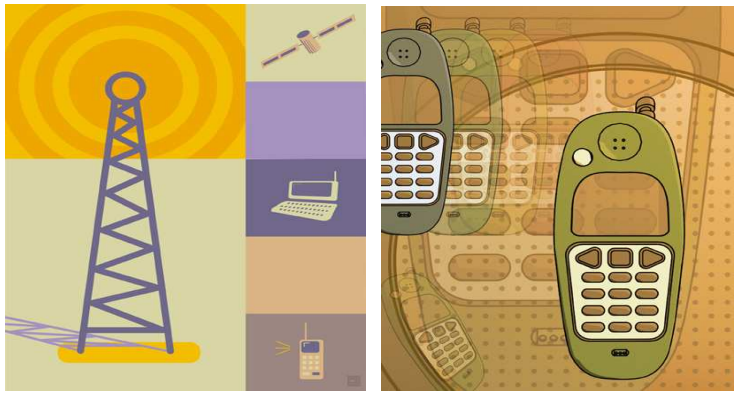
E²R II: La Radio Reconfigurable



Mr. Marco Fratti

Dr. Didier Bourse

Mr. Markus Muck

URSI CNFRS

28-29.03.06 - Paris

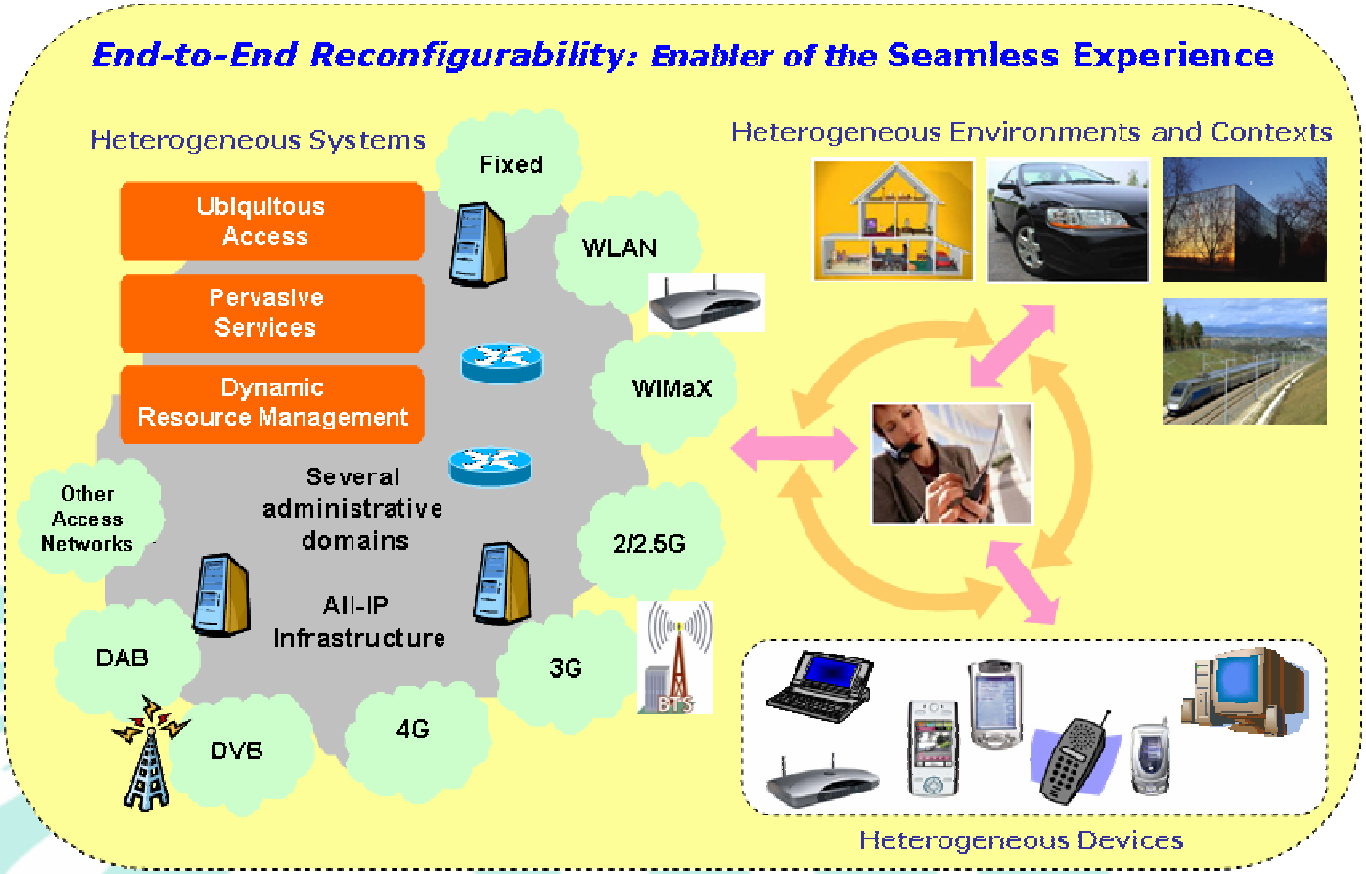
E²R Presentation Outline

Presentation Outline

- ✓ E²R Enabler of Seamless Experience
- ✓ E²R II in a Nutshell
- ✓ E²R II Research Challenges Highlights

E²R Enabler of Seamless Experience (1/3)

Beyond 3G (B3G) Systems



End-to-End Reconfigurability is the key enabler for providing a seamless experience to the end-user and the operators:

→ **Managing and increasing resilience of growingly complex architectures**

→ **Reducing costs of deployment, evolution and operation of large communication systems**

→ **Providing opportunities to develop and experiment rapidly new services and applications**

E²R Enabler of Seamless Experience (2/3)

E²R Definitions

- ✓ **End-to-End Reconfigurability means adaptability of the nodes along the complete communication path between communicating entities. This encompasses configuration and reconfiguration of equipment (terminals, base-stations, access points, gateways) and potentially impacts all OSI layers**
- ✓ **The End-to-End Reconfigurability Project develops concepts and solutions to enable, manage and control End-to-End Connectivity in B3G Heterogeneous Environment (Cellular, 802.xx, Broadcast…)**

E²R Enabler of Seamless Experience (3/3)

E²R – Global International Landscape

- ✓ **Competition**
  - ✓ DARPA and DoD are spending B$ on SDR/CR
  - ✓ CR is funded as the next step of SDR
  - ✓ IT industry has developed E2E and reconfigurable solutions in the last 10 years
- ✓ **European Leadership**
  - ✓ Bring reconfigurability technologies into the telecom space
  - ✓ SDR/CR: Trust, Scout, Mobivas, MuMoR, OverDRiVE, Credo, Cast, Mobydick
  - ✓ E²R: From SDR/CR to Reconfigurability towards End-to-End Reconfigurability

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"Meanwhile, in Europe the E2R research program took a brisk approach and is studying end-to-end reconfigurability. This could effectively position them to control the intellectual property of CR. If the United States wants leadership in software development it may be necessary to set a more aggressive pace in software development."
Bruce Fette (General Dynamics) EE Times CommsDesign Aug. 04 http://www.commsdesign.com/showArticle.jhtml?articleID=29100657

E²R is
✓Developing methods and tools for managing complex architectures
✓Reducing cost of deployement, evolution and operation of large communication systems
✓Providing opportunities to develop and experiment rapidly new services and applications
✓Enabling a seamless experience for the end user and the operators

E²R II in a Nutshell (1/7)

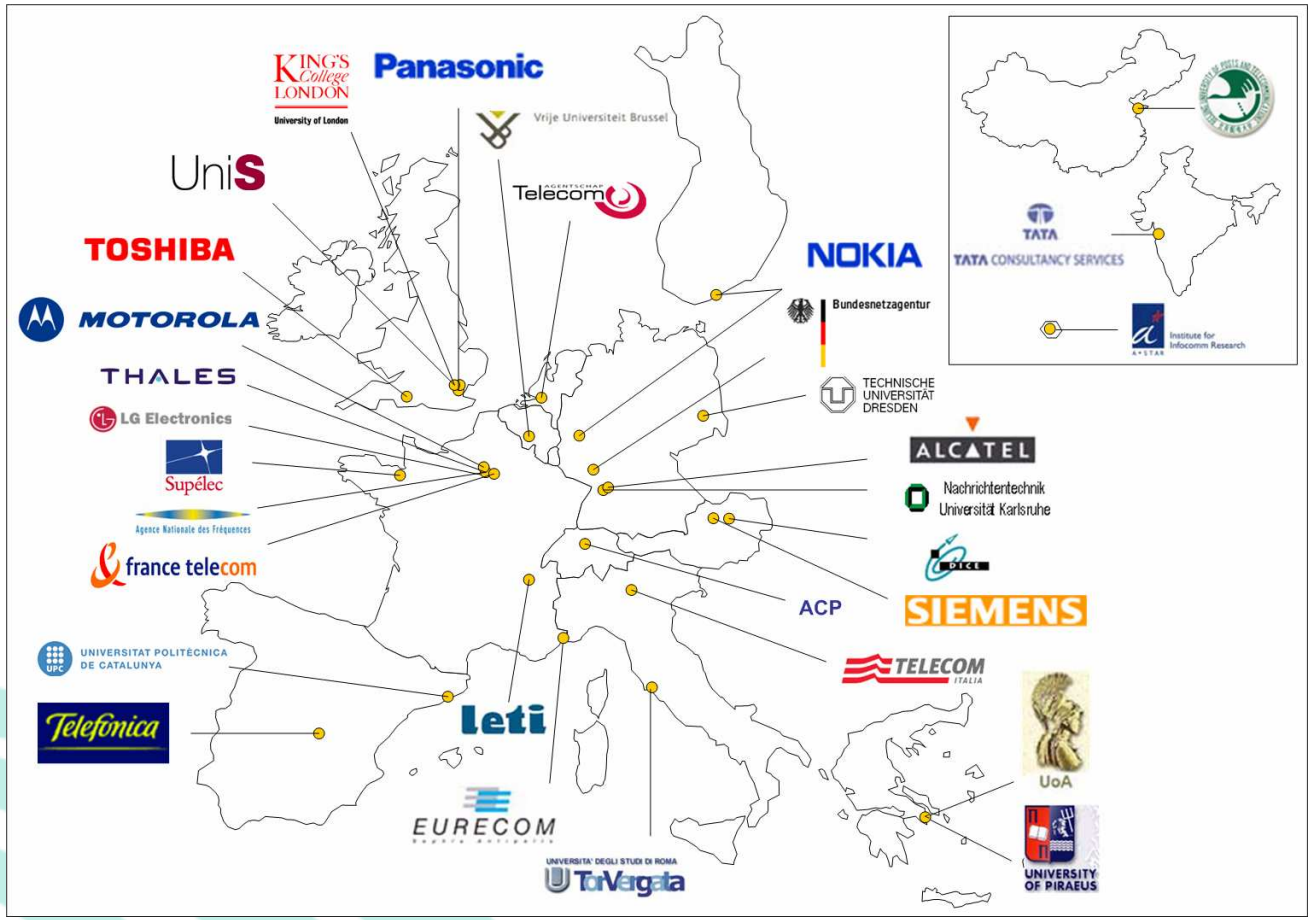
E²R II Project Objectives

- ✓ The key objective of the E²R II project is to devise, develop, trial and showcase architectural design of reconfigurable devices and supporting system functions to offer an extensive set of operational choices to the users, application and service providers, operators, manufacturers and regulators in the context of heterogeneous systems
- ✓ Innovative research, development and proof of concept are to be pursued from an end-to-end perspective, stretching from user device through all system levels. Furthermore reconfigurability support for intrinsic functionalities, such as management and control, download support, spectrum management, regulatory framework and business models complete the project scope

E²R II in a Nutshell (2/7)

E²R II Highlights

- ✓ **Phase 2 Duration**
  - Jan. 06 – Dec. 07
- ✓ **Consortium**
  - 32 Organizations
  - 14 Countries
- ✓ **Budget**
  - 19.0 MEuros
- ✓ **EU Budget**
  - 11.6 MEuros
- ✓ **Resources**
  - Around 67 PY/Y



- ✓ **Contractual Outcomes: 38 Deliverables and 45 Milestones**

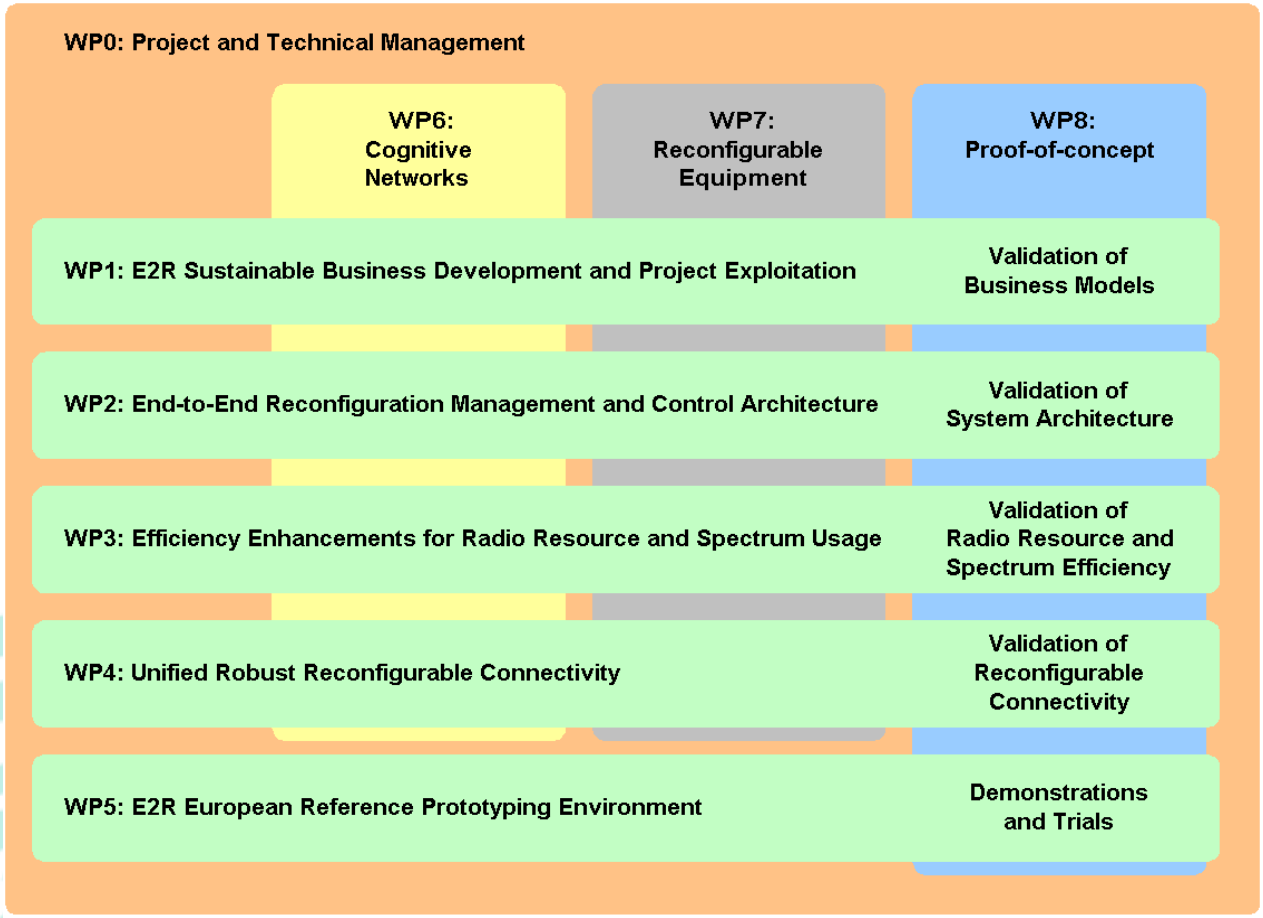
E²R II in a Nutshell (3/7)

E²R II Consortium

- ✓ Manufacturers (12): Motorola (FR), Siemens (AU), Alcatel (GE), Nokia (FI/GE), Panasonic (UK), Thales Communications (FR), Toshiba (UK), DICE (AUS), ACP (CH), LG (FR), Tata Consultancy Services (IND)
- ✓ Operators (3): FT R&D (FR), TILab (IT), Telefonica I+D (SP)
- ✓ Academics (14): UoAthens (GR), King's College London (UK), UoSurrey (UK), UoDresden (GE), Eurecom (FR), UoKarlsruhe (GE), UoPiraeus (GR), UPC (SP), I²R (SING), Supelec (FR), CEA (FR), BUPT (CHN), UoBrussels (BE), UROMA2 (IT)
- ✓ Regulators (3): BNetzA (GE), ANFR (FR), RA (NTH).

E²R II in a Nutshell (4/7)

E²R II Project Research

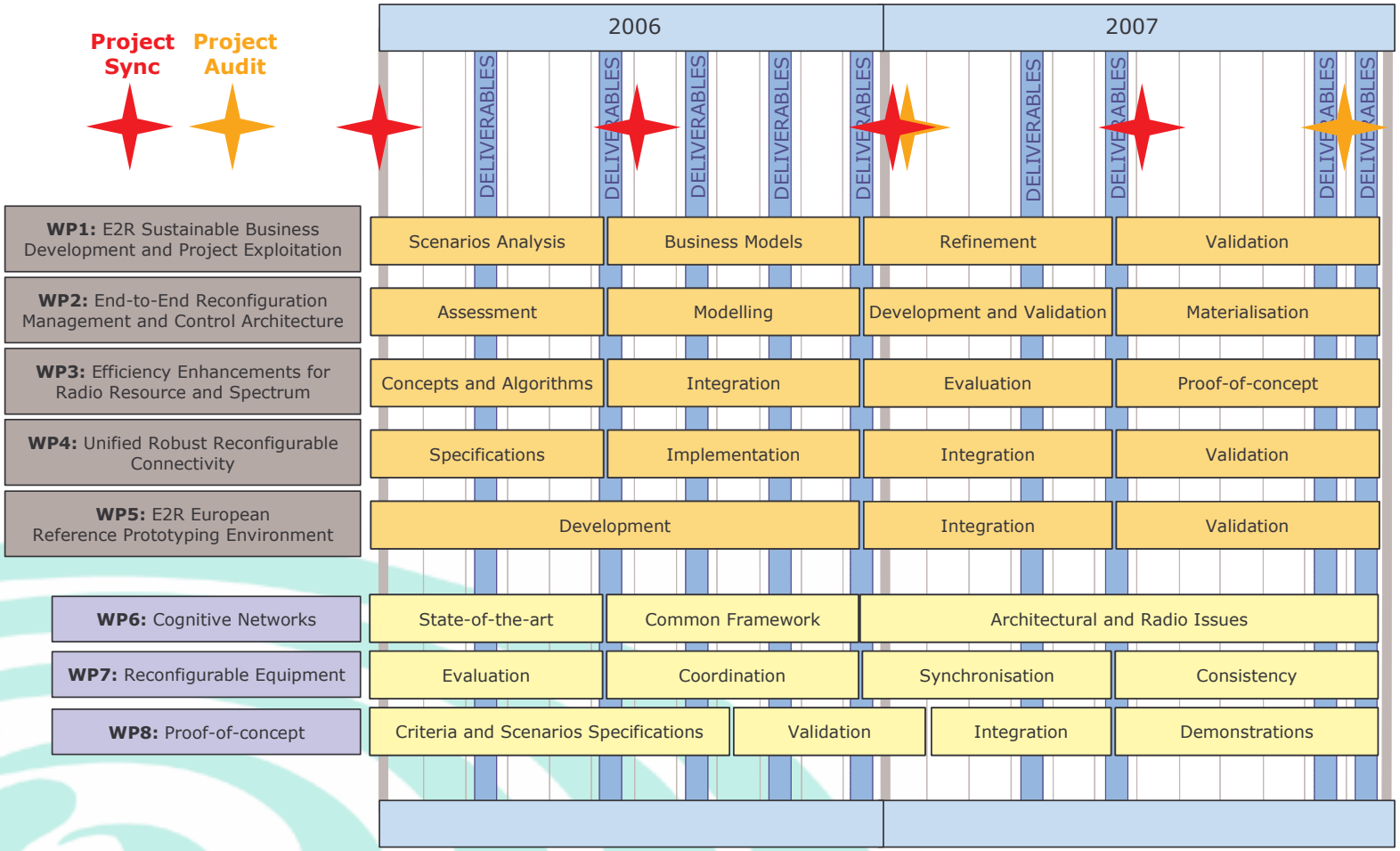


Enabling seamless access to communications and services in B3G context: Developing methods and tools for managing complex architectures
(Network management, equipment management, resource and spectrum management, security management, autonomics…)

Matricial Structure: Research Challenges (WP1 → WP5) & Research Domain Skills (WP6 → WP8)

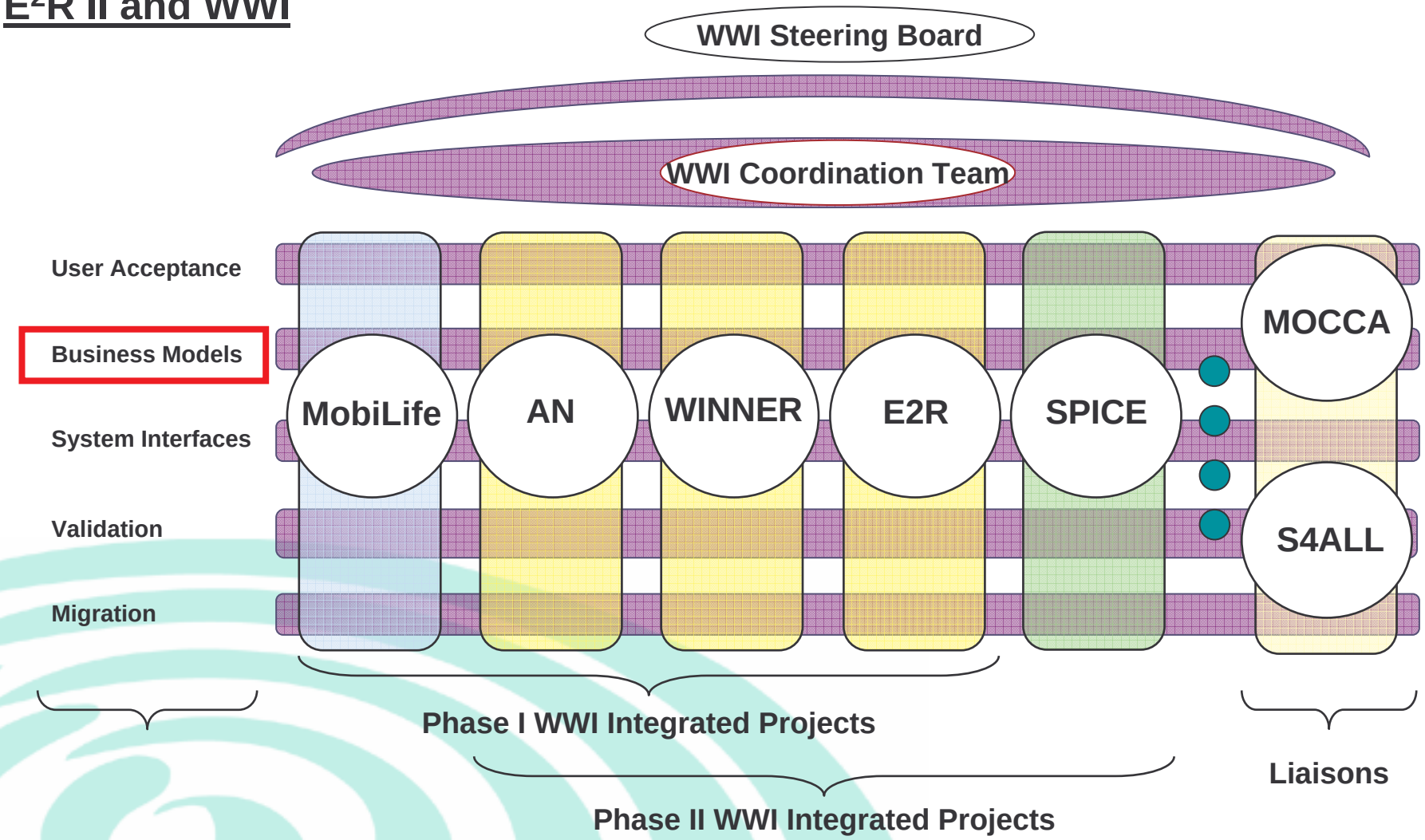
E²R II in a Nutshell (5/7)

E²R II Overall Macro-Planning



E²R II in a Nutshell (6/7)

E²R II and WWI



E²R II in a Nutshell (7/7)

E²R II Website

you are not logged in log in

END-TO-END RECONFIGURABILITY

SEE THE PHASE 1 CONTENT

welcome | announcements | contact us

- Project Overview
- Deliverables
- Partners
- Press Releases
- Related Links
- Impacts
- Key Challenges
- Schedule
- Approach
- Workpackages
- Partner News
- Workshops
- Dissemination
- Training/Tutorials
- Achievements
- Glossary
- IST Summits
- White Papers

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End-to-End Reconfigurability (E²R)

Welcome to the End-to-End Reconfigurability - Phase 2 (E2R II) website! E2R is an Integrated Project (IP) of the 6th Framework Programme of the European Commission, addressing the core of the strategic objective "Mobile and wireless systems and platforms beyond 3G". E2R II is the second phase of the project, starting on 01.01.06.

E²R II Website: First information on the E²R II project starting on 01.01.06. All E²R I information and documents are accessible through this website.

Visit the different sections of E2R website to learn more about this research project:
Project Overview, Workshops Technical Approach, Challenges and Impacts, Structure and Schedule, Partners.... The Dissemination section lists the Conferences contributions and Journals papers, presentations made at Concertation and Cluster meetings, contribution and edition of White Papers contributions, Standardisation contributions, Regulation contributions, Interviews and Flyers. The executive summary of all the E2R Deliverables can be downloaded. Moreover, public deliverables are accessible online, as well as E2R White Papers. Information on the Training activities, the Project Glossary and Workshops are available.

[Click here to enlarge]

Do not hesitate to contact and meet E2R partners for more information on this project!

News

E2R II co-organizing WWI Phase 2 Kick-off in Munich on 24-26.01.06
2006-01-18

More...

E²R Research on Network Support for Reconfiguration

- ⇒ Support of reconfigurability of terminals and network entities by network functions for secure download, reconfiguration management and validation
- ⇒ Definition of a suitable Reconfiguration Management Plane stretching across users, services, networks, and terminals
- ⇒ The end-to-end architecture facilitates intra- and inter-operator negotiations, flexible spectrum management, involving exchange of information for terminal reconfiguration and joint radio resource management, and provides mechanisms for the dynamic planning and management of heterogeneous, coupled, and multi-standard radio access networks
- ⇒ Concepts for end-to-end reconfigurations and its impact on end-user service provision management have been developed and applied for the design of heterogeneous coupled multi-standard networks based on reconfigurable network elements

Reconfiguration Management Plane

- **The necessity of a reconfiguration support plane**
- **Reconfiguration:** *the action of modifying the operation or behaviour of a system, a network node, or functional entity.*
- **Scope:** *spans across end-user devices, network equipment, software, and services. Target reconfigurable elements include, in the mid-term, the User Equipment (UE) and Base Stations or Access Points.*
- **End-to-end notion:** *dictates that, in certain cases, user and control plane interactions may occur from source to destination in order to modify the system, the equipment, the application/service, or the content. Such interactions should be coordinated by a* ***cohesive support plane****, aiming at diverse service offering.*

- **Reconfiguration Management Plane (RMP):** *coordinated management and control functions that govern the interactions between the involved entities, and orchestrate the decision-making and enforcement of mechanisms supporting reconfiguration in a dynamic fashion.*

Reconfiguration Management Plane

1. RMP: Plane- and layer-based approach

Traditional Plane Management (vertical plane)

ITU FCAPS (Faults; Configuration; Accounting; Performance; Security)

3GPP additional “management areas”: roaming mgmt; fraud mgmt; software mgmt; UEM; QoSM; SuM; Subscriber & Equipment Trace Management

Usually network-initiated scenarios, but not always (e.g., fault management is element-initiated)

Traditional Layer Management

Operations, Administration & Maintenance (OA&M) functions per layer

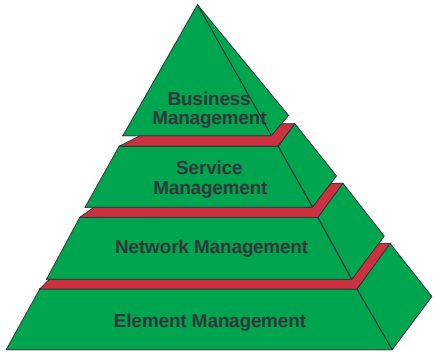
Interfaces to all protocol layers both in the Control and in the Management Plane

2. RMP: A Logical model

A Logical Model defines an ***abstract view of a network or network element*** by means of information objects representing network element, aggregations of network elements, the topological relationship between the elements, endpoints of connections (termination points), and transport entities (such as connections) that transport information between two or more termination points

The information objects defined in the Logical Model are used, among others, by connection management functions. In this way, a ***physical-implementation-independent management*** is achieved.

Traditional TMN Plane Management Model

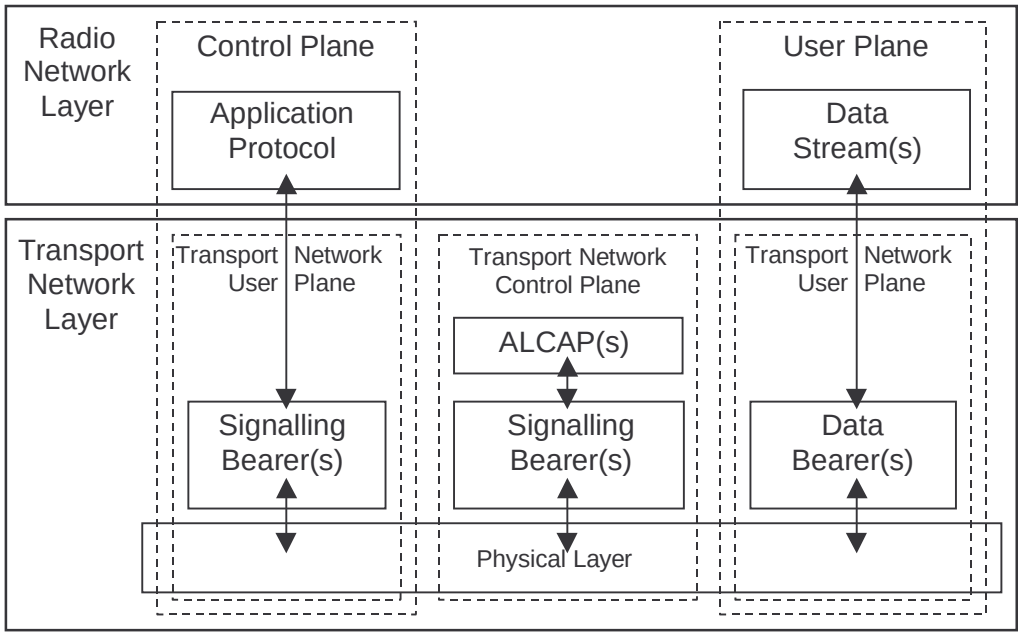


- **BML: manages the overall business, e.g. achieving ROI, market share, employment satisfaction, community and government goals.**
- **SML: Managing the service offered to customers, e.g. meeting customer service levels, service quality, cost and time-to-market objectives**
- **NML: Managing the network and systems that deliver those services, e.g. capacity, diversity, congestion**
- **EML: Managing the elements comprising the network and systems (e.g. Switches, transmission, distribution systems, etc.)**

Fault Mgmt.	*Configuration Mgmt.*	*Accounting Mgmt.*	*Performance Mgmt.*	*Security Mgmt.*
Alarm handling	System turn-up	Track service usage	Data collection	Control NE access
Trouble detection	Network provisioning	Bill for services	Report generation	Anable NE functions
Trouble correction	Autodiscovery		Data analysis	Access logs
Test and acceptance	Back up and storage			
Network recovery	Database handling			

Pure O&M operations. Not direct impact on the system ‘telecom’ functions

Traditional Layer Management (3GPP)



- **C-Plane**
  - **RANAP: RAB management, PCCH formatting, security management**
  - **NBAP: RB management, Node B configuration, BCCH 'composition'**
- **U-Plane (FP): transcoder configuration, radio frames timing management**

- **C-Plane, U-Plane: reusing ATM-based protocols (AAL2, AAL5). Note: Transport Network Control Plane:** mediates between C- and U-plane (The introduction of Transport Network Control Plane is performed in a way that the Application Protocol in the Radio Network Control Plane is kept completely independent of the technology selected for Data Bearer in the User Plane. Indeed, the decision to actually use an ALCAP protocol is completely kept within the Transport Network Layer.)

O&M operations with direct impact on the system 'telecom' functions

The RMP Added Value

RMP as a new plane

- Introducing additional functionality via new planes allows for independent evolution paths and refinements to legacy control and management planes

  (The alternative of integrating new functions to existing planes dictates NNI upgrades)

- Enables the addition of other planes to cover future demands

- No direct extensions of legacy planes; only “outband” hooks for the new plane

- Separate reconfiguration support plane => “passive/offline” enhancements to legacy control functions & management systems; gradual introduction of reconfiguration as plug-and-play feature with minimised impact on protocol modelling and testing: state machines, timers, etc. => ease of specification and testing procedures

- Whether RMP interfaces are implemented or not shall have limited impact on other entities of a PLMN, in the same way the optional Gs interface can be transparently deployed

- RMP operations should be seamlessly supported in Iu mode, in the same fashion CAMEL procedures are optionally triggered during, for example, location management procedures.

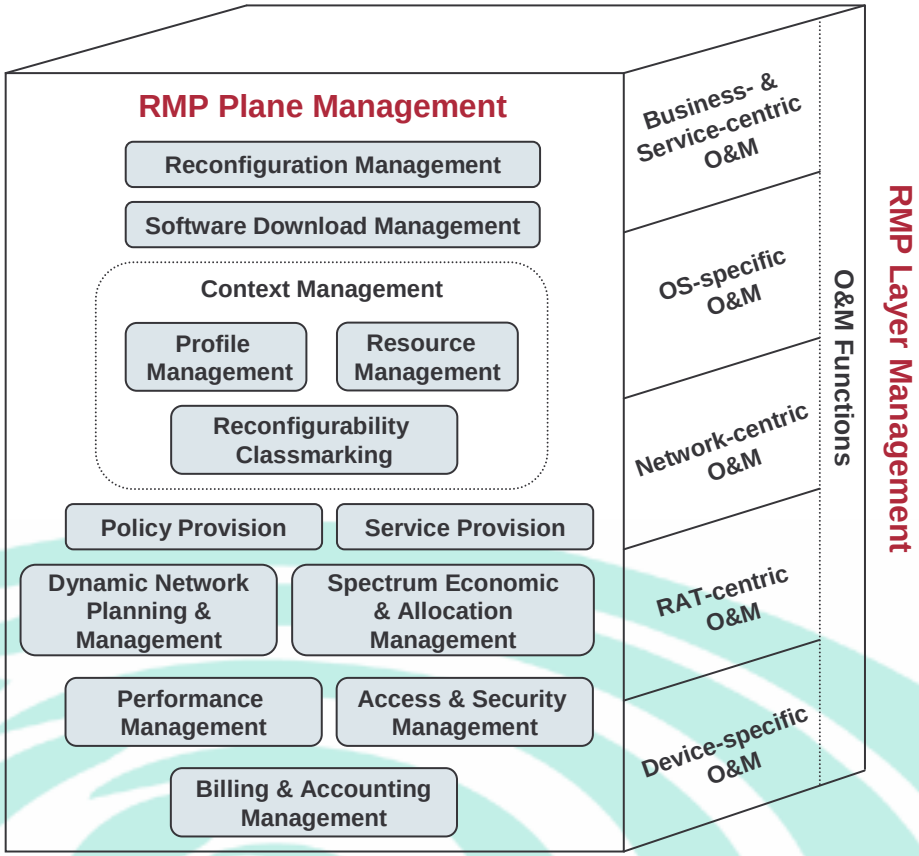
- Aims to functionally support the reconfiguration process in a way transparent to future network infrastructures; enables the addition of other subsystems to cover future demands

- Allows next-generation architectures to be adjusted with no or limited impact to other subsystems

- Can be seen as ***an intermediary between legacy control and management planes***

RMP Logical Model

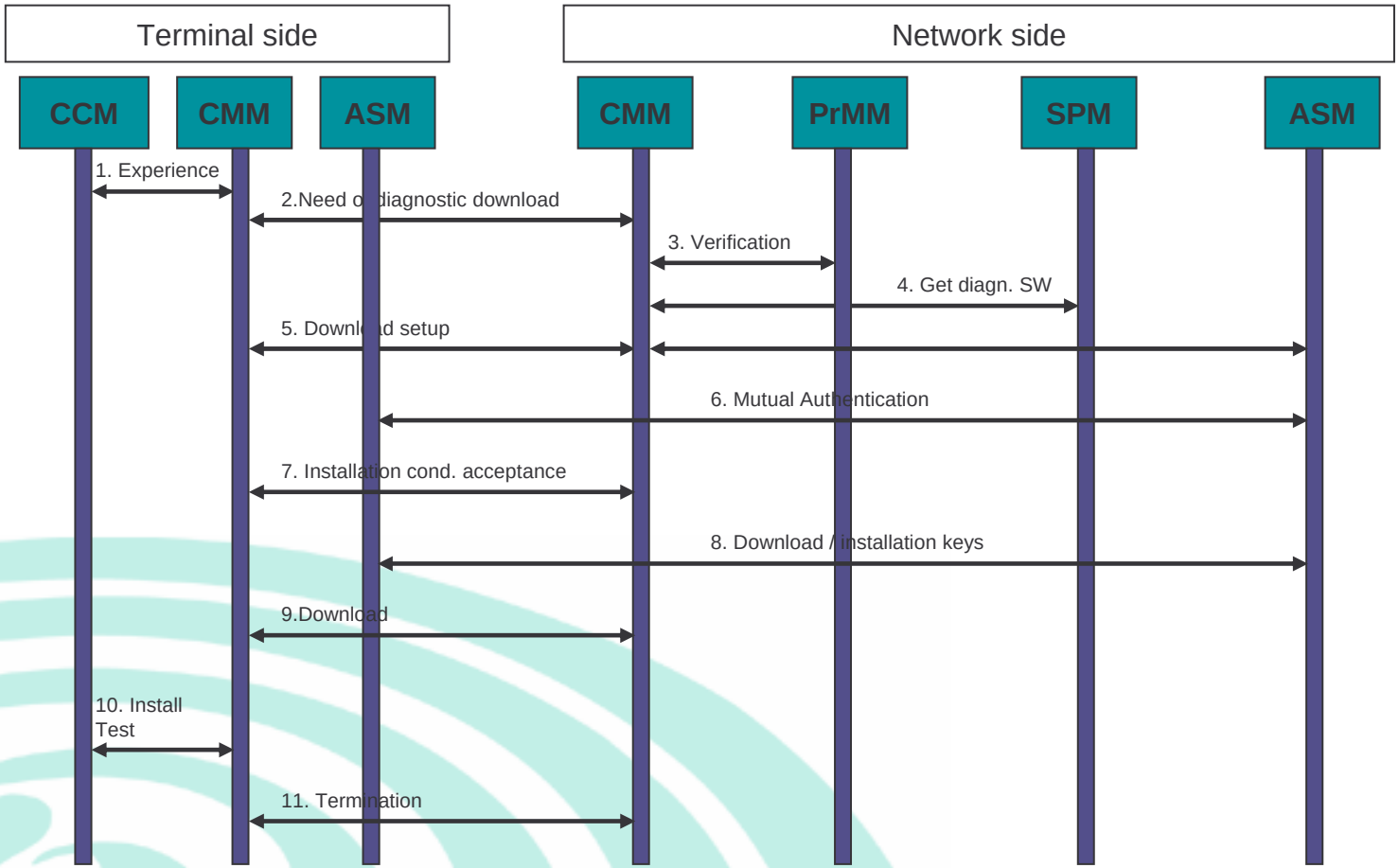
Q: What functionality is tailored to reconfiguration?



- **RMP *plane management:***
  - ⇒ Reconfiguration Management
  - ⇒ Software Download Management
  - ⇒ Context Management
  - ⇒ Dynamic Network Planning & Management
  - ⇒ Spectrum Economic & Allocation Management
  - ⇒ Policy Provision
  - ⇒ Service Provision
  - ⇒ Performance Management
  - ⇒ Access and Security Management
  - ⇒ Billing and Accounting Management
- **RMP *layer management*** (OA&M functions):
  - ⇒ Business- and Service-centric O&M
  - ⇒ Operating System specific O&M
  - ⇒ Network-centric O&M
  - ⇒ RAT-centric O&M
  - ⇒ Device-specific O&M

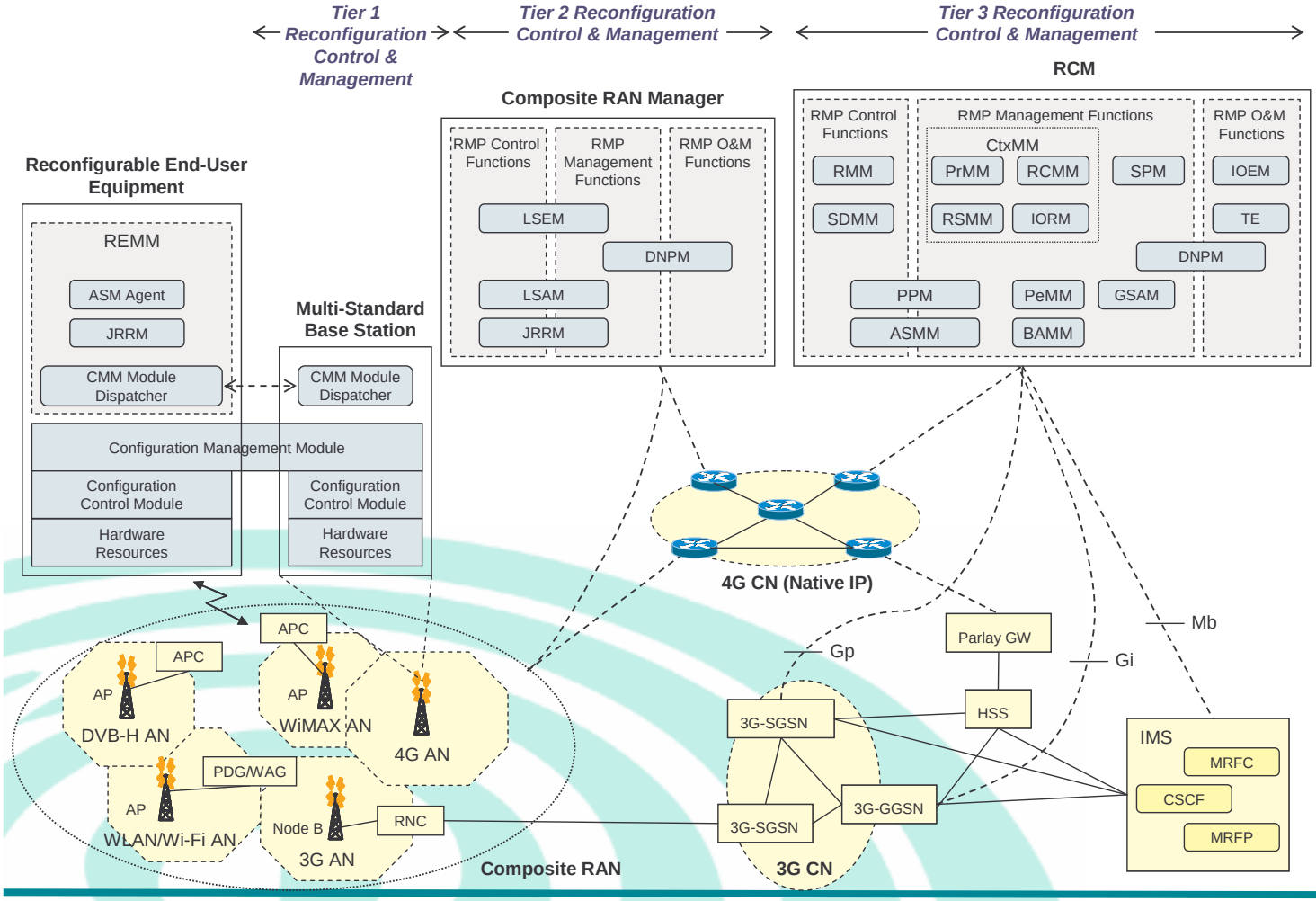
An exemplary use case

Downloading diagnosis software due to detected performance decrease

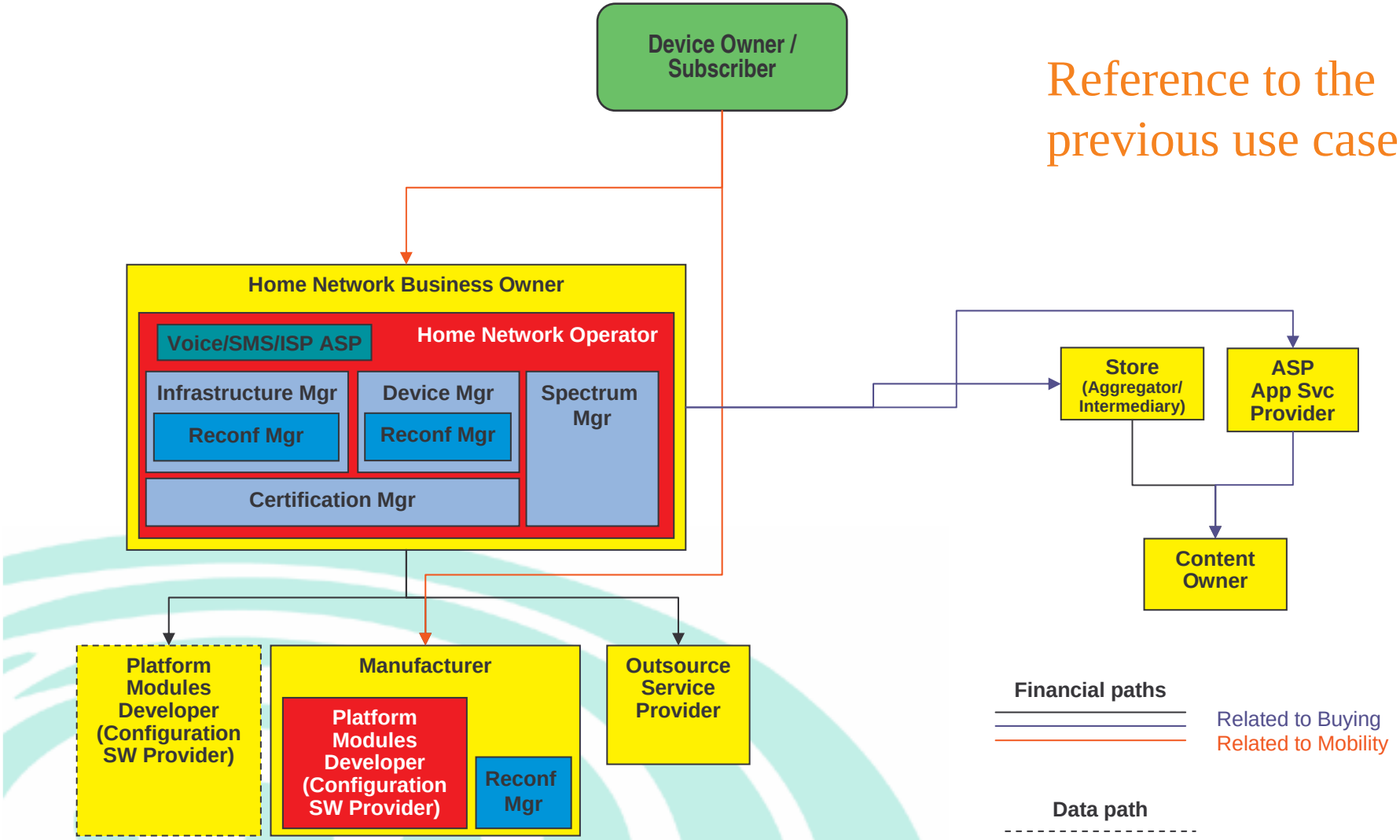


RMP & Network Architecture

Functional architecture for Composite Reconfigurable Mobile Networks



RMP exemplary ecosystem



E²R-II Next Steps

- End-to-End Reconfiguration Differentiation
  - ⇒ Policy-based QoS (classification; filtering; QoS policies in heterogeneous networks);
  - ⇒ Intra- and inter-domain QoS (interworking, mapping, protocols)
  - ⇒ SIP/SDP and COPS protocol extensions on top of legacy UMTS PDP procedures
  - ⇒ IETF NSLP QoS feature of in-call bandwidth modification can be exploited for reservations that are not necessarily end-to-end
  - ⇒ QoS negotiation in the CN that takes into account dynamic RAT selection and dynamic spectrum access
- Interworking architectural scenarios and support of mobility
  - ⇒ IMS Reconfiguration Control & Management functions
  - ⇒ Interworking: Wi-Fi / WiMAX with 3GPP PS / IMS
  - ⇒ Seamless MM in dynamic architectural configurations (intra- and inter-domain connection of RAN nodes to multiple CN nodes; network sharing; traffic diversity)
  - ⇒ Functional separation between Composite RAN Manager and MSBS
  - ⇒ Extension of TISPAN NGN independent subsystems (Core IMS: session control extensions; RACS: JRRM extensions; NASS: dynamic RAT & network selection extensions) vs. new subsystems (software upgrade subsystem; DSA & CPC subsystem; DNPM subsystem)
- Impact of DSA on end-to-end QoS signalling
  - ⇒ Coordination between spectrum brokers and bandwidth brokers in the CN => reducing session initiation/modification latencies when more spectrum available