



# Welcome to the World of Standards



## TC RRS STANDARDISATION FOR RECONFIGURABLE MOBILE DEVICES: AN UPDATE

4th Annual Tactical Radio Workshop at WInnComm-Europe 2014 , 5-6 November 2014 Rome

Presented by Andrea Lorelli, ETSI Secretariat

ETSI TC Reconfigurable Radio Systems (RRS)

Reconfigurable Architecture: rationale and benefits

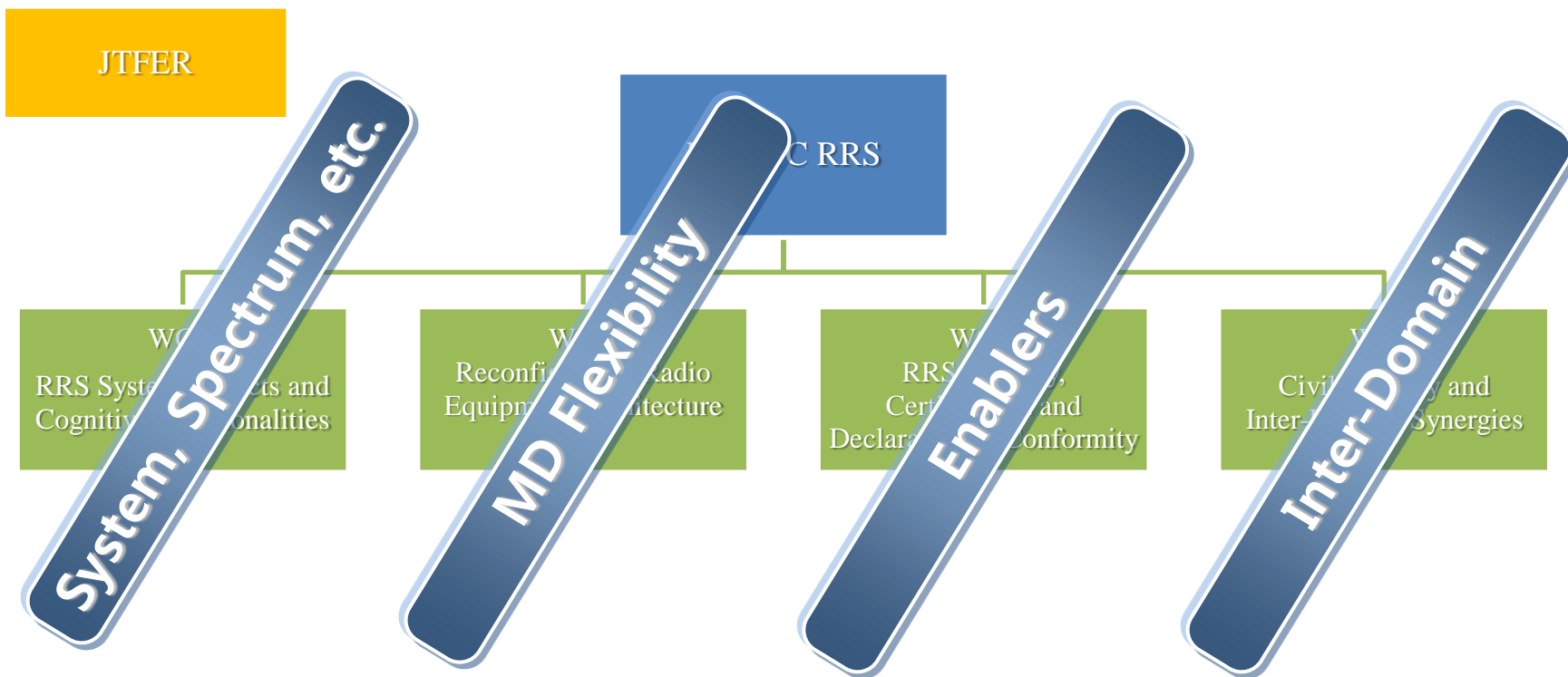
Reconfigurable Platform: MDRCs & Architecture

Reconfigurable Radio: Security ,Certification & the RED Directive

ETSI SDR-related Work Program and M/512

Conclusions

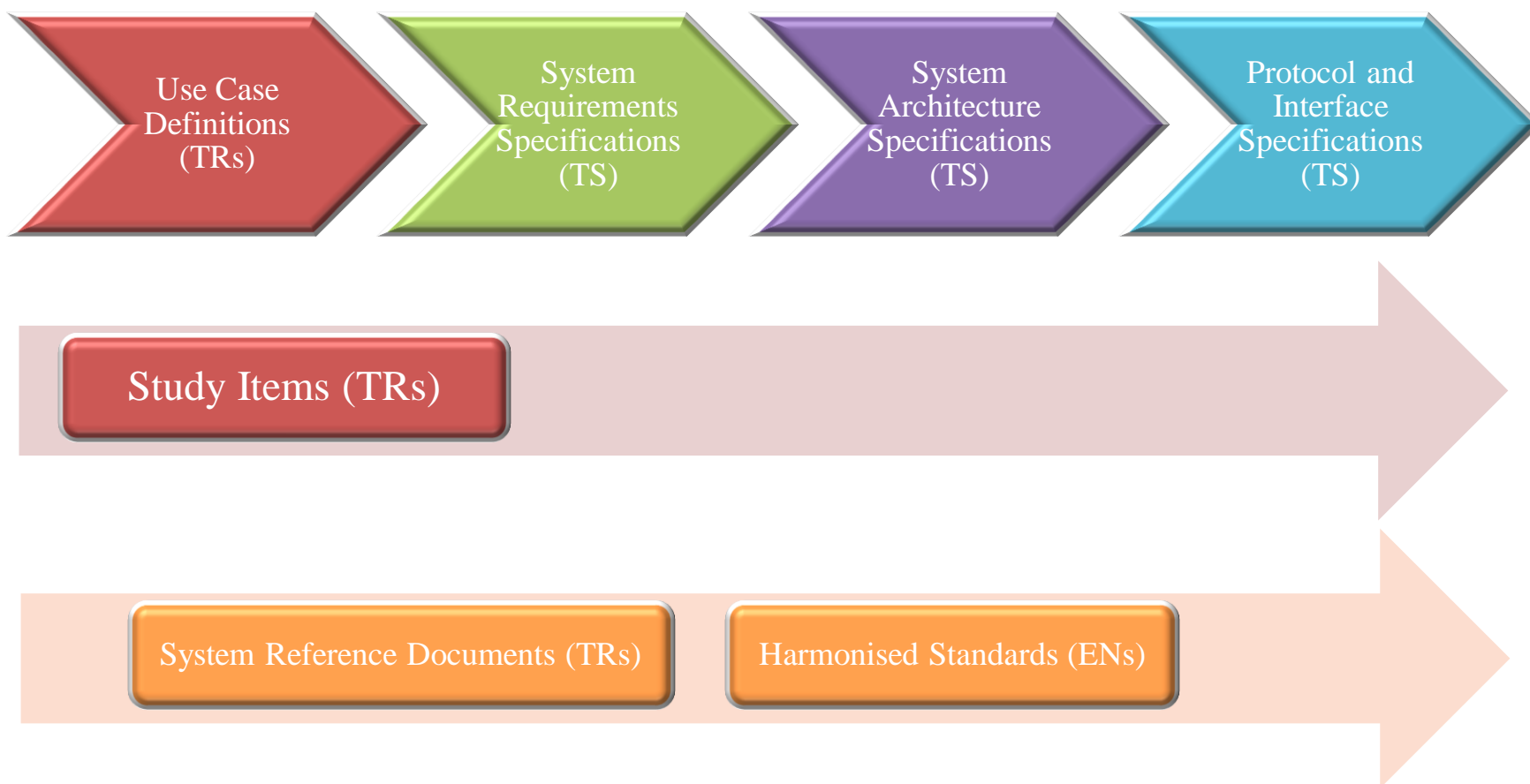




- The committee focuses on RRS encompassing both SDR and CR.
- The committee's activities include studies on the feasibility of RRS standardization, collecting and defining RRS requirements, identifying gaps where existing standards do not fulfill those requirements and proposing solutions to fill those gaps.
- JTFER is responsible for the development of HS as well as related SRDoc

- SDR Related activities take place in RRS WG2 (“Radio Equipment Architecture”) and RRS WG3 (“Security, Certification and Declaration of Conformity”)
  - RRS WG2: use cases, system requirements, architecture, interfaces
  - RRS WG3: all aspects related to the “reconfigurable radio approach”: security issues, certification of devices, conformance to regulations, etc.

# RRS Standardization Methodology





- The new reconfigurable architecture for MDs aims at maximizing efficiency in terms of power, size and performances:
  - Supporting SoC (System-on-Chip) methodology, where multiple IP cores are integrated in one chip.
  - Supporting joint optimization of HW and SW, which is the main source of efficiency for embedded devices
  - Supporting multi communications (i.e. several Radio Applications can be executed at the same time)
  - Supporting any level of programmability: starting from pure ASIC implementation to “pure” SDR where everything is “software controlled”.
  - Not introducing redundant SW components which would increase costs
  - Providing SW portability (i.e. allow the same radio application to be installed and run on different platforms)
  - Supporting SW development by 3<sup>rd</sup> parties (independent from chip vendors)
  - ...5 G “ready”

- All spectrum access protocols
  - While previous generations of wireless networks were characterized by fixed radio parameters and spectrum blocks, 5G will allow utilization of any spectrum and any access technology for the best delivery of services.
- Service delivery architecture
  - 5G will feature native support for new kinds of network deployments, including ultra-dense radio networking, device-to-device communications, dynamic spectrum refarming, SON (self-organizing networks) and SHN (self-healing networks).
- Mass-scale MIMO
- Virtualized and cloud-based radio access infrastructure

- Manufacturers: cheap implementation technique for multi-standard equipment, economy of scale worldwide
- Operators: Base Stations easy to update, cost savings
- Regulators: spectrum refarming “with ease”, spectrum efficiency
- End Users: smart and better communication, “one for everything”, “one for everywhere”
- SW providers: new opportunities (RAs)

ETSI work is currently focused on Mobile Device only, although the “reconfigurable radio” concept is applicable (and already applied) to base stations as well.



# Reconfigurable Platform Configuration

No reconfiguration	MDRC-0	
No resource share (fixed hardware)	MDRC-1	
Pre-defined static resources	MDRC-2	MDRC-5
Static resource requirements	MDRC-3	MDRC-6
Dynamic resource requirements	MDRC-4	MDRC-7
	Platform-specific executable code	Platform- independent source code or IR

- ❖ According to the type of resource requirements and the form of the Radio Application Package (RAP), eight different categories of Mobile Device Reconfiguration Classes (MDRCs) are defined.
- ❖ In the commercial sector it is expected that reconfiguration capabilities of MDs will be introduced “gradually”
- ❖ MDRCs are related to different resource allocations and radio application code

# Reconfigurable Platform Configuration



No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform- independent source code or IR

- ❖ No reconfiguration
- ❖ No resource share
- ❖ No resource manager
- ❖ Resource allocation at design time

# Reconfigurable Platform Configuration



No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform- independent source code or IR

- ❖ Multi radio
- ❖ No resource share
- ❖ No resource manager
- ❖ Resource allocation at design time

# Reconfigurable Platform Configuration



No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform- independent source code or IR

- ❖ RA is provided in platform-specific executable code.
- ❖ RA must be prepared differently for each kind of target radio platform.
- ❖ Each platform-specific executable code must be generated using a specific compiler and prepared for the corresponding target radio platform during design-time.
- ❖ MDRC2 only: Resource share can exist among Radio Access Technologies (RATs) in a given radio application

# Reconfigurable Platform Configuration

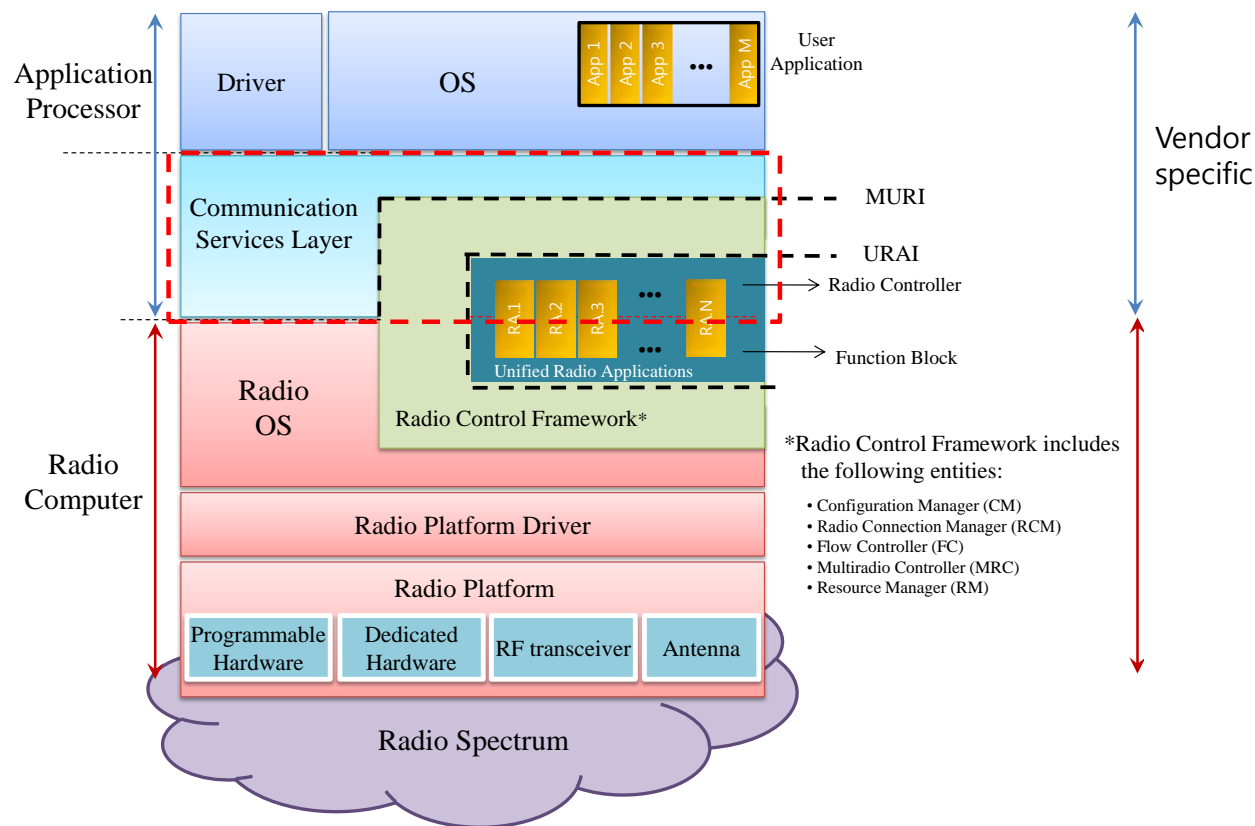
No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform-independent source code or IR

- ❖ RA is provided in independent source code or Intermediate Representation.
- ❖ Source code: it must be compiled to generate corresponding executable code using a compiler prepared for a specific radio platform of the MD
- ❖ IR: must be translated into executable code using back-end compiler prepared for the specific radio platform of the MD
- ❖ MDRC5 only: Resource share can exist among Radio Access Technologies (RATs) in a given radio application

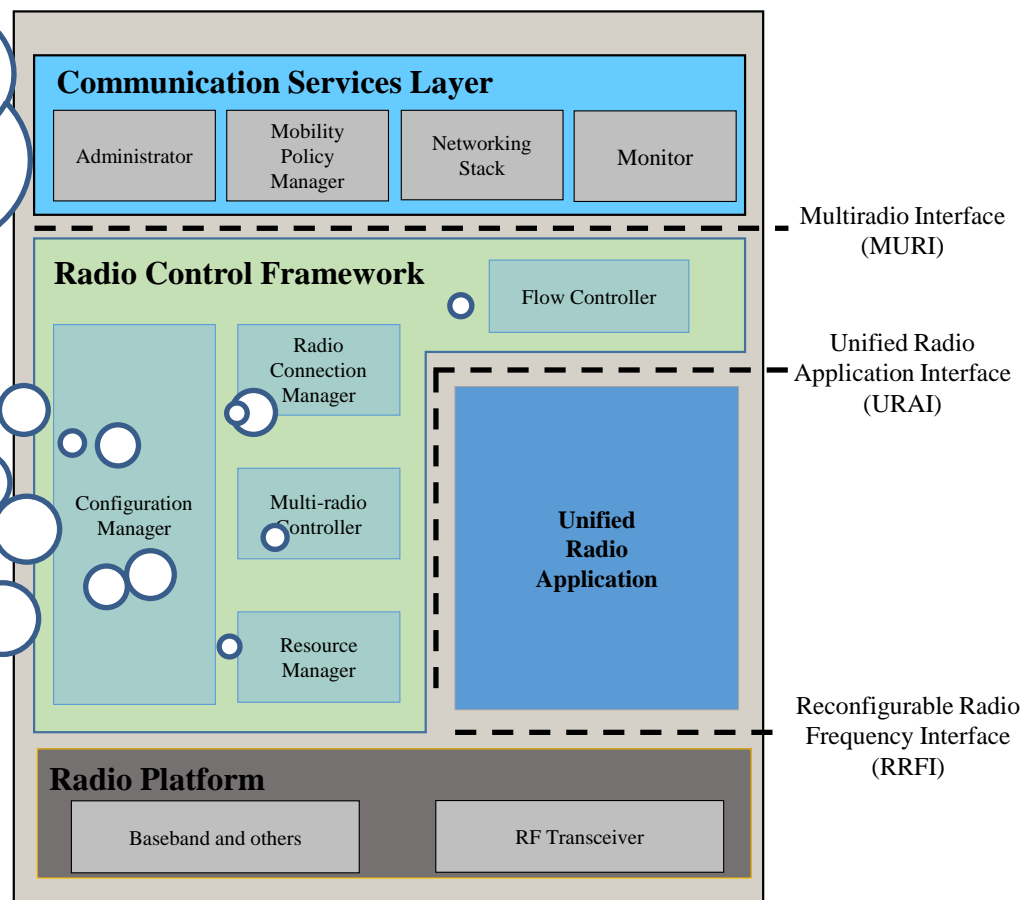
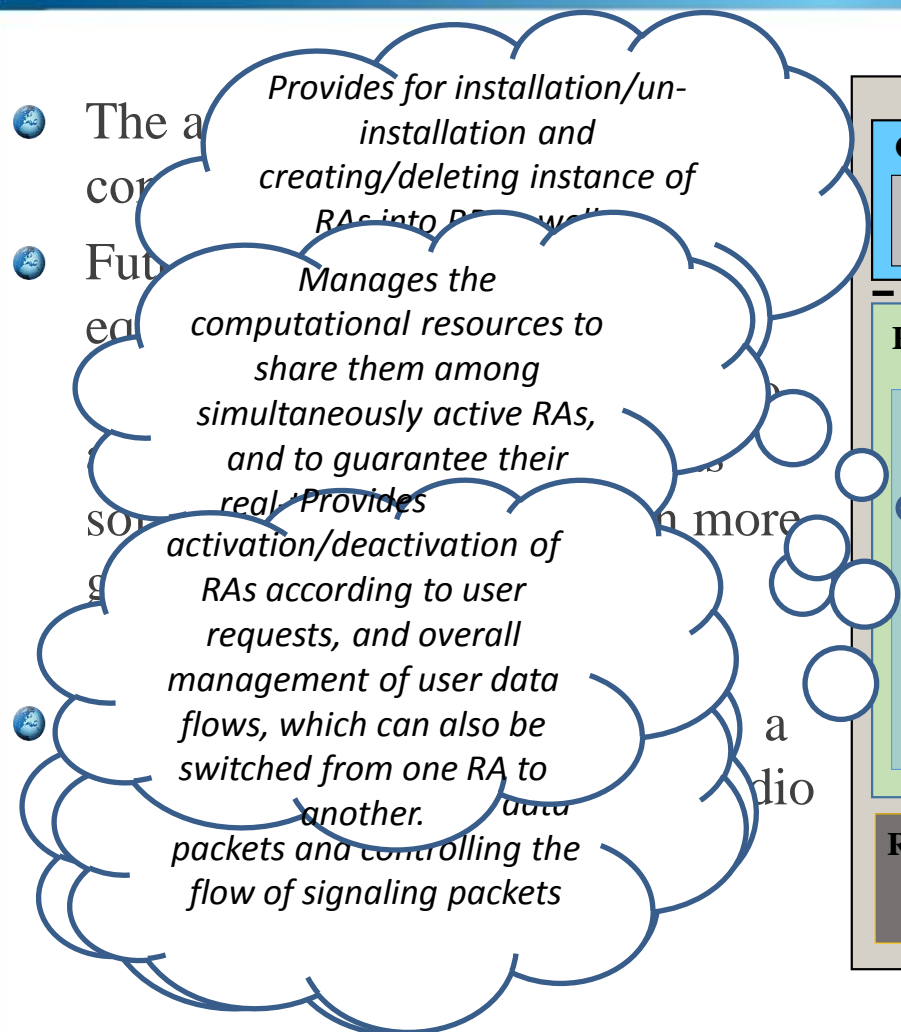
- **Radio Application** (waveform in SCA): software which enforces the generation of the transmit RF signals or the decoding of the receive RF signals
- **Radio Control Framework (RCF)**: control framework which, as a part of OS, extends OS capabilities in terms of radio resource management
- **Radio Computer**: part of mobile device hardware working under ROS control and on which Radio Applications are executed
- **Application Processor**: part of mobile device hardware working under OS control and on which User Applications, among others, are executed



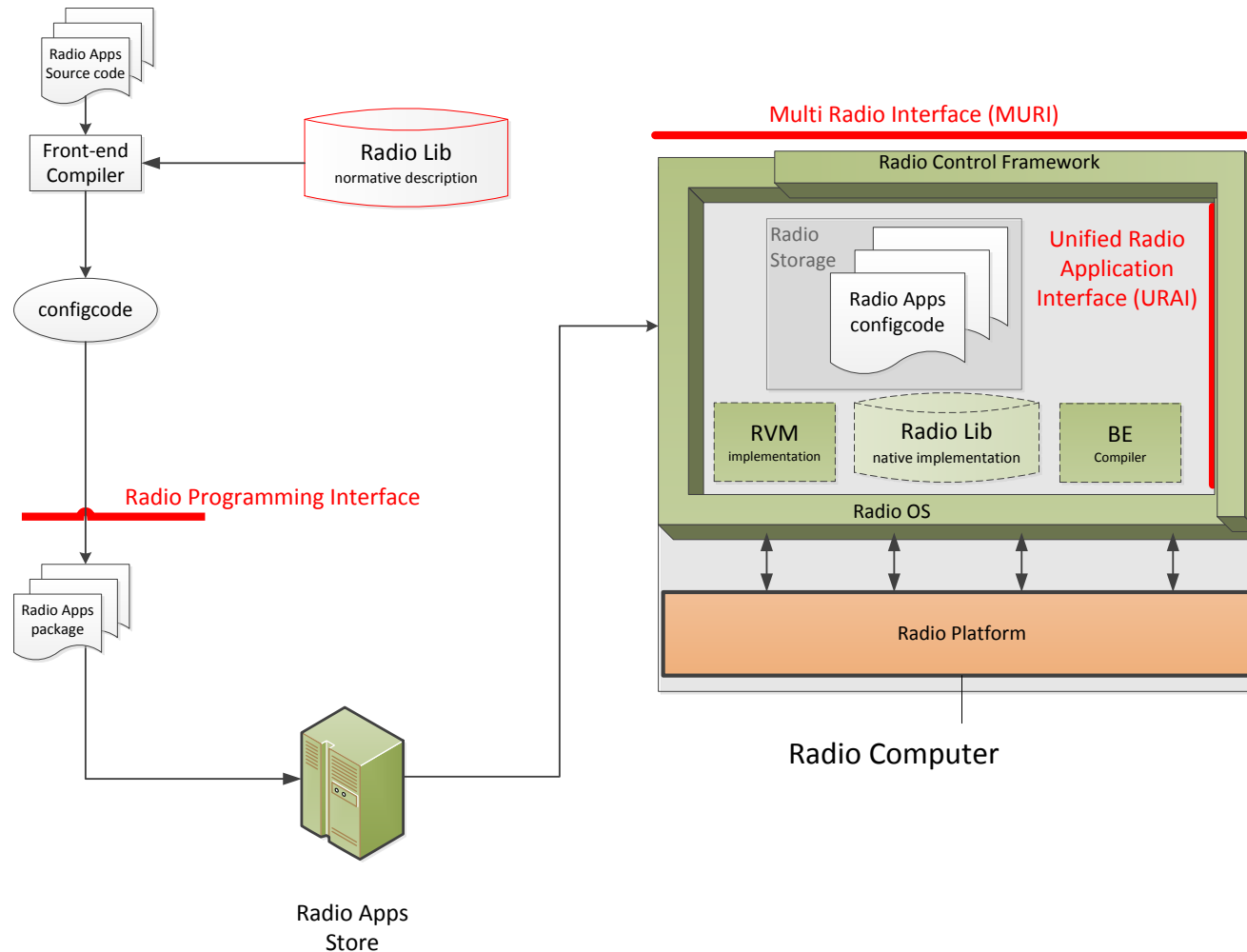
# Reconfigurable MD: Architecture



# RR ME: functional architecture



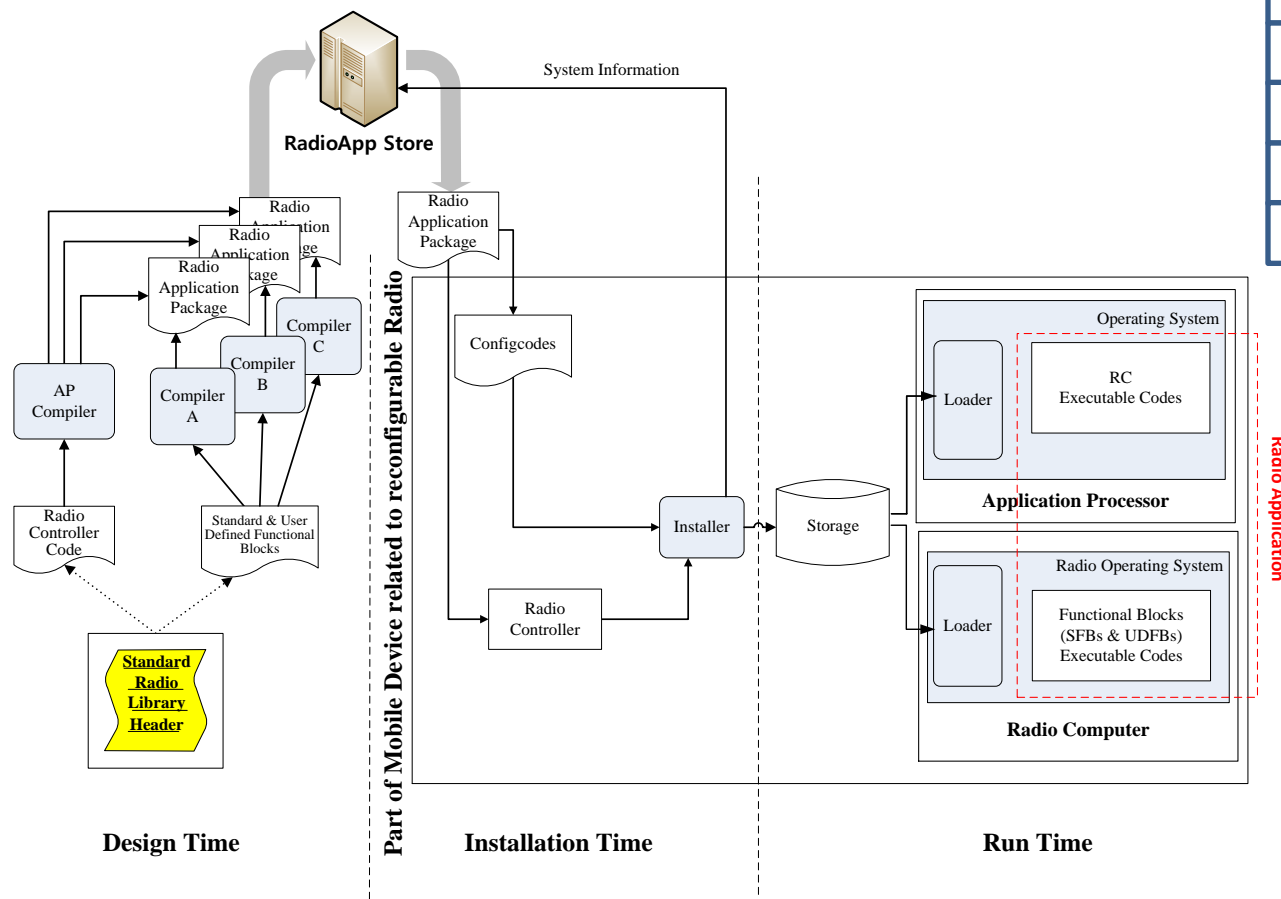
# Radio Computer System Architecture



- **MURI** (MUltiRadio Interface): interface between the user applications and the multiradio computer
- **URAI** (Unified Radio Application Interface): interface between the radio applications and the SDR control framework
- **RPI** (Radio Programming Interface): it includes programming models for signal processing, and primitives to access the services of the radio operating system.
- **RRFI** (Reconfigurable Radio Frequency Interface): interface to the reconfigurable RF transceiver

# RA deployment scenarios

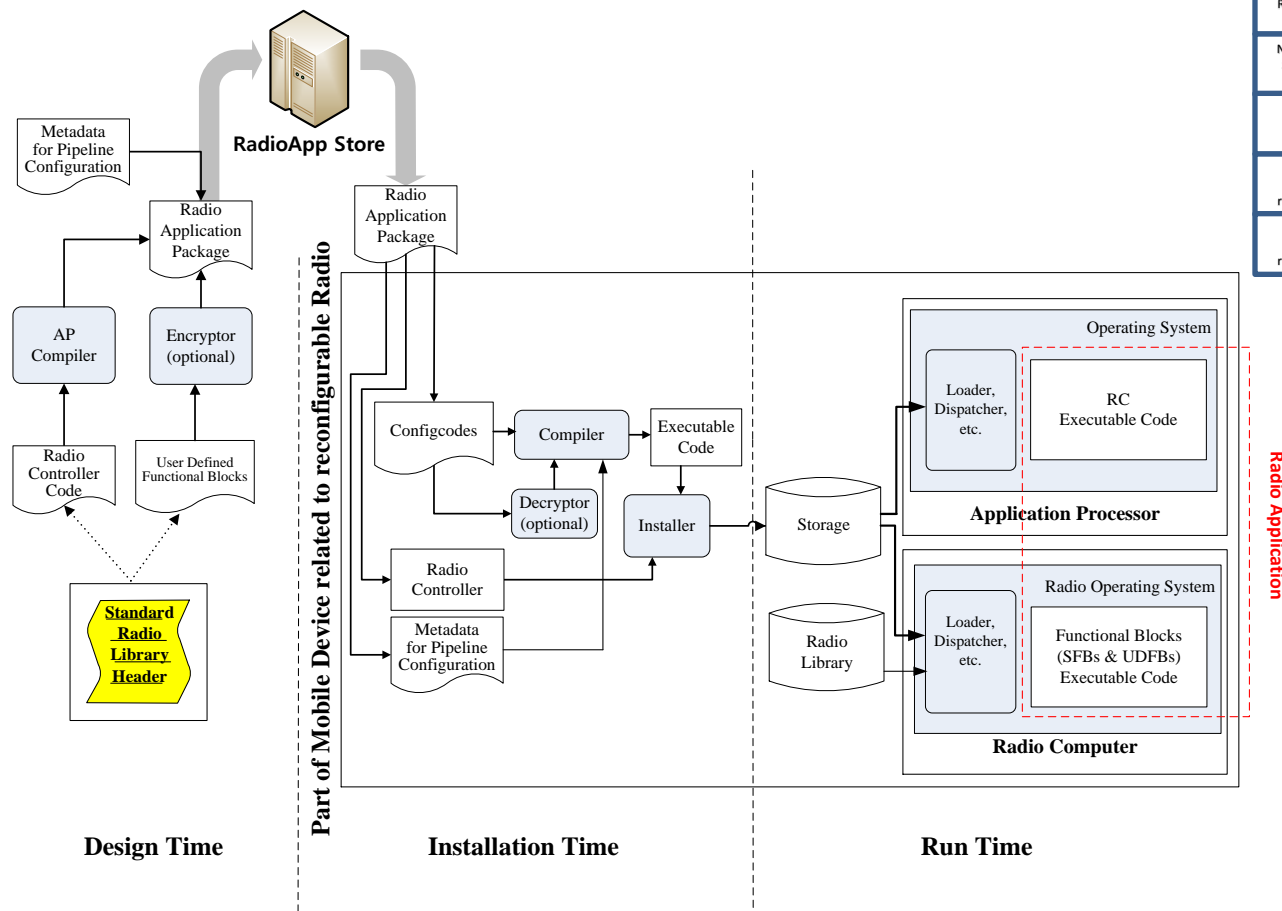
## Platform-specific executable code (MDRC-2, MDRC-3, MDRC-4)



No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform-independent source code or IR

# RA deployment scenarios

## Platform-independent source code (MDRC-5, MDRC-6, MDRC-7)

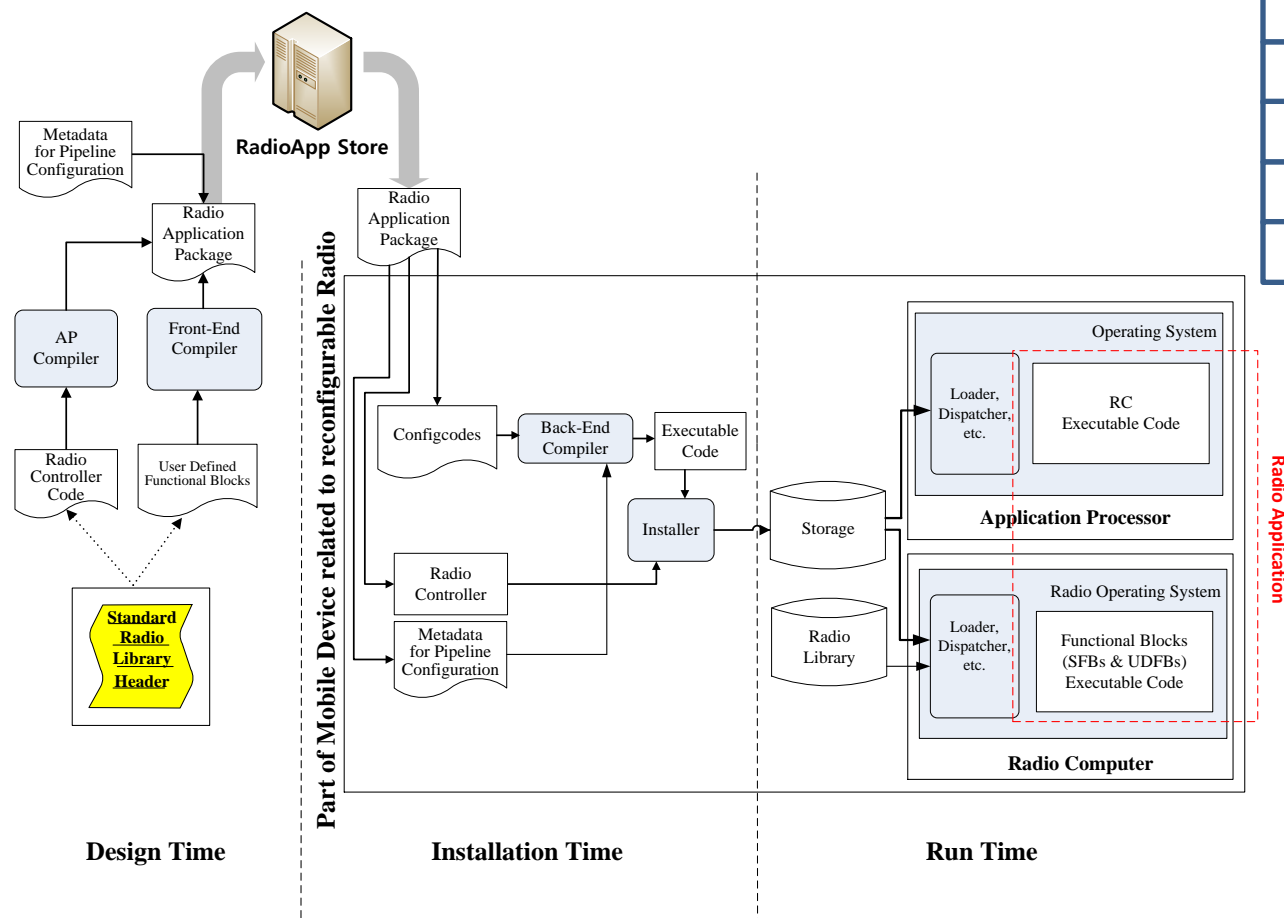


No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
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Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform-independent source code or IR



# RA deployment scenarios

## Platform-independent IR (MDRC-5, MDRC-6, MDRC-7)



No Reconfiguration	MDRC0	
No Resources Share (fixed Hardware)	MDRC1	
Pre-defined static resources	MDRC2	MDRC5
Static resource requirements	MDRC3	MDRC6
Dynamic resource requirements	MDRC4	MDRC7
	Platform-specific executable code	Platform-independent source code or IR

- The capability of downloading new RadioApps (RA) and MD reconfigurability may introduce new security threats, which may impact the service availability of the MD. Potential threats:
  - Download and activation of a malicious RA
  - Activation of incorrect configuration in the MD.
  - Extraction of data from the MD.
  - Unauthorized use of MD resources or services.
- Mitigation or Protection Solutions for Security Threats should include (at least):
  - Controlled access to the download and activation of the RA.
  - Protection of system and data integrity. Challenge to implement cost efficient but effective solutions.
  - Compliance to the spectrum regulations. Last check based on configuration files which maps the local spectrum regulations.
- The challenge is to implement a cost effective, scalable solution to address security threats.

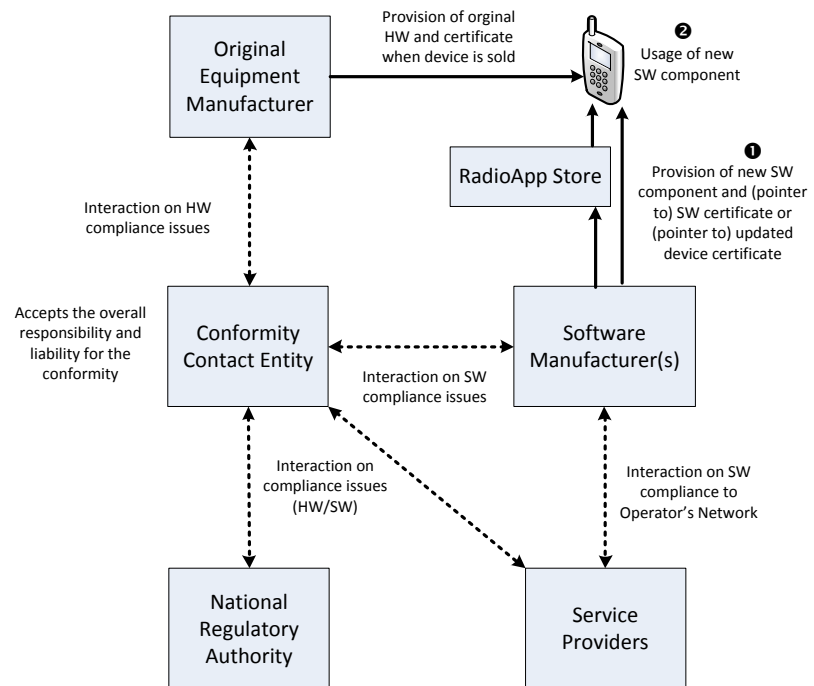
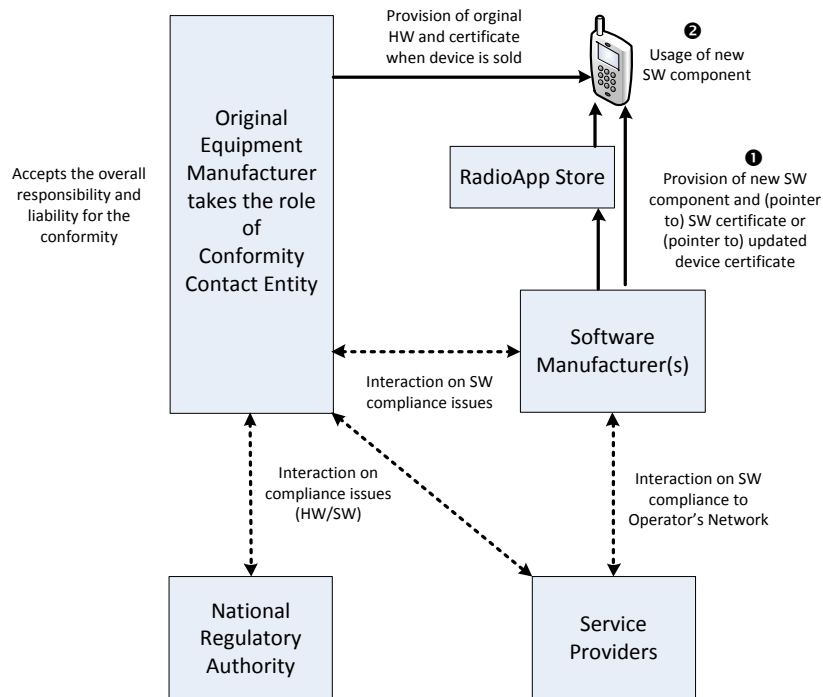
- The new RED Directive envisages the possibility of an advanced reconfiguration, enabling users to acquire and install “Radio Applications (RA)”
- New Essential Requirement: *radio equipment supports certain features in order to ensure that software can only be loaded into the radio equipment where the compliance of the combination of the radio equipment and software has been demonstrated (art. 3.3(i) of the RED)*
- The RED Directive (like the R&TTE) does not apply to military equipment but does apply to public safety equipment!
- Certification is a challenge (responsibility issue)

# Reconfigurable Equipment: Responsibility



- If a Reconfigurable Equipment does not operate “properly”, it is necessary to identify the “entity” taking over the overall responsibility of the RE behaviour.
- In the “horizontal market model”, this entity **IS** the original equipment manufactures but, when reconfigurable software is provided by a third party, it is a different story.
- One solution could be to have an entity (that could also be the OEM) accepting the overall responsibility and liability for the conformance.

# RMD: Responsibility (from TR 102 967)



## ETSI TC RRS WG2

- Radio Reconfiguration related Requirements for Mobile Devices (**EN 302 969**) is currently in ENAP
  - This is a revision of TS 102 969 published in 2012
- Radio Reconfiguration related Architecture for Mobile Devices (**EN 303 095**) is close to finalization
  - This is a revision of TS 103 095, published in 2013
- Mobile Device Information Models and Protocols; Part1: Multiradio Interface (**EN 303 146-1**) still in draft
  - This is a revision of TS 103 146-1 published in 2013
- Mobile Device Information Models and Protocols; Part 2: Reconfigurable Radio Frequency Interface (**TS 103 146-2**) still in draft



## ETSI TC RRS WG3

- Use Cases for Dynamic Declaration of Conformity (**TR 102 967**) was published last March
  - Work on a revision will start soon (alignment with the RED Directive)
- Security related use cases and threats in Reconfigurable Radio Systems
  - Work will start soon in the recently created **TC CYBER** in collaboration with TC RRS

## Future SDR-related work already planned (**RRS WG3 & WG4**)

- Development of **EN 303 146 part 2 to 4** for the other 3 interfaces to be standardised as defined in the architecture (**EN 303 095**)

- **M/512 Objective B** requests the standardisation of an SDR architecture (based on ESSOR/SVFuA programs) for the military domain but the objective is still “frozen”
- **M/512 Objective C** requests the development of hybrid standards and explicitly mentions a « dual-mode » reconfigurable device but there seems to be no commercial interest (or even a business case) for the time being
  - No input provided to the feasibility study in response to Objective C.1 (TR 103 217)

- TC RRS has decided to create a questionnaire in order to better understand the views/opinions of the different stakeholders
- Please take some time to have a look at it and fill it in by November 28<sup>th</sup>
- The results will be presented at the ETSI Workshop on Reconfigurable Radio Systems

- 3-4 December 2014, Sophia Antipolis – France
- Speakers from EC, NATO, Airbus Defense & Space....
- A number of demos will be shown

Registration, agenda and questionnaire at:

<http://www.etsi.org/news-events/events/807-etsi-rrs-workshop-2014>

- The regulatory framework is currently evolving, at least in Europe, such that the market introduction of novel “Radio Applications” features is becoming possible
- The proposed novel MDRCs and certificating procedures are expected to facilitate the gradual introduction of reconfigurability features for commercial wireless MDs
- The capability of downloading new RAPs and MD reconfigurability may introduce new security threats, which may impact the service availability of the MD.
- Dynamic declaration of conformity/certification is a challenge
- Public Safety domain could benefit of the “new approach”

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Thank you!