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Technical Specification

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

Reference

DTS/RRS-02008-1

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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.

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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.

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 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 103 062: "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	Mobile 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.

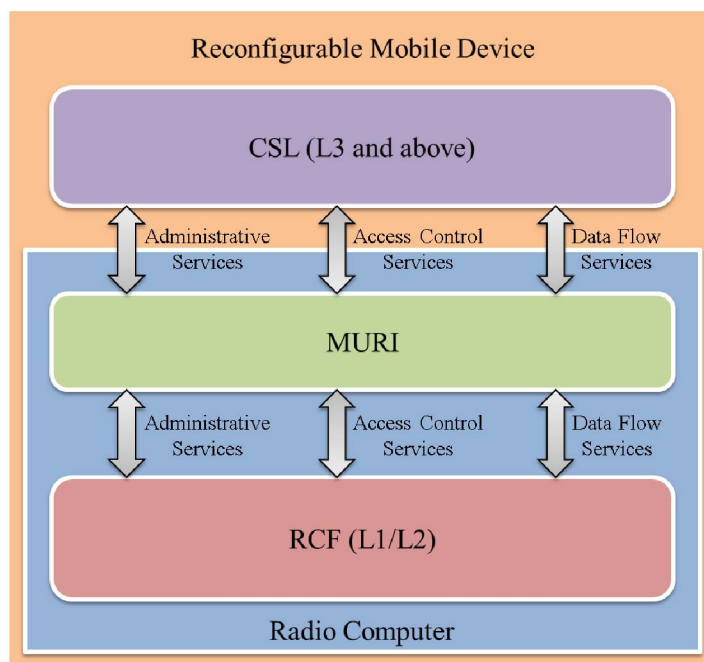


Figure 4.1: System architecture

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

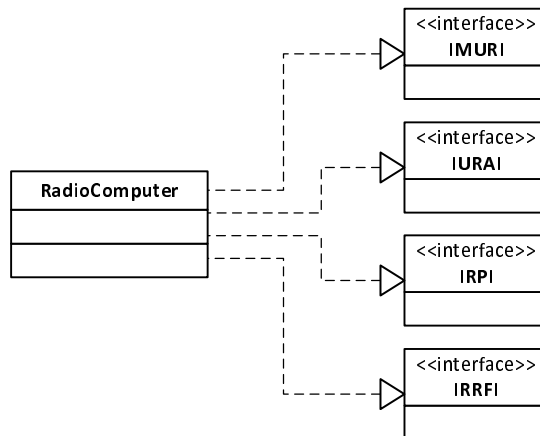


Figure 4.2: UML[®] class diagram for Radio Computer Interfaces

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

<i>Class</i> <Class name>[(<i>abstract class</i>)]			
<Description of the class>			
DERIVED FROM	<List of super-classes>		
ATTRIBUTES			
<Attribute name> [<optional>]	<i>Value type:</i> <Attribute value type>	<i>Possible access:</i> <Attribute access qualifier>	<i>Default value:</i> <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: <ul style="list-style-type: none"> • [*] - 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

<i>Class</i> <Class name>[(<i>abstract class</i>)]		
<Description of the class>		
OPERATIONS		
<Operation name>	<i>Return type:</i> <Operation return type>	<i>Value type:</i> <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.

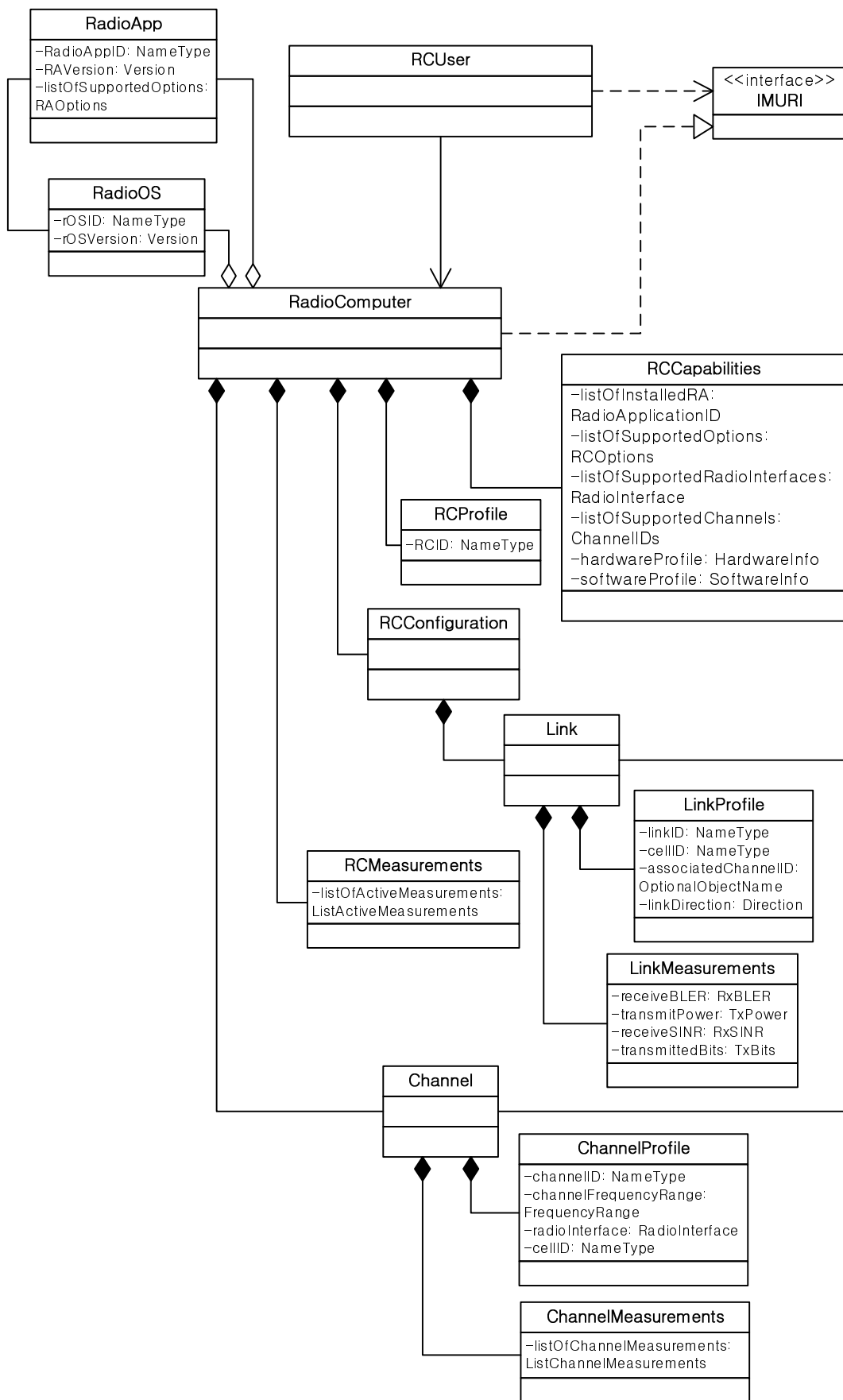


Figure 6.1: UML[®] class diagram for Radio Computer classes related to MURI

The Radio Computer classes related to MURI are defined as follows:

- **RCUser**

This class describes information related to a user of the Radio Computer. Each instance of RCUser class depends on one instance of RadioComputer class.
- **RadioComputer**

This class describes all resources and interfaces related to hardware and software of a reconfigurable wireless terminal as well as measurement information related to radio resources within the terminal.
- **RCCapabilities**

This class contains information about Radio Computer capabilities including hardware, software, transmission and measurement capabilities, for example, supported radio interfaces, maximum transmission power, etc. Each instance of Radio Computer class can have only one instance of RCCapabilities class as a member.
- **RadioApp**

This class describes installed Radio Application. Each instance of Radio Computer class can relate to zero or several instances of RadioApp class. Each instance of RadioApp class is associated with one instance of Radio OS class.
- **RadioOS**

This class describes installed Radio OS. Each instance of Radio Computer class can relate to zero or one instance of RadioOS class. Each instance of RadioOS class is associated with zero or several instances of RadioApp class.
- **RCProfile**

This class contains general information about the Radio Computer, for example, terminal Identification (ID). Each instance of RadioComputer class can have only one instance of RCProfile class as a member.
- **RCConfiguration**

This class contains information about the current configuration of Radio Computer. Each instance of RadioComputer class can have only one instance of RCConfiguration class as a member.
- **Link**

This class contains information about one active Radio Application and corresponding connection between Reconfigurable Radio terminal and Radio Access Networks (RANs). Each instance of RCConfiguration class can have zero or several instances of Link class as members. Each instance of Link class is associated with one instance of Channel class.
- **LinkProfile**

This class contains general information about this active connection, for example, link ID, serving cell ID, channel used, etc. Each instance of Link class can have only one instance of LinkProfile class as a member.
- **LinkMeasurements**

This class contains current measurements (instantaneous measurement data and performance statistics derived from this data) related to this active connection, such as Block Error Rate (BLER), power, and Signal to Interference plus Noise Ratio (SINR) measurements. Each instance of Link class can have only one instance of LinkMeasurements class as a member.
- **RCMeasurements**

This class contains current measurements (instantaneous measurement data and performance statistics derived from this data) related to Reconfigurable Radio terminal, for example, battery capacity and terminal location measurements. Each instance of RadioComputer class can have only one instance of RCMeasurements class as a member.

- Channel

This class describes one frequency channel that may or may not have active connections on it. Each instance of RadioComputerclass can have zero or several instances of Channel class as members.

- ChannelProfile

This class contains general information about this frequency channel, for example, channel ID, central frequency, bandwidth, and radio interface used. Each instance of Channel class can have only one instance of Channel Profile class as a member.

- ChannelMeasurements

This class contains current measurements (instantaneous measurement data and performance statistics derived from this data) related to this frequency channel, for example, interference and load measurements. Each instance of Channel class can have only one instance of ChannelMeasurements class as a member.

6.2 Class Definitions for Information Model

Each class of Radio Computer can be defined using the template presented in clause 5.1 in accordance with the UML[®] diagram of figure 6.1 which specifies relations among all the classes of Radio Computer. Radio Computer classes are defined as follows:

Table 6.1: RadioComputerClass

Class RadioComputer	
This class describes all resources and interfaces related to hardware and software of a reconfigurable wireless terminal, as well as, measurement information related to radio resources within the terminal.	
DERIVED FROM	
ATTRIBUTES	
CONTAINED IN	
CONTAINS	RCCapabilities [1], RCProfile [1], RCConfiguration [1], RCMeasurements [1], Channel [1], RadioApp[*], RadioOS[0-1]
SUPPORTED EVENTS	

Table 6.2: RadioAppClass

Class RadioApp			
This class describes installed Radio Application.			
DERIVED FROM			
ATTRIBUTES			
RadioAppID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of installed Radio Application.			
RAVersion	<i>Value type:</i> Version	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a version of Radio Application.			
listOfSupportedOptions	<i>Value type:</i> RAOptionsList	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute contains a list of supported options.			
CONTAINED IN	RadioComputer		
CONTAINS			
SUPPORTED EVENTS			

Table 6.3: RadioOSClass

Class RadioOS			
This class describes installed Radio OS.			
DERIVED FROM			
ATTRIBUTES			
rOSID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of Radio OS.			
rOSVersion	<i>Value type:</i> Version	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a version of Radio OS.			
CONTAINED IN		RadioComputer	
CONTAINS			
SUPPORTED EVENTS			

Table 6.4: RCCapabilitiesClass

Class RCCapabilities			
This class contains information about Radio Computer capabilities including hardware, software, transmission and measurement capabilities.			
DERIVED FROM			
ATTRIBUTES			
listOfInstalledRA	<i>Value type:</i> RadioApplicationIDList	<i>Possible access:</i> Read-Add-Remove	<i>Default value:</i> Not specified
This attribute describes a list of installed Radio Application.			
listOfSupportedOptions	<i>Value type:</i> RCOptionsList	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes a list of supported options.			
listOfSupportedRadioInterfaces	<i>Value type:</i> RadioInterfacesList	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes radio interfaces supported by this Radio Computer.			
listOfSupportedChannels	<i>Value type:</i> ChannelIDsList	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attributes describes frequency channels supported by this Radio Computer.			
hardwareProfile	<i>Value type:</i> HardwareInfo	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attributes describes hardware capabilities of this Radio Computer.			
softwareProfile	<i>Value type:</i> SoftwareInfo	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attributes describes software capabilities of this Radio Computer.			
CONTAINED IN		RadioComputer	
CONTAINS			
SUPPORTED EVENTS			

Table 6.5: RCProfileClass

Class RCProfile			
This class contains general information about the Radio Computer.			
DERIVED FROM			
ATTRIBUTES			
RCID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of radio computer.			
CONTAINED IN		RadioComputer	
CONTAINS			
SUPPORTED EVENTS			

Table 6.6: RConfigurationClass

Class RConfiguration			
This class contains information about the current configuration of Radio Computer.			
DERIVED FROM			
ATTRIBUTES			
listOfActiveLink	<i>Value type:</i> ObjectNameList	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes ID activated link.			
CONTAINED IN		RadioComputer	
CONTAINS		Link[*]	
SUPPORTED EVENTS			

Table 6.7: LinkClass

Class Link	
This class contains information about one active Radio Application and corresponding connection between Reconfigurable Radio terminal and RANs.	
DERIVED FROM	
ATTRIBUTES	
CONTAINED IN	RConfiguration
CONTAINS	LinkProfile [1], LinkMeasurements [1]
SUPPORTED EVENTS	

Table 6.8: LinkProfile Class

Class LinkProfile			
This class contains general information about this active connection.			
DERIVED FROM			
ATTRIBUTES			
linkID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of link about activated connection.			
cellID	<i>Value type:</i> NameType	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes ID connected cell.			
associatedChannelID	<i>Value type:</i> OptionalObjectName	<i>Possible access:</i> Read-Add-Remove	<i>Default value:</i> Not specified
This attribute describes ID of associated channel.			
linkDirection	<i>Value type:</i> Direction	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a direction of link.			
CONTAINED IN		Link	
CONTAINS			
SUPPORTED EVENTS			

Table 6.9: LinkMeasurementsClass

Class LinkMeasurements			
This class contains current measurements related to this active connection.			
DERIVED FROM			
ATTRIBUTES			
receiveBLER	<i>Value type:</i> RxBLER	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes a value of BLER for received data.			
transmitPower	<i>Value type:</i> TxPower	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes a power of transmit signal.			
receiveSINR	<i>Value type:</i> RxSINR	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes a value of SINR for received data.			
transmittedBits	<i>Value type:</i> TxBits	<i>Possible access:</i> Read-Write	<i>Default value:</i> Not specified
This attribute describes transmitted bits.			
CONTAINED IN	Link		
CONTAINS			
SUPPORTED EVENTS			

Table 6.10: RCMeasurementsClass

Class RCMeasurements			
This class contains current measurements related to Reconfigurable Radio terminal.			
DERIVED FROM			
ATTRIBUTES			
listOfActiveMeasurements	<i>Value type:</i> ActiveMeasurementsList	<i>Possible access:</i> Read-Add-Remove	<i>Default value:</i> Not specified
This attribute describes a list of active measurements.			
CONTAINED IN	Link		
CONTAINS			
SUPPORTED EVENTS			

Table 6.11: ChannelClass

Class Channel	
This class describes one frequency channel that may or may not have active connections on it.	
DERIVED FROM	
ATTRIBUTES	
CONTAINED IN	RadioComputer
CONTAINS	ChannelProfile [1], ChannelMeasurements [1]
SUPPORTED EVENTS	

Table 6.12: ChannelProfileClass

Class ChannelProfile			
This class contains general information about this frequency channel.			
DERIVED FROM			
ATTRIBUTES			
channelID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of channel.			
channelFrequencyRange	<i>Value type:</i> FrequencyRange	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a value of channel frequency range.			
radiInterface	<i>Value type:</i> RadiInterface	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a radio interface.			
cellID	<i>Value type:</i> NameType	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes ID of connected cell.			
CONTAINED IN	Channel		
CONTAINS			
SUPPORTED EVENTS			

Table 6.13: ChannelMeasurementsClass

Class ChannelMeasurements			
This class contains current measurements related to this frequency channel.			
DERIVED FROM			
ATTRIBUTES			
listOfChannelMeasurements	<i>Value type:</i> ChannelMeasurementsList	<i>Possible access:</i> Read	<i>Default value:</i> Not specified
This attribute describes a list of channel measurements.			
CONTAINED IN	Channel		
CONTAINS			
SUPPORTED EVENTS			

7 Interface Definition

7.1 Interface Overview

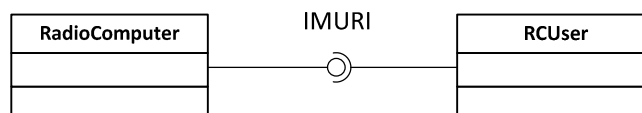


Figure 7.1: Multiradio interface (MURI)

Figure 7.1 illustrates the relationship among RadioComputer, RCUser, and MURI. As shown in figure 7.1, MURI shall be the provided interface to Radio Computer, while the MURI shall be the required interface to RCUser.

Figure 7.2 illustrates a UML[®] diagram for MURI. As shown in figure 7.2, MURI supports 3 basic services, i.e. Administrative Services, Access Control Services, and Data Flow Services.

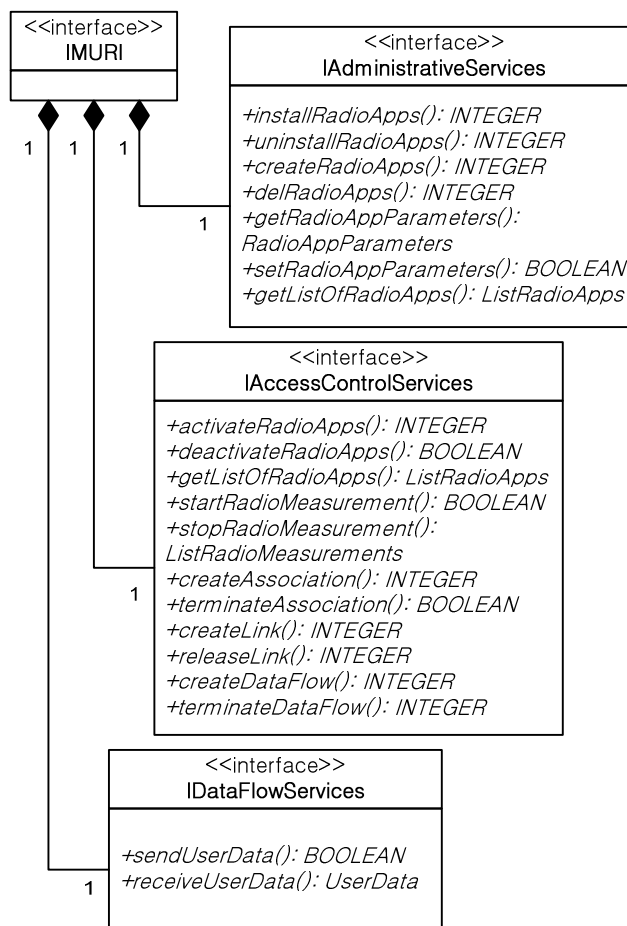


Figure 7.2: UML[®] diagram for MURI

7.2 Administrative Services

7.2.1 Interfaces for Administrative Services

Figure 7.3 illustrates interfaces supporting Administrative Services.

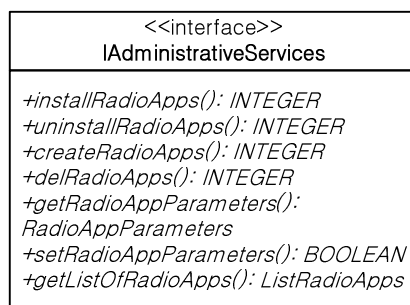


Figure 7.3: IAdministrativeServices interface

Administrative Services are responsible for operations with RA as follows:

- Installation/Uninstallation of RA from Radio Package;
- Creating/Deleting instance of RA;
- Providing information about the RA and their status.

7.2.2 Messages for Administrative Services

Interfaces for Administrative Services are used to transmit the following messages:

- From CSL to RCF:
 - Request of installation/uninstallation of RA
 - Request of creating/deleting instance of RA
 - Request of getting/configuring parameters of RA
 - Request of installed/instantiated/activated RA(s) list
- From RCF to CSL:
 - Confirmation of installation/uninstallation of RA
 - Confirmation of creating/deleting instance of RA
 - Failure of RA installation/uninstallation
 - Failure of RA creating/deleting instance
 - Information of RA(s) list

7.3 Access Control Services

7.3.1 Interfaces for Access Control Services

Figure 7.4 illustrates interfaces supporting Access Control Services.

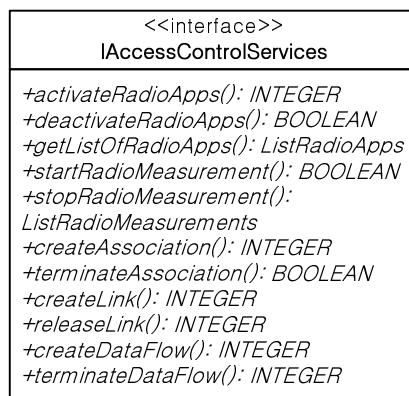


Figure 7.4: IAccessControlServices interface

Access Control Services include the following operations:

- activation/deactivation of RA;
- monitoring radio environment and Radio Computer capabilities;
- providing information about the RA list;
- discovering peer communication equipment;
- arrangement of associations.

7.3.2 Messages for Access Control Services

Interfaces for Access Control Services are used to transmit the following messages:

- From CSL to RCF:
 - Request of activation/deactivation of RA
 - Request of installed/instantiated/activated RA(s) list
 - Request of measurements for radio environment
 - Request of measurements for MD capabilities
 - Request of creating data flow
 - Request of creating network and logical radio link association
- From RCF to CSL:
 - Confirmation of RA activation
 - Confirmation of creating data flow
 - Confirmation of creating network and logical radio link association
 - Failure of RA activation
 - Failure of creating data flow association
 - Failure of creating network association
 - Information of RA(s) list
 - Information of radio environment
 - Information of MD capabilities

7.4 Data Flow Services

7.4.1 Interfaces for Data Flow Services

Figure 7.5 illustrates interfaces supporting Data Flow Services.

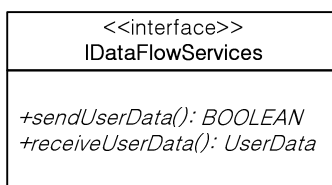


Figure 7.5: IDataFlowServices interface

Data Flow Services provide means for sending or receiving user data. Data Flow Services support the following operations:

- sendingUser Data;
- receivingUser Data.

7.4.2 Messages for Data Flow Services

Interfaces for Data Flow Services are used to transmit the following messages:

- From CSL to RCF:
 - Request of transfer user data
- From RCF to CSL:
 - Confirmation of transfer user data
 - Failure of transfer user data

7.5 Class Definitions for Interface

Each interface class related to MURI can be defined using the template presented in clause 5.2 in accordance with the UML[®] diagram of figure 7.2 which specifies the interface classes related to MURI. The interface classes are specified as follows:

Table 7.1: IAdministrativeServices Class

Class IAdministrativeServices		
This class describes interfaces supporting Administrative Services.		
OPERATIONS		
installRadioApps	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to install of RA.		
uninstallRadioApps	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to uninstall of RA.		
createRadioApps	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to create of RA instance.		
delRadioApps	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to delete of RA instance.		
getRadioAppParameters	<i>Return type:</i> RadioAppParameters	<i>Value type:</i> public
This operation relates to get parameters of RA.		
setRadioAppParameters	<i>Return type:</i> BOOLEAN	<i>Value type:</i> public
This operation relates to set parameters of RA.		
getListOfRadioApps	<i>Return type:</i> RadioAppsList	<i>Value type:</i> public
This operation relates to get list of installed/instantiated/activated RA(s).		

Table 7.2: IAccessControlServices Class

Class IAccessControlServices		
This class describes interfaces supporting Access Control Services.		
OPERATIONS		
activateRadioApps	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to activate of RA.		
deactivateRadioApps	<i>Return type:</i> BOOLEAN	<i>Value type:</i> public
This operation relates to deactivate of RA.		
getListOfRadioApps	<i>Return type:</i> RadioAppsList	<i>Value type:</i> public
This operation relates to get list of installed/instantiated/activated RA(s).		
startRadioMeasurement	<i>Return type:</i> BOOLEAN	<i>Value type:</i> public
This operation relates to take measurements of radio environments and MD capabilities.		
stopRadioMeasurement	<i>Return type:</i> RadioMeasurementsList	<i>Value type:</i> public
This operation relates to stop measurements of radio environments and MD capabilities.		
createAssosiation	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to create network association.		
terminateAssociation	<i>Return type:</i> BOOLEAN	<i>Value type:</i> public
This operation relates to terminate network association.		
createLink	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to create logical radio link association.		
releaseLink	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to release logical radio link association.		
createDataFlow	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to create data flow.		
terminateDataFlow	<i>Return type:</i> INTEGER	<i>Value type:</i> public
This operation relates to terminate data flow.		

Table 7.3: IDataFlowServices Class

Class IDataFlowServices		
This class describes interfaces supporting Data Flow Services.		
OPERATIONS		
sendUserData	<i>Return type:</i> BOOLEAN	<i>Value type:</i> public
This operation relates to send user data.		
receiveUserData	<i>Return type:</i> UserData	<i>Value type:</i> public
This operation relates to receive user data.		

8 Conclusion

In the present document, we have suggested the information model and protocol for multiradio interface for MD reconfiguration.

- System Identification:
 - Detailed substances of system identification are given in clause 4.
- Notational Tools:
 - Detailed substances of notational tool for defining both information model classes and interface classes are given in clause 5.
- Information Model for Radio Computer:
 - Detailed substances of information model for radio computer are given in clause 6.
- Interface Definition:
 - Detailed substances of interface definition are given in clause 7.

Note that no specific verification mechanism is mandated for the interfaces defined in the present document.

Annex A (informative): Abstract data definitions

The following ASN.1 [i.5] module contains all necessary abstract data definitions used in the attribute definitions in clauses 6.2 and 7.5.

```

ETSI-TS-103-146-1-Type-Definitions DEFINITIONS ::= BEGIN
-----
-- START Common Data Types
-----
-- START Name Related Data Types

NameType ::= CHOICE {
    number    INTEGER,
    string    PrintableString
}

ObjectName ::= SEQUENCE OF NameType

OptionalObjectName ::= CHOICE {
    id        ObjectName,
    void      NULL
}

ObjectNameList ::= SEQUENCE OF ObjectName

-- END Name Related Data Types
-----

-----
-- START Version Related Data Types

Version ::= CHOICE {
    intVersion    INTEGER,
    stringVersion PrintableString
}

-- END Version Related Data Types
-----

-- END Common Data Types
-----

-----
-- START Radio Application Related Data Types

RAOptionID ::= ENUMERATED {
    lte5Mhz, lte10Mhz, lte20Mhz, ...
}

RAOptionsList ::= SEQUENCE OF SEQUENCE {
    rAOptionName    RAOptionID,
    rAOptionValue   ANY
}

-- END Radio Application Related Data Types
-----

-----
-- START Radio Computer Related Data Types

RadioApplicationIDList ::= SEQUENCE OF OptionalObjectName

```



```

RCOptionID ::= ENUMERATED {
    mdrcc-0, mdrcc-1, mdrcc-2, maximumTxPower, ...
}

RCOptionsList ::= SEQUENCE OF SEQUENCE {
    rOptionName RCOptionID,
    rOptionValue ANY
}

RadioInterfaceID ::= ENUMERATED {
    umts, hsdpa, wimax, lte, wifi, gsm, ...
}

RadioInterface ::= CHOICE {
    id RadioInterfaceID,
    void NULL
}

RadioInterfacesList ::= SEQUENCE OF RadioInterfaceID

ChannelIDsList ::= SEQUENCE OF OptionalObjectName

HardwareInfo ::= ENUMERATED {
    fixedPipeline, programmablePipeline, hybridPipeline, ...
}

SoftwareInfo ::= ENUMERATED {
    rOSVersion, compiler, ...
}

Direction ::= ENUMERATED {
    downlink, uplink
}

RxBLER ::= SEQUENCE {
    accBLER REAL,
    period REAL OPTIONAL,
    instBLER REAL OPTIONAL
}

TxPower ::= SEQUENCE {
    power REAL,
    unit CHARACTER
}

RxSINR ::= SEQUENCE {
    accSINR REAL,
    period REAL OPTIONAL,
    instSINR REAL OPTIONAL
}

TxBits ::= SEQUENCE {
    transmittedBit REAL,
    unit CHARACTER
}

ActiveMeasurementID ::= ENUMERATED {
    transmitPower, transportLoad, processingLoad, ...
}

ActiveMeasurementIDs ::= SEQUENCE OF {
    activeMeasurementID
}

ActiveMeasurementsList ::= SEQUENCE OF SEQUENCE {
    activeMeasurementName ActiveMeasurementID,
    activeMeasurementValue ANY
}

```

```

FrequencyRange ::= SEQUENCE {
    centralFrequency REAL,
    frequencyBand REAL
}

ChannelMeasurementID ::= ENUMERATED {
    channelInterference, channelLoad, ...
}

ChannelMeasurementsList ::= SEQUENCE OF SEQUENCE {
    channelMeasurementName ChannelMeasurementID,
    channelMeasurementValue ANY
}

-- END Radio Computer Related Data Types
-----
-----

-- START Multiradio Interface Related Data Types

RadioAppParameterID ::= ENUMERATED {
    A, b, c, ...
}

RadioAppParameters ::= SEQUENCE OF SEQUENCE {
    radioAppParameterName RadioAppParameterID,
    radioAppParameterValue ANY
}

RadioAppsList ::= SEQUENCE OF SEQUENCE {
    RadioAppID INTEGER,
    RadioAppName PrintableString
}

RadioMeasurementID ::= ENUMERATED {
    A, B, C, ...
}

RadioMeasurementsList ::= SEQUENCE OF SEQUENCE {
    radioMeasurementName RadioMeasurementID,
    radioMeasurementValue ANY
}

UserData ::= SEQUENCE OF {
    userDataID INTEGER,
    userDataValue OBJECT
}

-- END Multiradio Interface Related Data Types
-----
-----

```

History

Document history		
V1.1.1	November 2013	Publication