] ETSI TS 102 969 (V1.1.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Requirements for Mobile Devices".

[2] ETSI TS 103 095 (V1.1.1): "Reconfigurable Radio Systems (RRS); Radio Reconfiguration related Architecture for Mobile Devices".

2.2 Informative references

The following referenced documents arenot necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 103 062: "Reconfigurable Radio Systems (RRS) Use Cases and Scenarios for Software Defined Radio (SDR) Reference Architecture for Mobile Device".

[i.2] ETSI TR 102 839: "Reconfigurable Radio Systems (RRS); Multiradio Interface for Software Defined Radio (SDR) Mobile Device Architecture and Services".

[i.3] ETSI TR 102 944: "Reconfigurable Radio Systems (RRS); Use Cases for Baseband Interfaces for Unified Radio Applications of Mobile Device".

[i.4] 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.5] 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:

Communication Services Layer (CSL): software layer related to communication services supporting generic applications

NOTE: 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.

Radio Control Framework (RCF): control framework which, as a part of 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.

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
MD	Moblile Device
MPM	Mobility Policy Manager
MRC	Multiradio Controller
MURI	Multiradio Interface
OS	Operating System
RA	Radio Application
RAN	Radio Access Network
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
UML	Unified Modeling Language
URA	Unified Radio Applications
URAI	Unified Radio Application Interface

4 System Identification

Multiradio Interface (MURI) is an interface to be defined between Communication Services Layer (CSL) and Radio Control Framework (RCF) [2] in the present document. Figure 4.1 illustrates how CSL and RCF interact with each other using MURI. As shown in figure 4.1, MURI supports 3 kinds of services, i.e. Administrative Services, Access Control Services and Data Flow Services. Note that CSL consists of L3 (Layer 3) and above, while RCF consists of L1/L2.

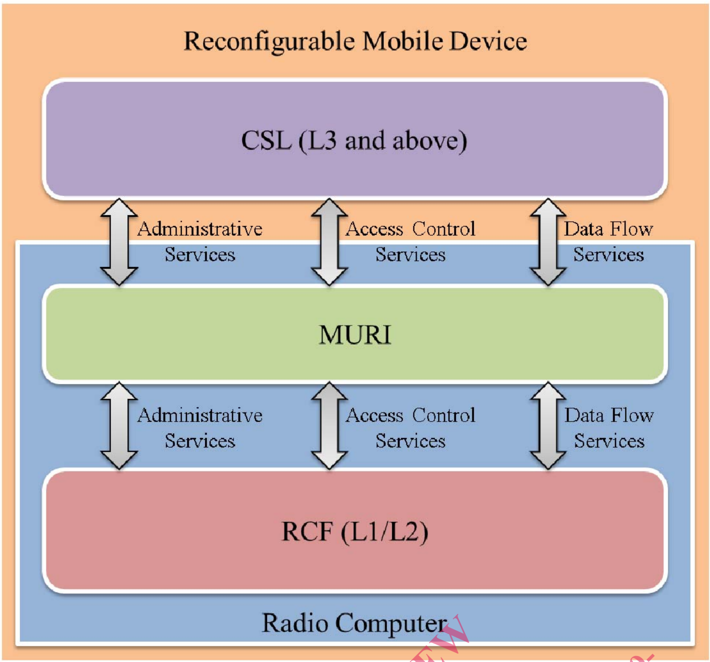

Figure 4.1: System architecture

4.1 Communication Services Layer

CSL is a software layer that is related to communication services supporting generic applications like, for example, Internet access. CSL includes the following functional components [2]: Administrator, Mobility Policy Manager (MPM), Networking stack and Monitor. Mobile Device (MD) user can control and manage each Radio Application (RA) through the components of CSL because each component of CSL can control and manage the RA through the interaction with each component of RCF. The main functionality of the 4 entities of CSL should include the following ones.

1) Administrator requests the installation or uninstallation of an RA, and the creating or deleting instance of an RA. It also requests RA list and the status of each RA.

2) MPM monitors the radio environments and MD capabilities, to request activation or deactivation of the RA, and to request information about the RA list. It also selects among different Radio Access Technologies (RATs) and discovers peer communication equipment and the arrangement of associations.

3) Networking stack is responsible for sending and receiving user data.

4) Monitor is for the MD users to monitor the context information. It is also to transfer the context information to the desired destination(s) such as Administrator and/or MPM.

4.2 Radio Control Framework

RCF is a control framework which, as a part of the Operating System (OS), extends the OS capabilities in terms of radio resource management. Any appropriate OS empowered by RCF, is referred to as Radio Operating System (ROS). RCF provides functionalities of processing instructions for the CSL to manage the URA. RCF consists of 5 functional components [2], i.e. Configuration Manager (CM), Radio Connection Manager (RCM), Flow Controller (FC), Multiradio Controller (MRC), and Resource Manager (RM), of which the function is described as follows.

1) CM provides commands for the ROS to perform installation/uninstallation and creating/deleting instance of RAs into Radio Processor as well as management of, and access to, the radio parameters of the RAs.

2) RCM provides commands for the ROS to perform activation/deactivation of RAs according to user requests, and overall management of user data flows, which can also be switched from one RA to another.

3) FC is responsible for sending and receiving of user data packets and controlling the flow of signalling packets.

4) MRC schedules the requests for radio resources issued by concurrently executing RAs and detects and manages the interfaces among the concurrently executing RAs.

5) RM manages the computational resources to share them among simultaneously active RAs, and to guarantee their real-time requirements.

4.3 Radio Computer Interfaces

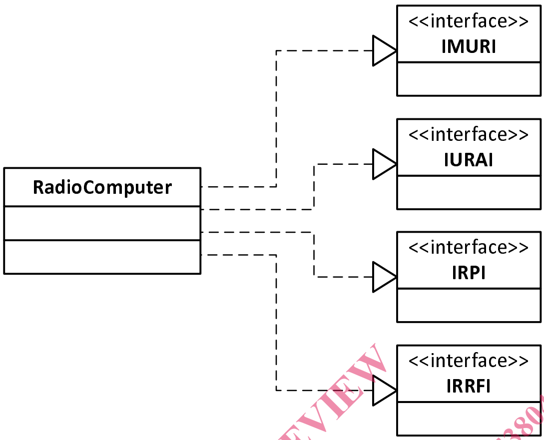

Figure 4.2: UML® class diagram for Radio Computer Interfaces

Figure 4.2 illustrates UML® (Unified Modeling Language™) class diagram for Radio Computer Interfaces. As shown in figure 4.2, Radio Computer shall realize 4 interfaces, i.e. MURI, Unified Radio Applications Interface (URAI), Radio Programming Interface (RPI), and Reconfigurable Radio Frequency Interface (RRFI). MURI is an interface between CSL and RCF, which are defined in figure 4.1. URAI is an interface between RCF and URA [2]. RPI is an internal interface in URA. Finally, RRFI is an interface between URA and RF part [2]. Note that the present document defines an information model and protocol related to MURI only.

5 Notational Tools

5.1 Notational Tool for Information Model Classes

Table 5.1 shows a template for defining information model classes [i.4]. Each information model class will be defined in clause 6.2 in accordance with the template shown in table 5.1. Although neither "DERIVED FROM" nor "SUPPORTED EVENTS" are used in present document, these are presented in table 5.1 to maintain compatibility with the IEEE 1900.4 standard [i.4].

Table 5.1: Template for defining Information Model Classes

Class<Class name>*[(abstract class)]*			
<Description of the class>			
DERIVED FROM	<List of super-classes>		
ATTRIBUTES			
<Attribute name> *[<optional>]*	*Value type:* <Attribute value type>	*Possible access:* <Attribute access qualifier>	*Default value:* <Default value>
<Description of the attribute>			
CONTAINED IN	<List of classes, whose instances may contain an instance of this class. If this class is an abstract class, that is, it is used for further refinement only and will never be instantiated, then this list is empty.>		
CONTAINS	<List of classes, whose instances may be contained in an instance of this class. Constraints used are: • [*] - zero or more instances, • [+] - one or more instances, • [<n>] - exactly n instances, • [<m> - <n>] - not less than m and not more than n instances.>		
SUPPORTED EVENTS	<List of event names that are detected by this class and lead potentially to a corresponding event report>		

A description of the template is provided within the following list:

- <Class name> is the name of the Class as it is appeared in the corresponding model. Additional information is also included in case the class in question has been specified as an abstract one.
- DERIVED FROM field identifies the super class of the class in case of sub-classing.
- ATTRIBUTES field describes the attributes that have been defined in the class. More specifically:
  - <Attribute name> identifies the name of an attribute, as it is included in the class definition.
  - <Attribute value type> holds the type of the attribute specified in Abstract Syntax Notation One (ASN.1). Readers shall refer to the ASN.1 module for details (see annex A).
  - <Attribute access qualifier> provides information about the level of accessibility of the attribute. This may include: 'Read', 'Write', 'Read-Write', 'Add-Remove' (for list-type attributes), 'Read-Add-Remove', and 'None' (for internal access only).
- CONTAINED IN field includes a list of classes whose instances may contain an instance of this class; containment is a strong aggregation relationship, that is, a contained instance is for its lifetime bound to its container object and it is contained only in this one container.
- CONTAINS field provides a list of classes whose instances may be contained in an instance of the class in question.
- SUPPORTED EVENTS field includes a list of event names that are detected by this class and lead potentially to a corresponding event report.

5.2 Notational Tool for Interface Classes

Table 5.2 shows a template for defining interface classes for MURI. Each interface class for MURI will be defined in clause 7.5 in accordance with the template shown in table 5.2.

Table 5.2: Template for defining Interface Classes

Class<Class name>*[(abstract class)]*		
<Description of the class>		
OPERATIONS		
<Operation name>	*Return type:* <Operation return type>	*Value type:* <Operation value type>
<Description of the operation>		

A description of the template is provided within the following list:

- <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. Readers shall refer to the ASN.1 module for details (see annex A).
  - <Value type> identifies the access levels for member functions: public, private, protected.

6 Information Model for Radio Computer

6.1 Information Model Classes

In this clause, each class of Radio Computer is defined using the template presented in clause 5.1. In order to define each class of Radio Computer, UML® class diagram for all the Radio Computer classes related to MURI should be determined [i.4]. Figure 6.1 illustrates the UML® class diagram for Radio Computer classes related to MURI.