

State of the art in ETSI SDR and CR related Standardization and preparation of commercialization

Wireless Innovation Conference and Product Exposition
Washington, USA, Nov 30 – Dec 3, 2010

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Never stop thinking

Overview

- ETSI Reconfigurable Radio Systems (RRS) Standardization – Structure and mandate
- ETSI RRS Working Groups
- Selection of available deliverables
- Next steps in ETSI RRS
- Conclusion

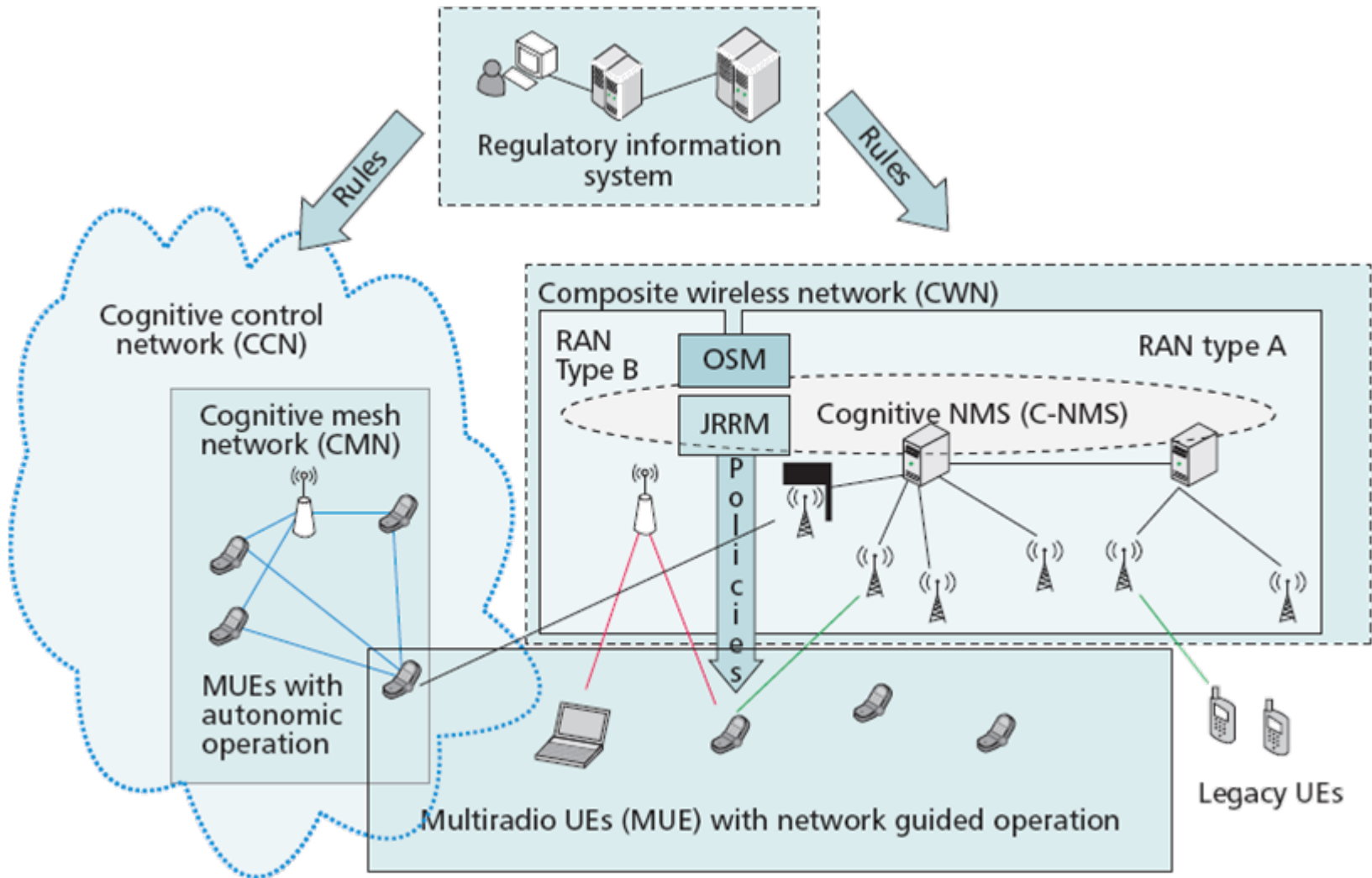
■ **The Work of ETSI RRS TC is organized within four WGs (chairs)**

- WG1 – System Aspects (Ari Ahtiainen, NOKIA)
- WG2 – Radio Equipment Architecture (Markus Mueck, Infineon Technologies)
- WG3 – Functional Architecture and Cognitive Pilot Channel (Jens Gebert, Alcatel-Lucent)
- WG4 – Public Safety (Dearlove Alan, Copsey Telecommunications)

■ **Mandate (selection) : TC RRS shall have responsibility**

- of standardization activities related to Reconfigurable Radio Systems encompassing system solutions related to Software Defined Radio (SDR) and Cognitive Radio (CR);
- to collect and define the related Reconfigurable Radio Systems requirements from relevant stakeholders;
- to deliver its findings in the form of ETSI deliverables as appropriate.

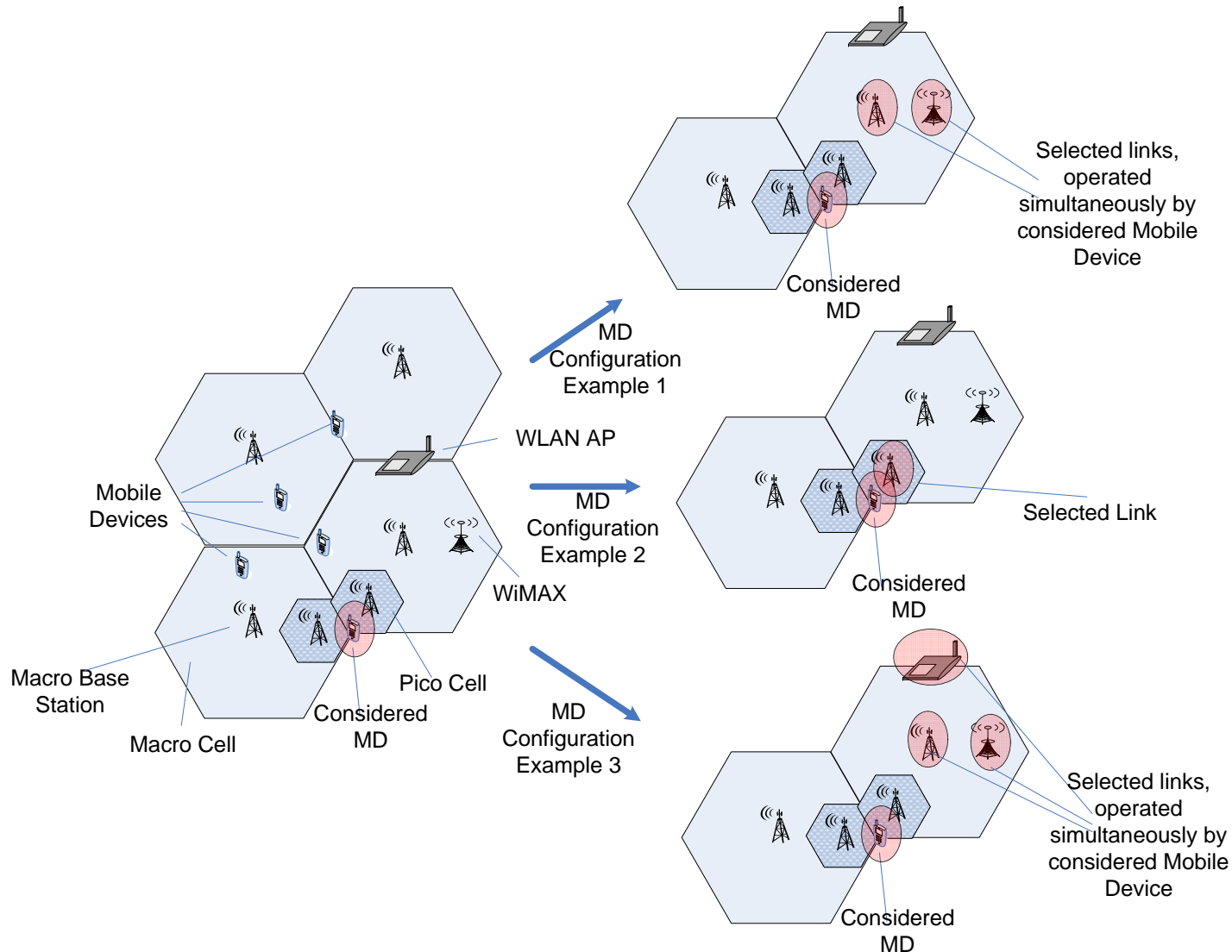
WG1 - System Aspects / Architectural approaches for CRS



WG1 - System Aspects / Use Cases

- Use Cases related to SDR Reference Architecture for Mobile Device
 - **Terminal-Centric Configuration in a Heterogeneous Radio Context**
 - Network driven Terminal Configuration in a Heterogeneous Radio Context
 - Addition of new features, such as support for novel radio systems, to Mobile Devices
 - Provision of a new cognitive feature (e.g. cross-technology spectrum measurement)
- Use Cases related to Reconfigurable Radio Systems operating in IMT bands and GSM bands
- Use Cases related to Operation in White Space Frequency bands

Terminal-Centric Configuration in a Heterogeneous Radio Context

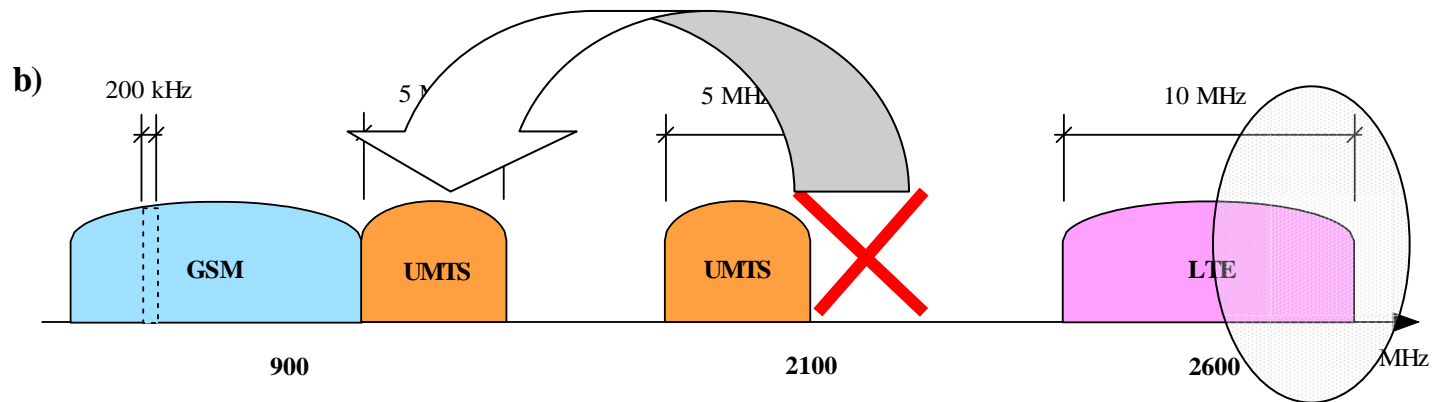
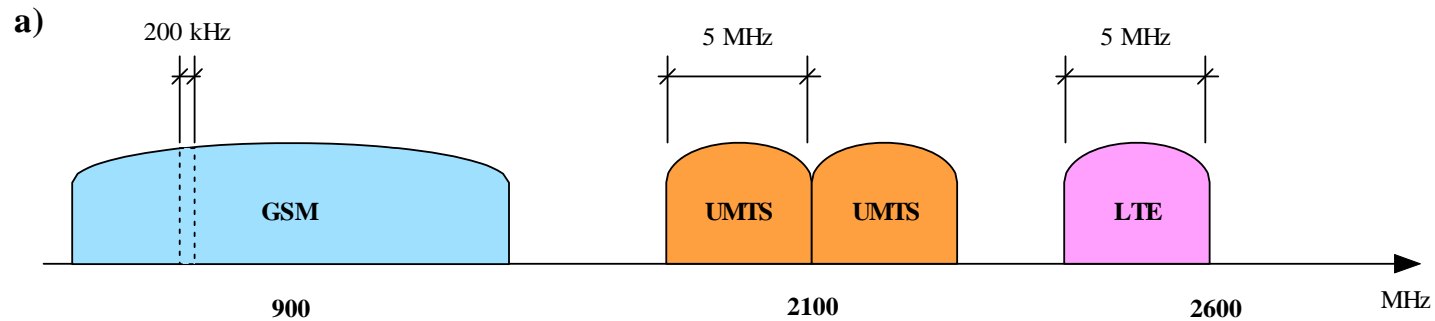


■ MDs exploit context knowledge / NW policies for link selection

Use Case for a selected family

- Use Cases related to SDR Reference Architecture for Mobile Device
- Use Cases related to Reconfigurable Radio Systems operating in IMT bands and GSM bands
 - ▢ Spectrum refarming
 - ▢ Upgrading a pre-existing RAT and deploy of a new RAT to a pre-existing network
 - ▢ Addition of multiple standards modes
 - ▢ **Radio Resource optimization**
- Use Cases related to Operation in White Space Frequency bands

Radio Resource optimization



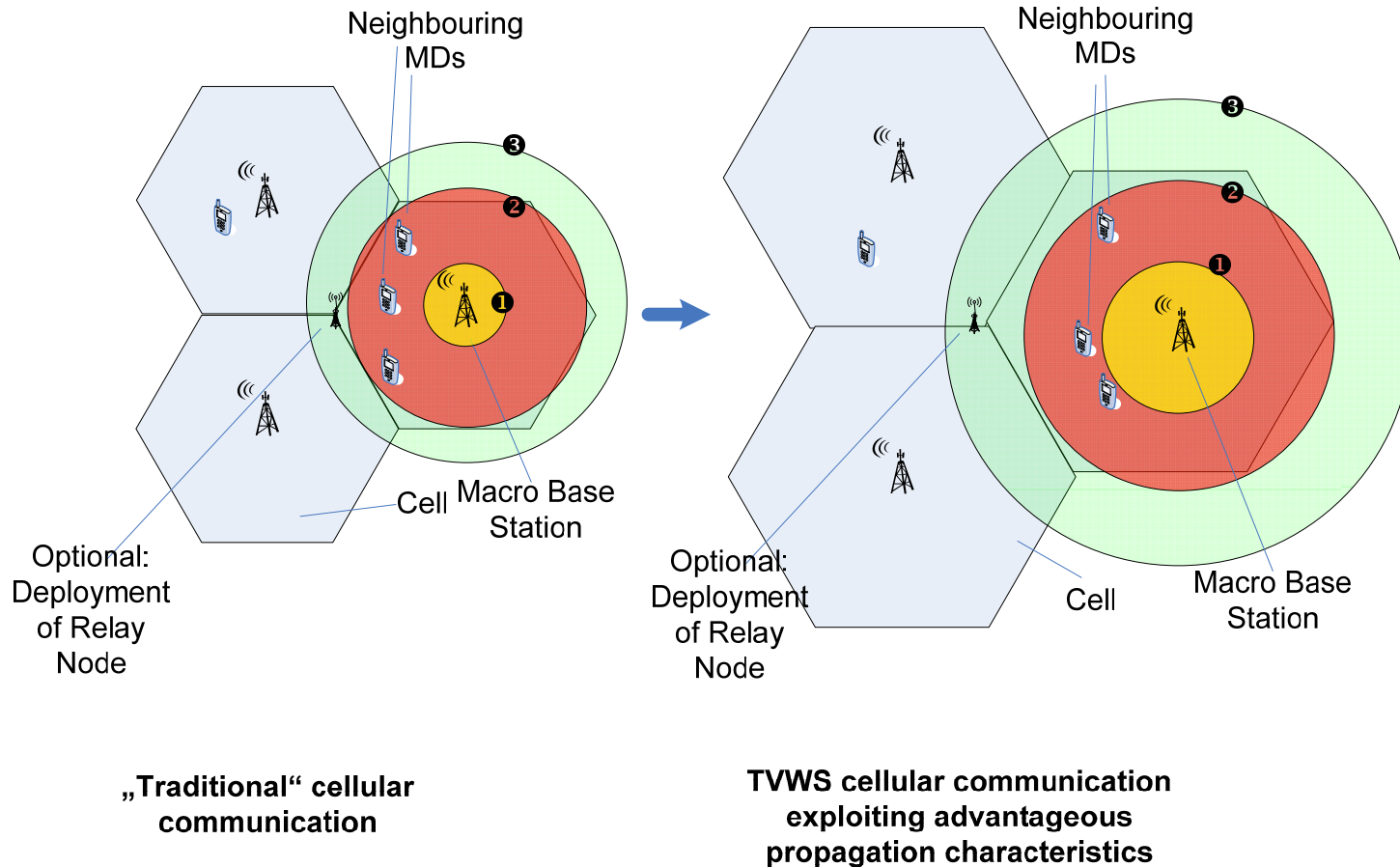
* Release of 25 x 200 KHz GSM channels

- HW resources in the BS are allocated to different RATs such that user needs are met in the most optimum way. User devices on the other hand need to adapt to a dynamically changing radio context.

Use Case for a selected family

- Use Cases related to SDR Reference Architecture for Mobile Device
- Use Cases related to Reconfigurable Radio Systems operating in IMT bands and GSM bands
- Use Cases related to Operation in White Space Frequency bands
 - Mid-/long range wireless access over white space frequency bands
 - Short range wireless access over white space frequency bands
 - Ad-hoc networking over white space frequency bands
 - **TV White Space (TVWS) usage for Cellular Communication**
 - *Scenario "Lighter infrastructure deployment through larger cell sizes"*
 - *Scenario "Increased spectral efficiency through reduced propagation loss"*
 - *Scenario "Increased spectral efficiency through extended macro diversity"*
 - *Scenario "TVWS Band-Switch in case that primary user re-enters"*

TV White Space (TVWS) usage for Cellular Communication



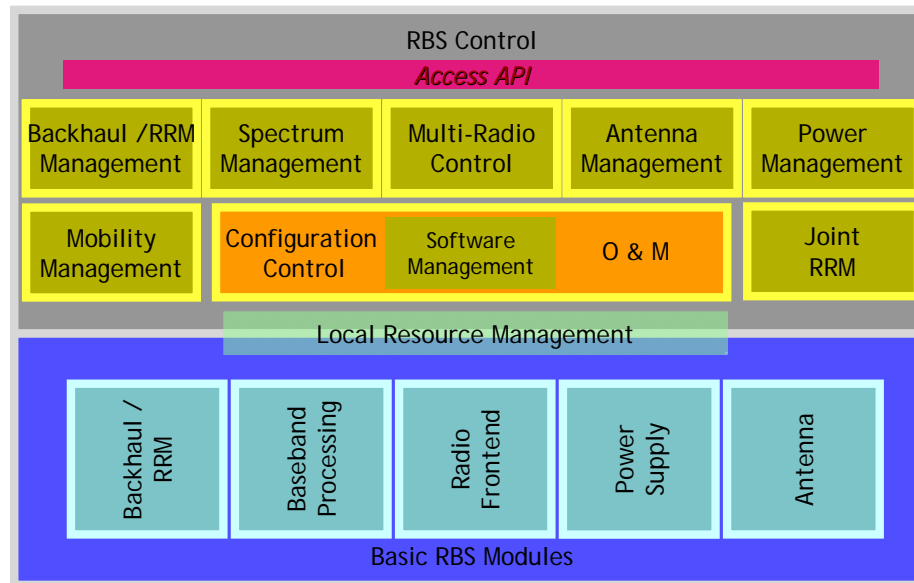
- The lower propagation losses experienced by the wireless signals over the TV band allow to increase the cell size of the cellular system. This results in a less dense infrastructure deployment of macro RBSs, which reduces CAPEX and OPEX of cellular operators. The system design has to take into account that the TVWS bands are eventually only available for a limited period.

WG1 - System Aspects

- The objective of this working group is to summarize the overall SDR/CR vision of ETSI RRS and to guide the technical work
- Furthermore, WG1 considers potential regulatory issues and barriers for the usage of SDR/CR technology, such as
 - **Responsibility Issues:** In the case that a device does not operate within the regulatory framework, the regulators typically request that the responsibility must relay within one single entity which needs to be easily identifiable.
 - It is recommended to consider at least the the following possibilities: Building on TCAM (*Telecommunications Conformity Assessment and Market Surveillance Committee*) studies which propose two market models – horizontal and vertical markets:
 - **Vertical Markets:** All hardware and SDR software which is relevant for the declaration of conformity with the essential requirements for the intended use during the whole life cycle are controlled by one entity,
 - **Horizontal market:** Independent companies placing separately on the market hardware and SDR software (3rd party SW providers, etc.) which, when used together, are subject to the declaration of conformity with the essential requirements for the intended use of the equipment

WG2 – Radio Equipment Architecture

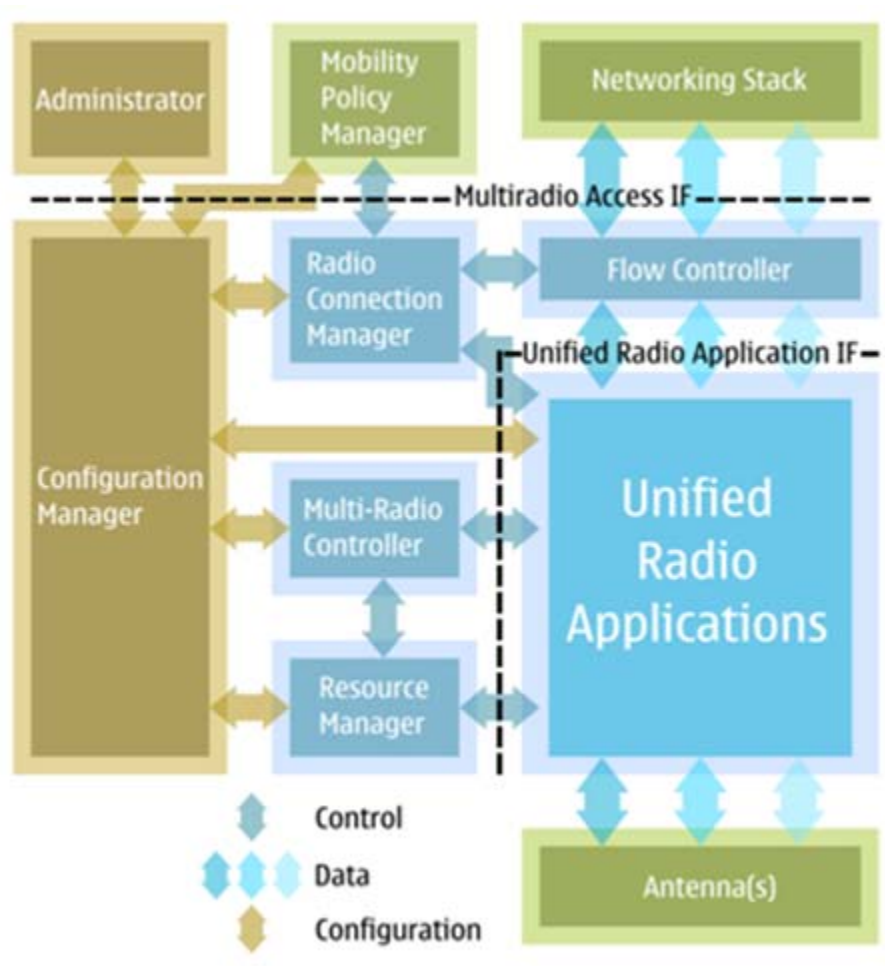
- WG2 studies the potential for SDR standardization, from the perspective of Reconfigurable Base Stations (RBS) and Mobile Devices (MDs)
- Concerning RBS, WG2 proposes a reconfigurable architecture representation:



- Several axes are identified – but no strong industry support yet:
 - Configuration control
 - Provides interface for triggering re-configuration actions (candidate for standard)
 - Operations and maintenance
 - Controls activation/de-activation of measurements (candidate for standard)
 - ...

WG2 – Radio Equipment Architecture

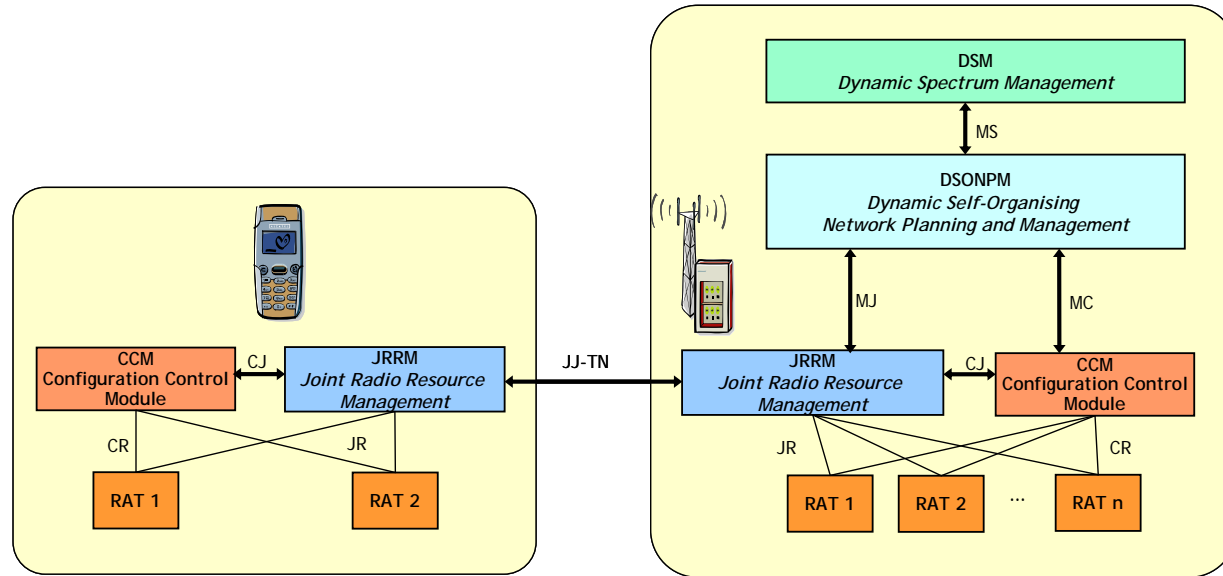
- Concerning MDs, a SDR Reference Architecture is defined



- **Configuration Manager (CM):** (de)installation and (un)loading of radio applications into radio computer as well as management of and access to the radio parameters of those radio applications
- **Radio Connection Manager (RCM):** (de)activation of radio applications according to user requests and overall management of user data flows, which can also be switched from one radio application to another
- **Flow Controller (FC):** sending and receiving of user data packets and controlling the flow
- **Multiradio Controller (MRC):** scheduling the requests on spectrum resources issued by concurrently executing radio applications in order to detect in advance the interoperability problems between them
- **Resource Manager (RM):** management of radio computer resources in order to share them among simultaneously active radio applications, while guaranteeing their real-time requirements

WG3 - Functional Architecture and Cognitive Pilot Channel

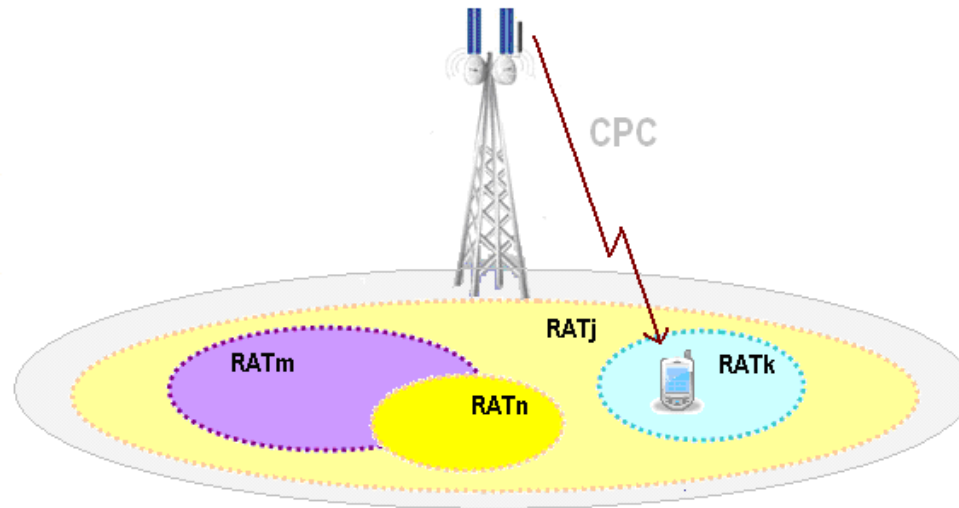
- WG3 studies the need for Cognitive Radio related standardization – Functional Architecture



- The proposed FA concentrates on the network and terminal aspects, and in particular on the different optimisation needs of different use cases within such a composite radio environment.
- The FA constitutes an amalgamation of different advanced resource management mechanisms, including
 - (i) the Dynamic, Self-Organising Planning and Management (DSONPM),
 - (ii) the Dynamic Spectrum Management (DSM),
 - (iii) the Joint Radio Resources Management (JRRM), and
 - (iv) the Configuration Control Module (CCM).

WG3 - Functional Architecture and Cognitive Pilot Channel

- WG3 studies the need for Cognitive Radio related standardization – Cognitive Pilot Channel



- Objective: To enable optimisation of radio resource usage as cognitive capability of the terminal, in order to switch to the most appropriate technology and frequency for the required service.
- Means: Avoid sensing of the considered reachable frequency range (e.g. from 400 MHz up to 6 GHz) and rather convey the necessary information through a kind of common pilot channel (to let the terminal know the status of radio channel occupancy).

WG4 – Public Safety

- ETSI RRS needs to adopt the concept of Software Assurance in Information Technology, requiring
 - a certification processes to guarantee that the software modules to be downloaded and activated will behave as expected,
 - a secure download mechanism, which guarantees the authenticity of the downloaded software.
 - a secure execution environment in the RRS to guarantee that only trusted software can be activated and executed,
 - a component to ensure that spectrum regulations will be validated regardless of the software modules running on the RRS terminal.
- In the military and public safety domain, RRS can be used to remove or mitigate the interoperability barriers among the organizations involved in emergency crisis or natural disasters.
 - Using the capability of RRS technology to communicate with different RATs, it is theoretically possible to create interoperable “bridges” across public safety organizations using different systems
 - Military and public safety organizations operate with various levels of security. A significant challenge is how to design RRS wireless communication systems and terminals so that they can guarantee interoperability without sacrificing the security of data in each network.

Selection of available deliverables

- ETSI TR 102 680 "Reconfigurable Radio Systems (RRS); SDR Reference Architecture for Mobile Device"
- ETSI TR 102 681 "Reconfigurable Radio Systems (RRS); Radio Base Station (RBS) Software Defined Radio (SDR) status, implementations and costs aspects, including future possibilities"
- ETSI TR 102 682 "Reconfigurable Radio Systems (RRS); Functional Architecture for Cognitive Network Management"
- ETSI TR 102 683 "Reconfigurable Radio Systems (RRS); Cognitive Pilot Channel (CPC)"
- ETSI TR 102 734 "Reconfigurable Radio Systems (RRS); User Requirements for Public Safety"
- ETSI TR 102 838 "Summary on Feasibility Studies and Potential Standardization Topics"

**All documents are available at
<http://pda.etsi.org/pda/queryform.asp>**

Conclusions

- The SDR and CR framework elaborated by ETSI RRS for heterogeneous wide area (cellular) and short range system scenarios has been presented.
- Key scenarios are presented with a focus on 3 Use Case classes
 - Use Cases related to SDR Reference Architecture for Mobile Device;
 - Use Cases related to Reconfigurable Radio Systems operating in IMT bands and GSM bands;
 - Use Cases related to Operation in White Space Frequency bands.
- Key elements, such as a harmonized SDR architecture, context provision via a CPC, resource control and management by the proposed FA, security features, etc. are expected to provide the basis for a broad market acceptance.

Opportunity

- Next ETSI RRS TC Meeting:
 - 8-10-Feb-2011, Paris, France

- Expectations:
 - Progress on Use Cases,
 - Initiation of derivation of normative system requirements,
 - New Work Items on Smart Antenna framework,
 - Ongoing study work is continued (working groups WG1-WG4 may meet prior or after the ETSI RRS TC meeting dates, typically on Monday or Friday in the same week).

- How to register:
 - See instructions on <http://portal.etsi.org/> selecting "RRS" on top of the page.



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We innovate.
We partner.
We create value.



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