IEEE P1900.4
Overview
Date: **2007-01-17**

Authors:

Name	Company	Address	Phone	email
Soodesh Buljore	Motorola Labs	Parc Les Algorithmes, 91193 Gif-sur-Yvette, FR	+33 169352566	Soodesh.Buljore@motorola.com
Markus Muck	Motorola Labs	Parc Les Algorithmes, 91193 Gif-sur-Yvette, FR	+33 169352573	Markus.Muck@motorola.com
Patricia Martigne	France Telecom R&D	28 chemin du vieux chêne	+33 476764403	patricia.martigne@orange-ft.com

Presenter

Soodesh Buljore PhD
SEAMLESS RADIO ACCESS LAB
PROJECT MANAGER

Motorola, SAS
Parc les Algorithmes – Saint Aubin.
91193 Gif sur Yvette cedex - France

+33 (0)1 69 35 25 66
+33 (0)1 69 35 48 01 fax
soodesh.buljore@motorola.com

*The authors would like to **acknowledge** the contributions of all participants from IEEE P1900, P1900.B Study group including the E2R II colleagues for their valuable contributions.*

Agenda-P1900.4 Overview

- P1900 History
- P1900.4 Scope & Purpose
- System Concept
- Envisaged Scenarios
- Architectural Building blocks
- Functions
- Possible liaisons with 802.21?
- Conclusions & Next Steps
- Back-up – Usage and Enablers Examples

Purpose of IEEE P1900 SC

To develop standards dealing with next generation radio and advanced spectrum management

The IEEE P1900 Standards Group was established in the first quarter 2005 jointly by the IEEE Communications Society (ComSoc) and the IEEE Electromagnetic Compatibility (EMC) Society. The objective of this effort is to develop supporting standards dealing with new technologies and techniques being developed for next generation radio and advanced spectrum management.

From MoA between ComSoc & EMC-S

Current Standards Activities of IEEE P1900 (1/2)

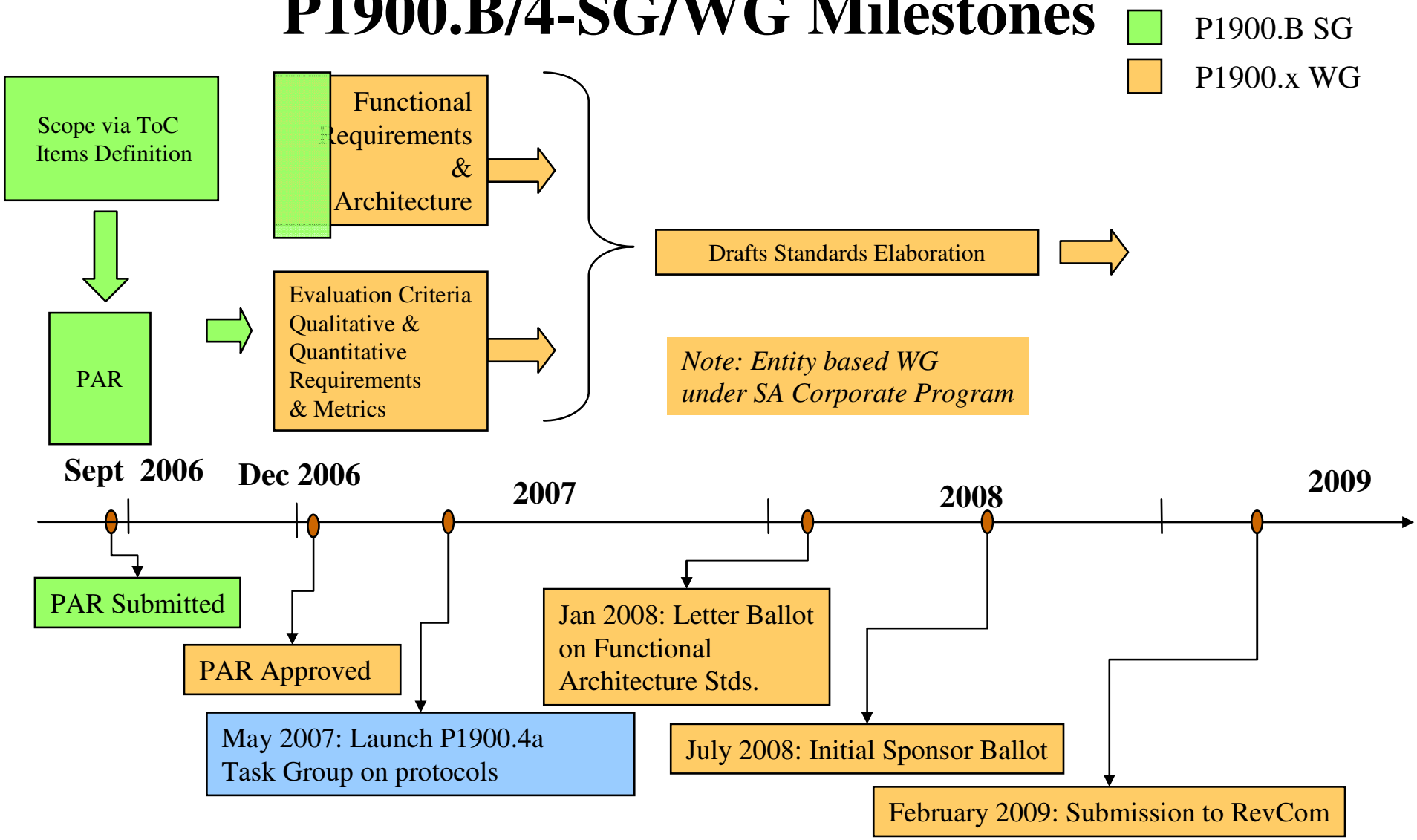
- 1900.1 WG: Standard Definitions and Concepts for Spectrum Management and Advanced Radio Technologies
  - *Project Approval Request approved March 2005*; Chair: Jim Hoffmeyer jhoffmeyer@IEEE.org
- 1900.2 WG: Recommended Practice for the Analysis of In-Band and Adjacent Band Interference and Coexistence between Radio Systems
  - *PAR approved March 2005;* Chair: Steve Berger Stephen.Berger@ieee.org
- 1900.3 WG: Recommended Practice for Conformance Evaluation of Software Defined Radio (SDR) Software Modules
  - *PAR approved May 2005;* Chair: Andre Kruetzfeldt: Andre@aplixcorp.com
- Study Group A: Dependability and Evaluation of Regulatory Compliance for Radio Systems with Dynamic Spectrum Access
  - *Study Group approved March 2006*; Chair: John Chapin (Vanu Corporation): jchapin@vanu.com
  - Depending on level of interest, it may become a new Working Group

For more details please refer to http://www.ieeep1900.org/

Current Standards Activities of IEEE 1900 (2/2)

- 1900.4 WG: Architectural building blocks enabling network-device distributed decision making for optimized radio resource usage in heterogeneous wireless access networks
  - *PAR approved December 2006*; Table of Contents Document created during SG: 2 Physical Meetings (~25 Participants)
  - Acting Chair: Soodesh Buljore: soodesh.buljore@motorola.com
  - Acting Vice Chair: Patricia Martigne patricia.martigne@orange-ftgroup.com

P1900.B/4-SG/WG Milestones



1900.4 WG Scope

- The standard defines the building blocks comprising
  i) network resource managers,
  ii) device resource managers and
  iii) the information to be exchanged between the building blocks,
- for enabling coordinated network-device distributed decision making
  - which will aid in the optimization of radio resource usage, including spectrum access control,
- in heterogeneous wireless access networks.
- The standard is limited to the architectural and functional definitions at a first stage.
- The corresponding protocols definition related to the information exchange will be addressed at a later stage.

1900.4 WG Purpose

- The purpose is to improve overall composite capacity and quality of service of wireless systems in a multiple Radio Access Technologies (RATs) environment,
  - by defining an appropriate system architecture and protocols which will facilitate the optimization of radio resource usage,
  - in particular, by exploiting information exchanged between network and mobile Terminals,
  - whether or not they support multiple simultaneous links and dynamic spectrum access.

Proposed System Concept – Context & Key Challenges

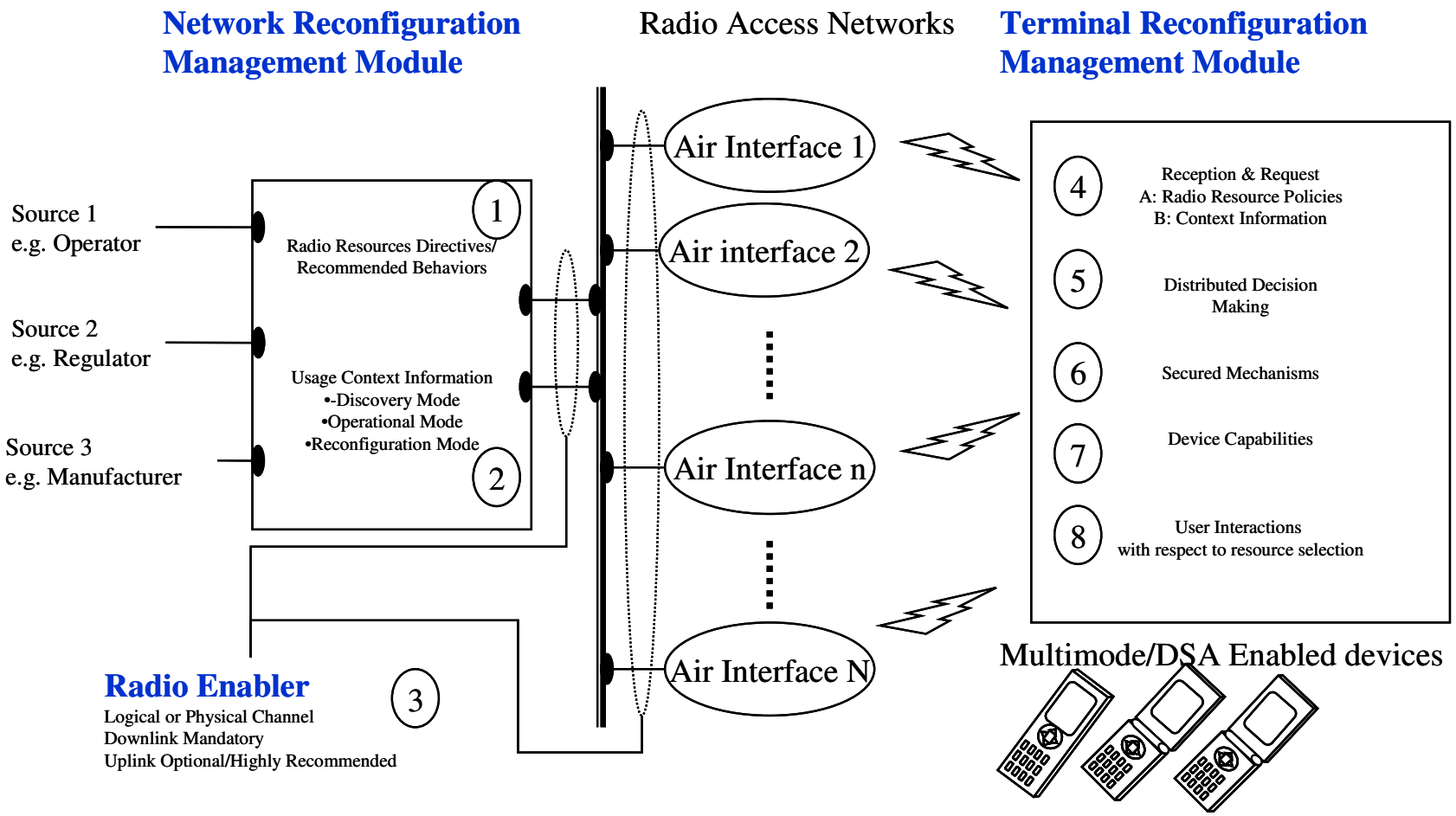
- **Context/target**:
  - Optimization of radio usage resources of next generation wireless systems, while building on existing standards (e.g., WiFi, WiMAX, GSM, etc.)
  - Multimode Devices and Networks with dynamic spectrum access capabilities allowing the use of spectrum resource dynamically or simultaneously among different Radio Access Technologies (RATs)
  - User Terminals have Radio Multi-Homing functionalities enabling simultaneous links to several distinct RATs.
- **Challenges**:
  - Efficient usage of system capacity & efficient choice of access strategies (low parameterization overhead & split of optimization complexity between network & users)
    - ➔ Distributed Decision Making.
  - Backwards-compatibility to existing wireless radio standards.
    - ➔ Addition of new building blocks transparent to legacy devices.
  - Efficient coexistence of Legacy equipment with Next Generation equipment.
    - ➔ Access control distinguishes between Legacy & Next Generation users.

Proposed System Concept – Approach (1/3)

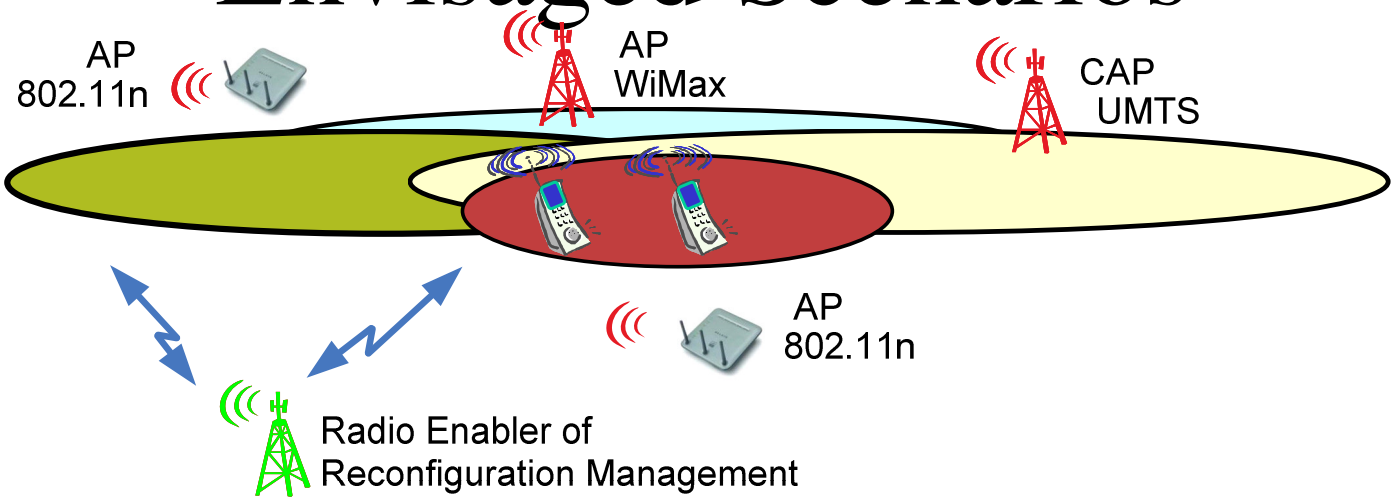
- **Assumption**: Numerous heterogeneous wireless systems are operated by a (Meta-)Operator.
- **Approach**: Introduce three new building blocks:
  - **Network Reconfiguration Management**
    - Define resource selection constraints (***policies***) for user devices.
  - **Radio Enabler of Reconfiguration Management**
    - Communicate ***policies*** & context information to user devices.
  - **Terminal Reconfiguration Management**
    - Distributed resource selection subject to ***policies*** by user devices.

System Model & Building blocks

Approach (2/3)



Envisaged Scenarios



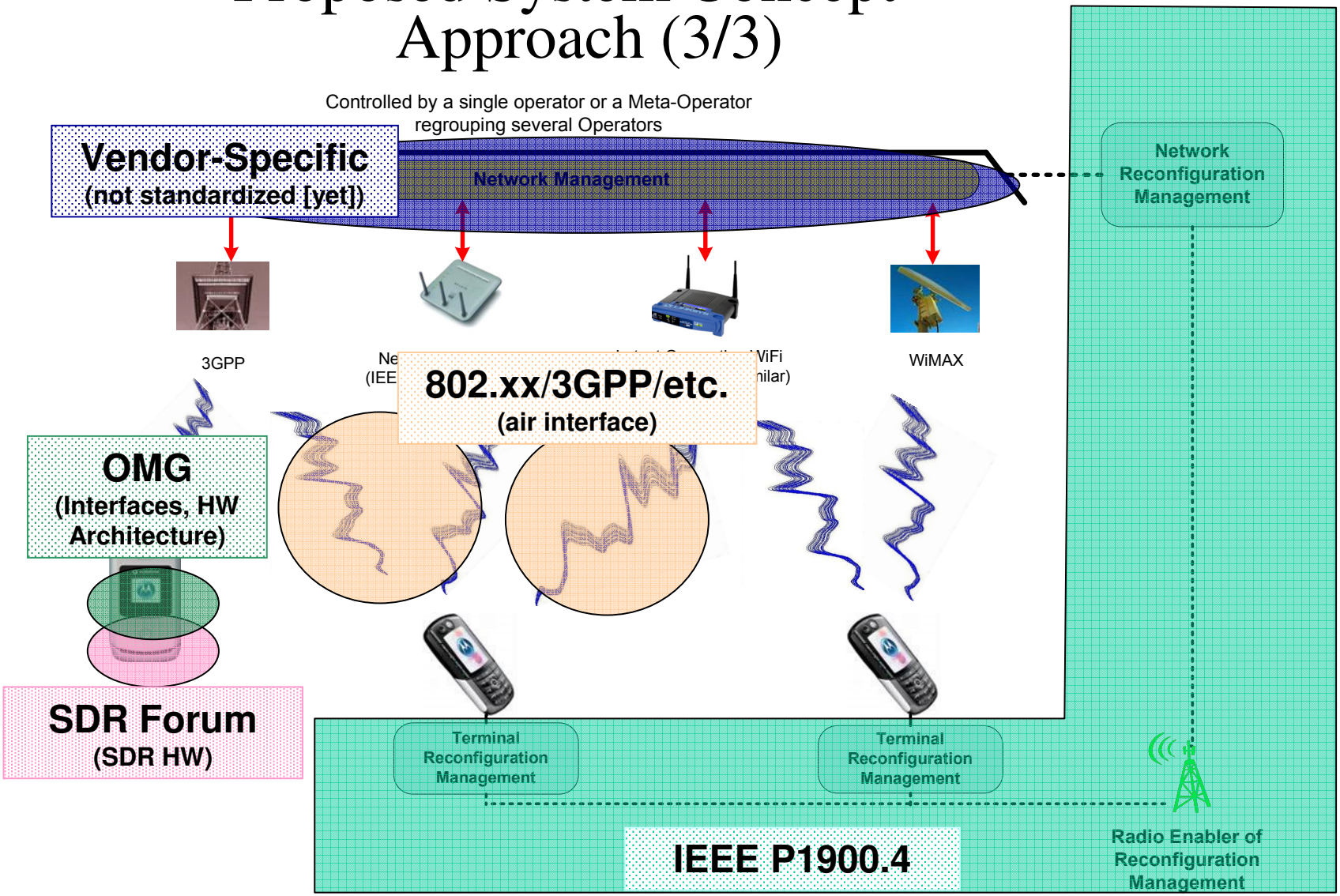
- **Scenario 1**: Network context changes and users adapt to optimally use available resources, e.g operator adds/removes RATs (BS no more operational, etc.).
- **Scenario 2**: User context changes and remaining users adapt to optimally use available resources, e.g. users arrive/leave.
- **Scenario 3**: Changes in the allocation of frequency bands to RATs.
  - Examples:
    - a new carrier is added for 3G.
    - a frequency band previously used for 3G is allocated to WIMAX.
    - network switches from WiMAX to IEEE802.11n if a large number of users are suddenly close to the station

Note: All operations need to be transparent for the user !

Proposed System Concept – Approach (3/3)

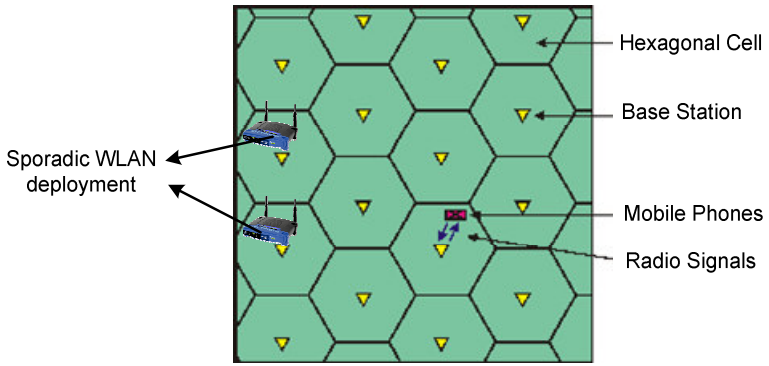
Anarchy !

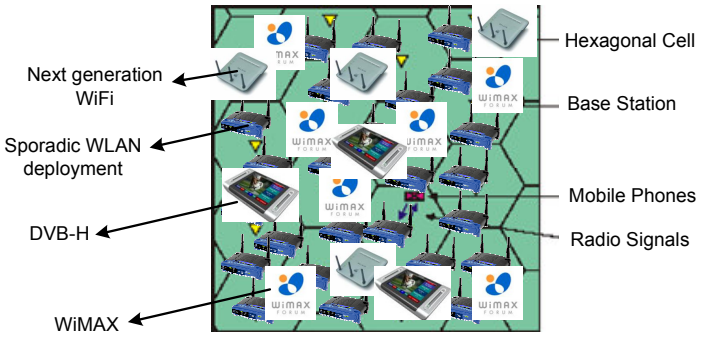
Lack of Standard ?



IEEE P1900.B – Benefits (1/2)

- Which are the benefits for **network operators** ?





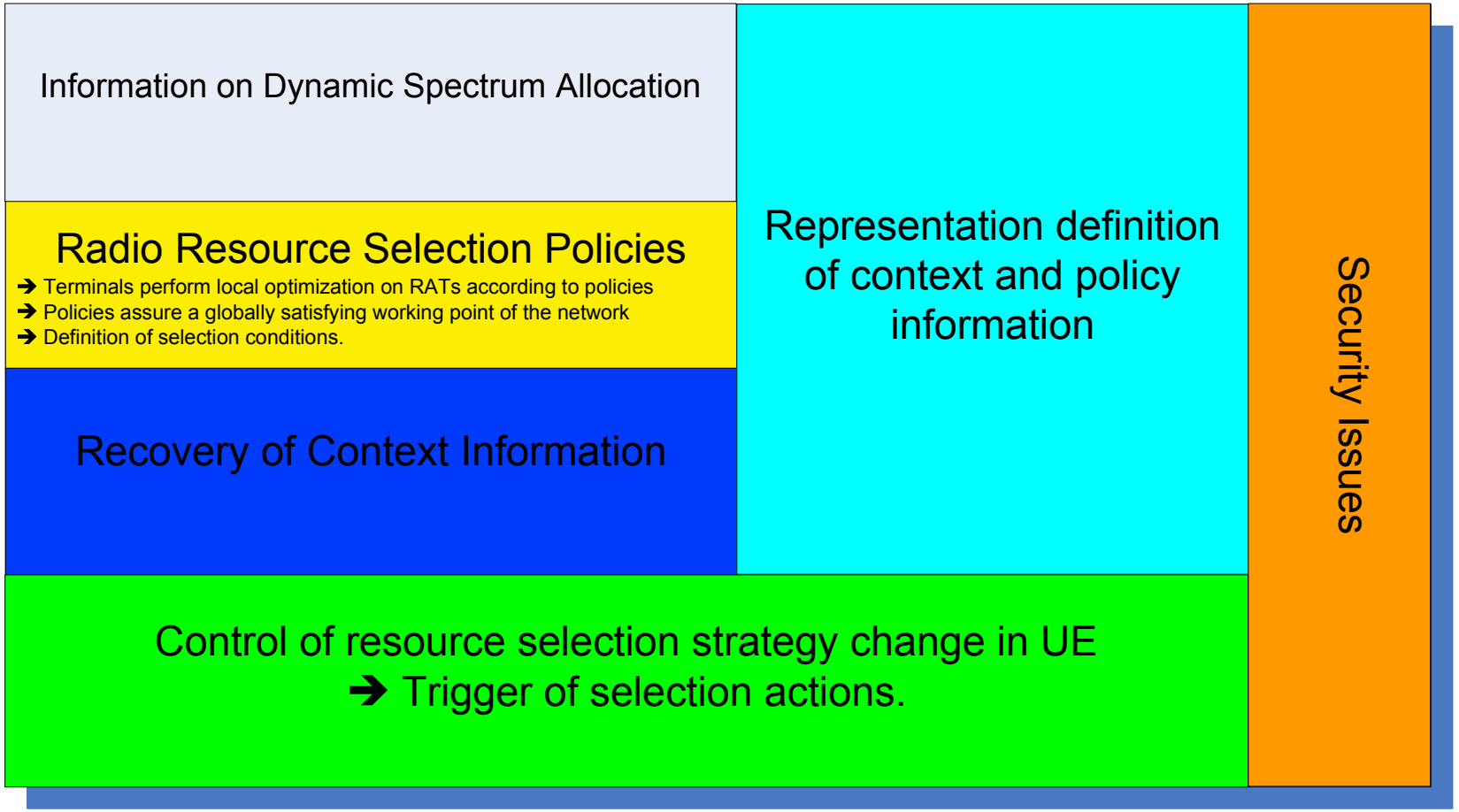
- Control over composite Resource Usage in complex heterogeneous scenario
- Limitation of calculation complexity requirements and signaling overhead for organizing resource usage
- Provision of new services

IEEE P1900.B – Benefits (2/2)

- Which are the benefits for **manufacturers** ?
  - Lead in Next Generation mobile phones/equipment: Enable users to obtain required QoS / throughput / latency at minimum cost and assurance of access any-time, any-where.
  - Provision of new network equipment products, such as
    - **Network Reconfiguration Management** equipment/SW
    - **Radio Enabler of Reconfiguration Management** equipment/SW
- Which are the benefits for **users** ?
  - Optimum exploitation of radio eco-space: obtain required QoS / throughput / latency at minimum cost and assurance of access any-time, any-where.
  - Availability of new services, transparent Seamless Mobility

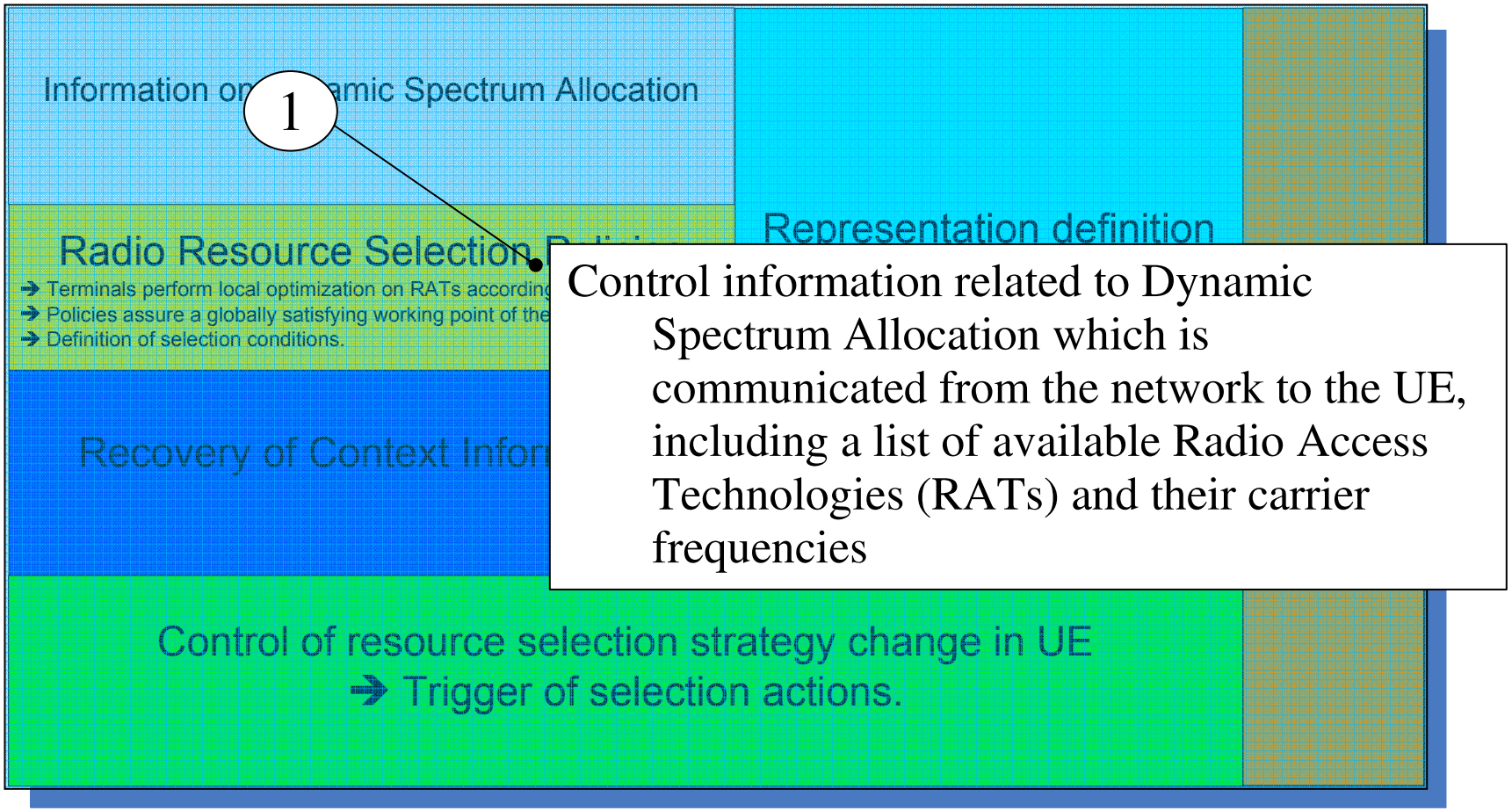
Network Reconfiguration Management

Baseline functions (0/6)



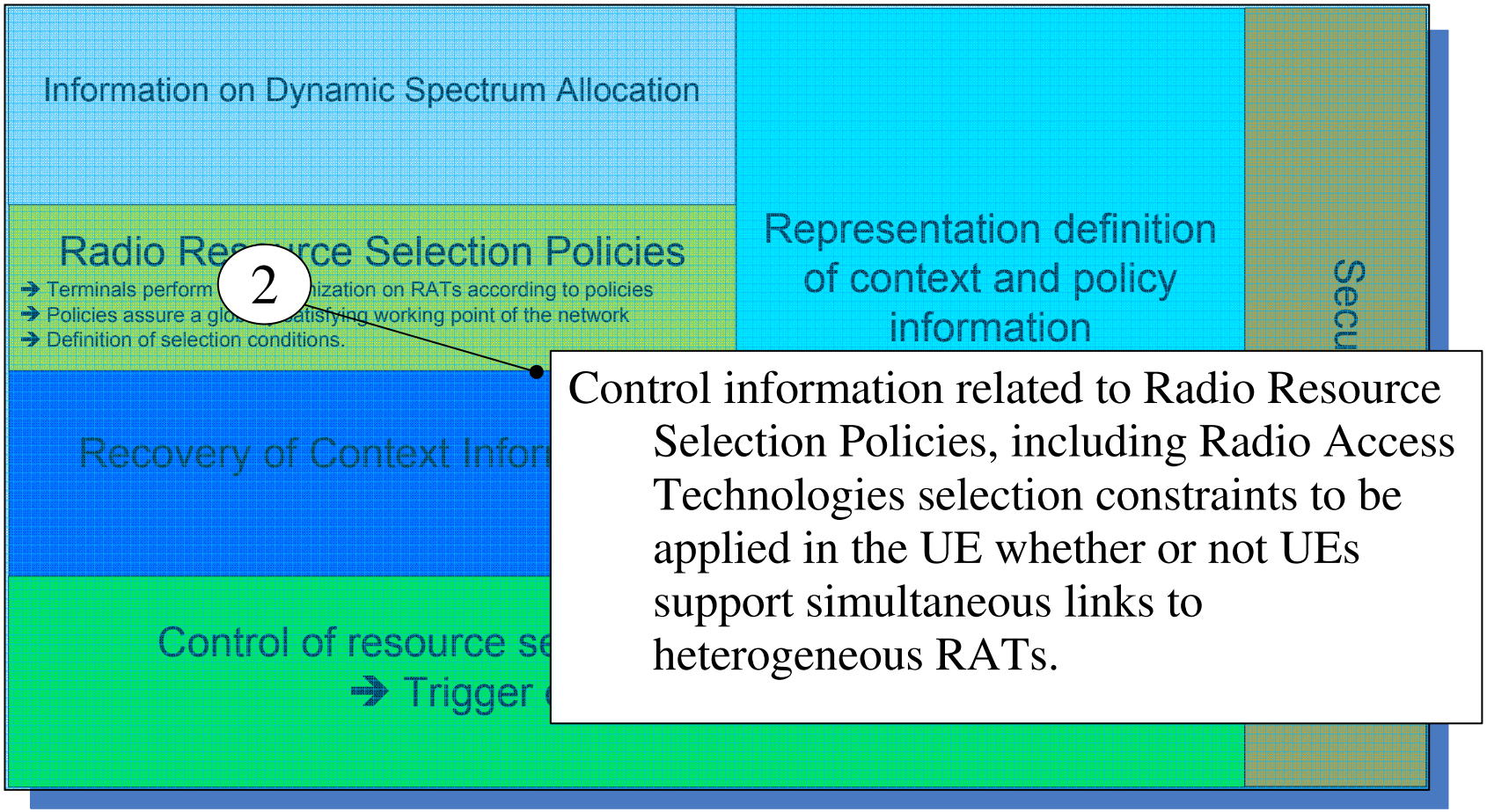
Network Reconfiguration Management

Baseline functions (1/6)



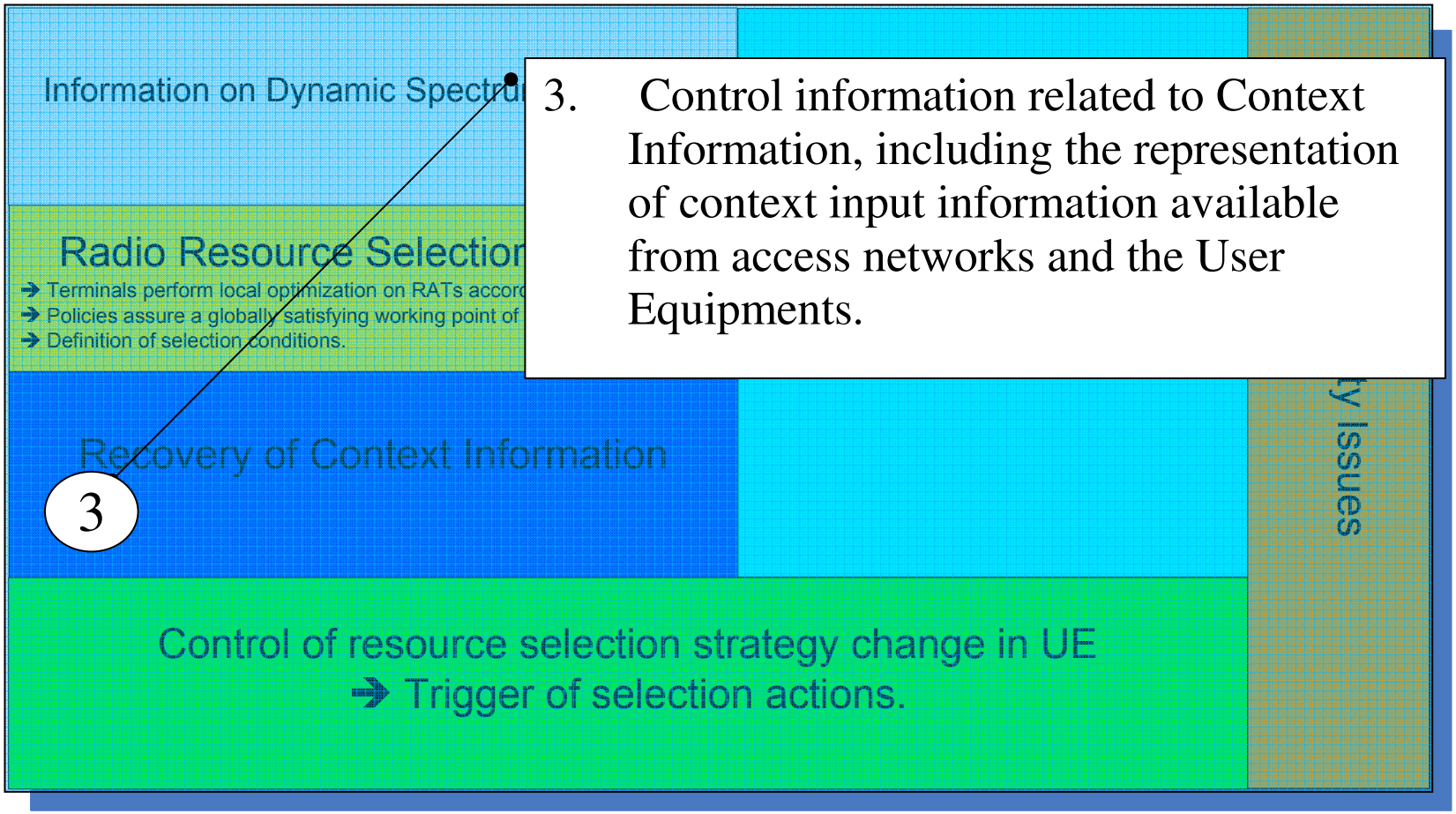
Network Reconfiguration Management

Baseline functions (2/6)



Network Reconfiguration Management

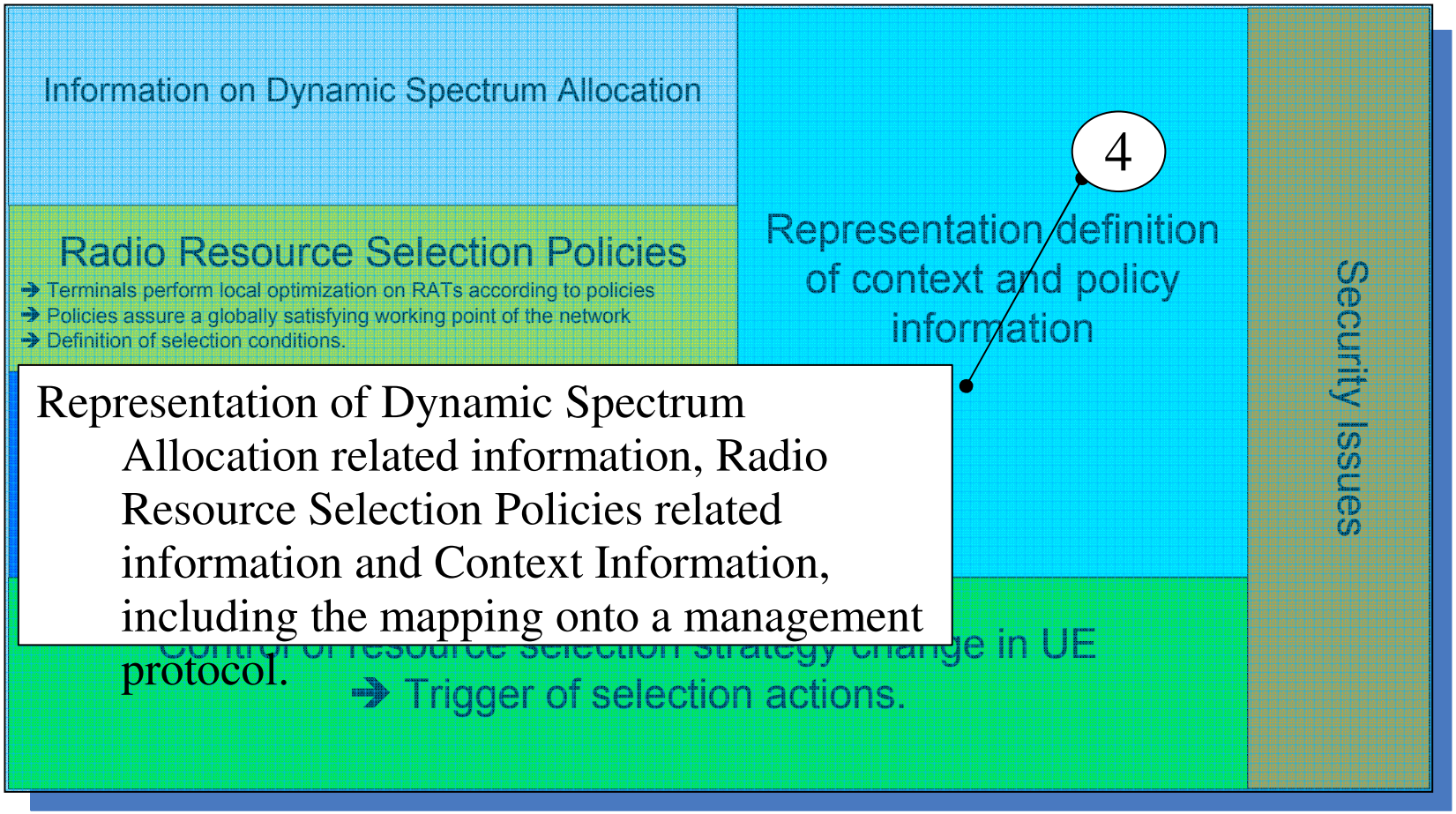
Baseline functions (3/6)



3. Control information related to Context Information, including the representation of context input information available from access networks and the User Equipments.

Network Reconfiguration Management

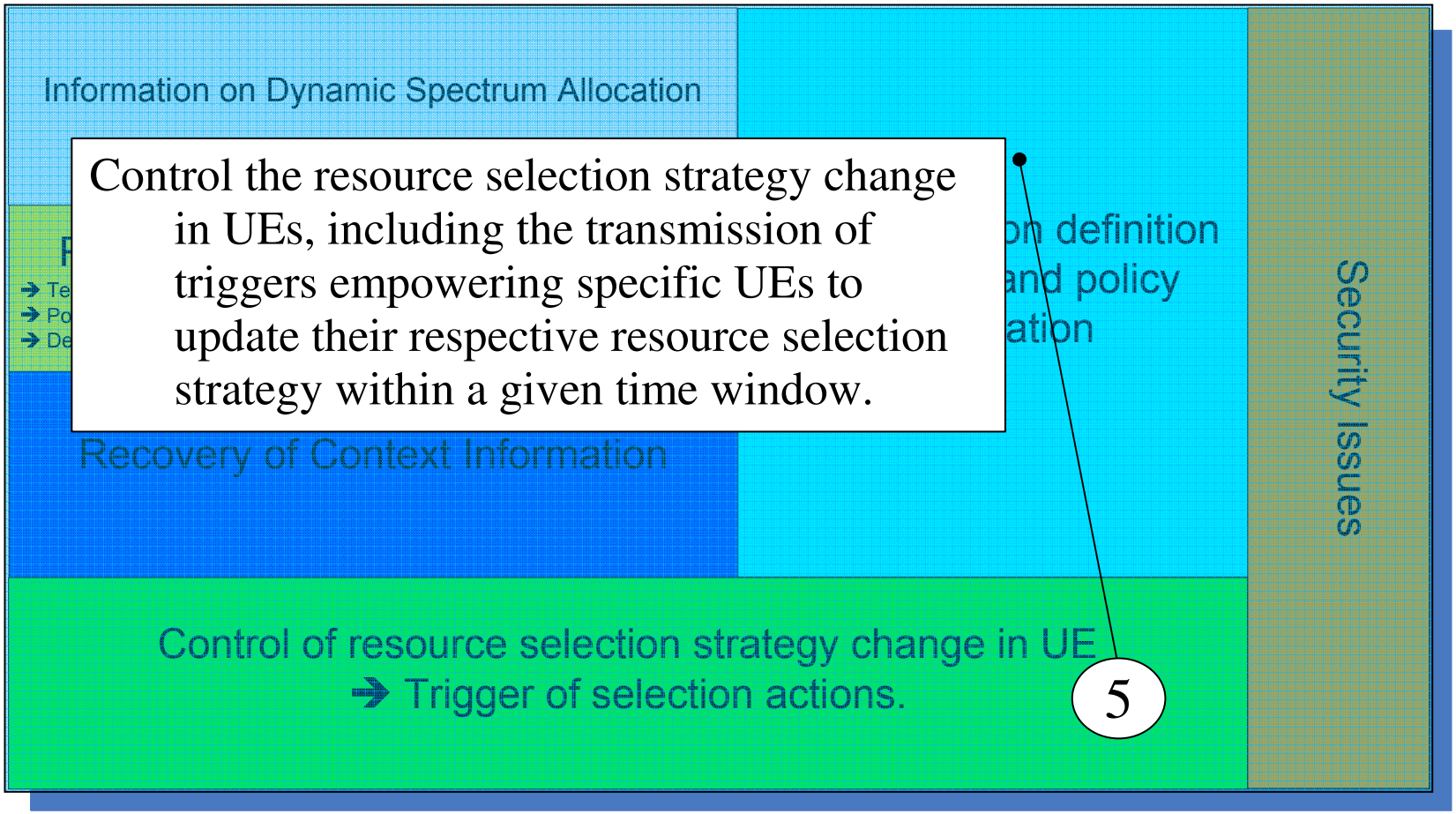
Baseline functions (4/6)



Representation of Dynamic Spectrum Allocation related information, Radio Resource Selection Policies related information and Context Information, including the mapping onto a management protocol.

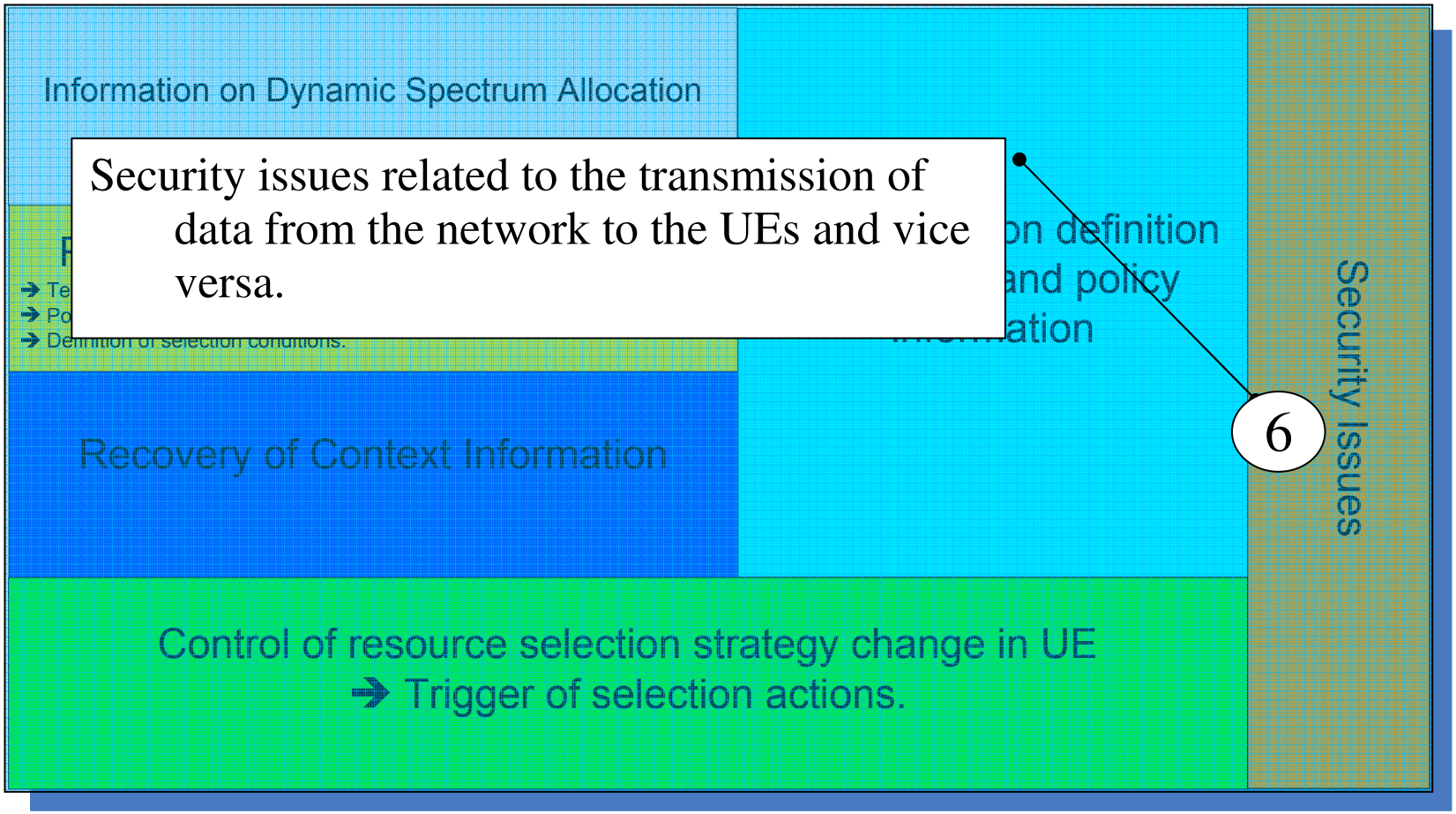
Network Reconfiguration Management

Baseline functions (5/6)



Network Reconfiguration Management

Baseline functions (6/6)



Radio Enabler

Baseline functions (0/2)

Mapping of information (protocols) onto data transport channels .

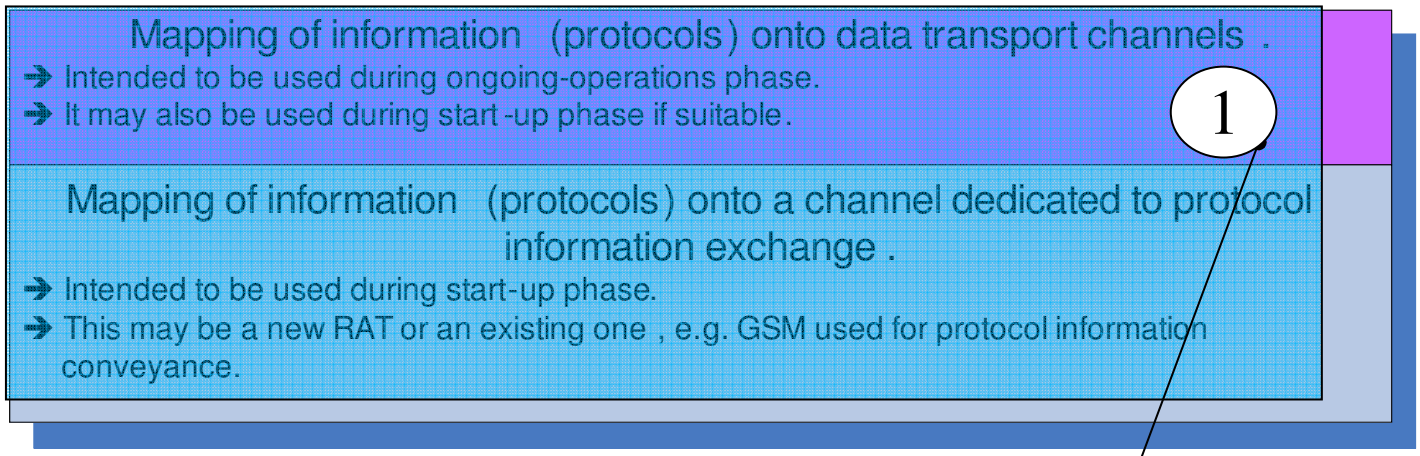
- ➔ Intended to be used during ongoing-operations phase.
- ➔ It may also be used during start-up phase if suitable.

Mapping of information (protocols) onto a channel dedicated to protocol information exchange .

- ➔ Intended to be used during start-up phase.
- ➔ This may be a new RAT or an existing one , e.g. GSM used for protocol information conveyance.

Radio Enabler

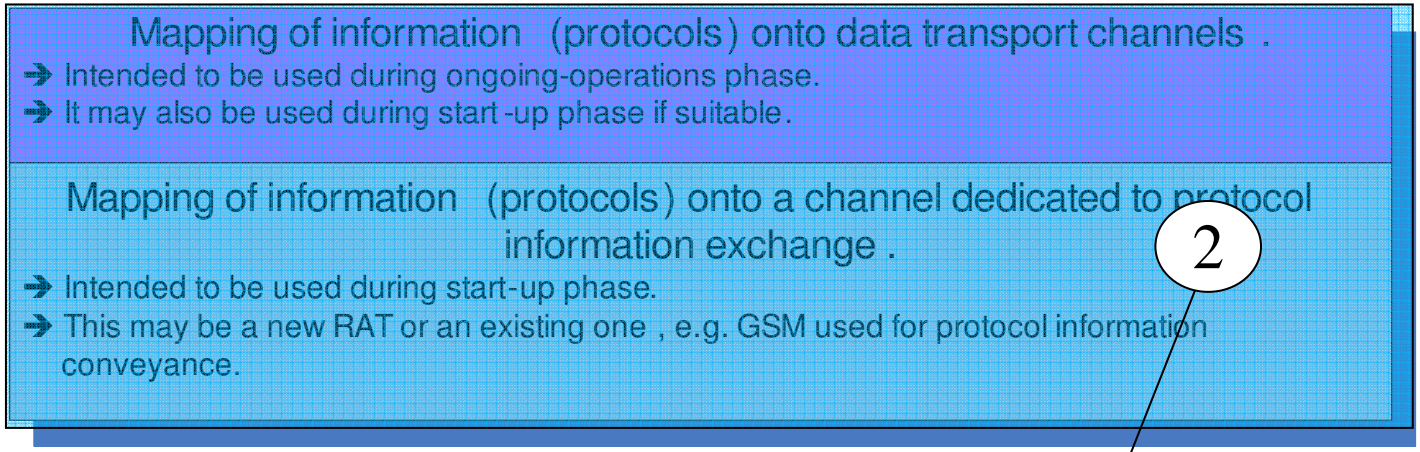
Baseline functions (1/2)



Management protocol mapping onto specific RATs which are not exclusively used for the transmission of IEEE P1900.4 related information

Radio Enabler

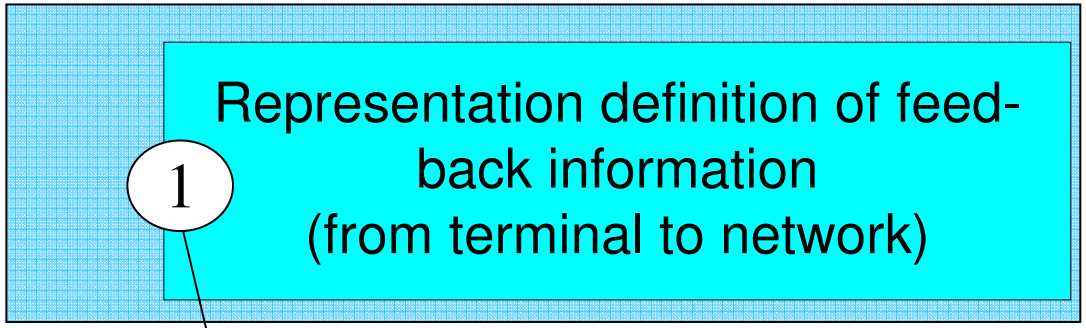
Baseline functions (2/2)



Management protocol mapping onto specific RATs which are exclusively used for the transmission of IEEE P1900.4 related information.

Terminal Reconfiguration Management

Baseline functions (1/2)



Control the representation of UE inherent observations from the UE to the network; these observations may include QoS related information.

- **Open Issues**
  - Procedures for discovering and decoding the Radio Enabler information, during start-up, connecting, connected mode
  - Vendor/Implementation specific
    - Cost function definition inherent to each UE,
    - Choice of resource selection strategy and
    - Dynamic Spectrum Allocation related self-configuration.

Liaisons possibilities with 802.21 *based on D01.09?*

1. Representation definition of context and Resource Usage Constraints (Policies) ?
   - *Media Independent Information Service*
   - *RDF Schema Representation*
2. Choice of radio resource selection strategy within terminal
   - *Leveraging of MIH services for efficient handover and mobility management?*

Conclusions and Next Steps

➡"Seamless" coordination & coexistence of multi-radio devices and systems is key for the next generation wireless systems (for both PC and telecommunications industry)

➡ Challenging problem(s)
- step-by-step approach
- Functional Requirements and architecture of building blocks and then protocols
- First Deployments around 2010

➡P1900.B/.4 is targeting
- Distributed terminal decision on Radio Resource usage strategies
- Simultaneous exploitation of radio links within a multi-mode device
- Dynamic Spectrum Access control

➡Liaise in order to possibly(?) leverage on
- MIH services for efficient handover and mobility management
- Media Independent Information Service
- RDF.

➡Form of liaisons to be defined

➡Contributions on Functional Requirements from 802.21?

The authors would like to acknowledge the contributions of all participants from IEEE P1900, P1900.B Study group including the E2R II colleagues for their valuable contributions.

Thank You

FIRST IEEE P1900™ .4 Working Group Meeting

Architectural building blocks enabling network-device distributed decision making for optimized radio resource usage in heterogeneous wireless access networks.

6-8 February, 2007

Madrid, SPAIN

The meeting will be hosted by **Telefonica I+D** at the following location:

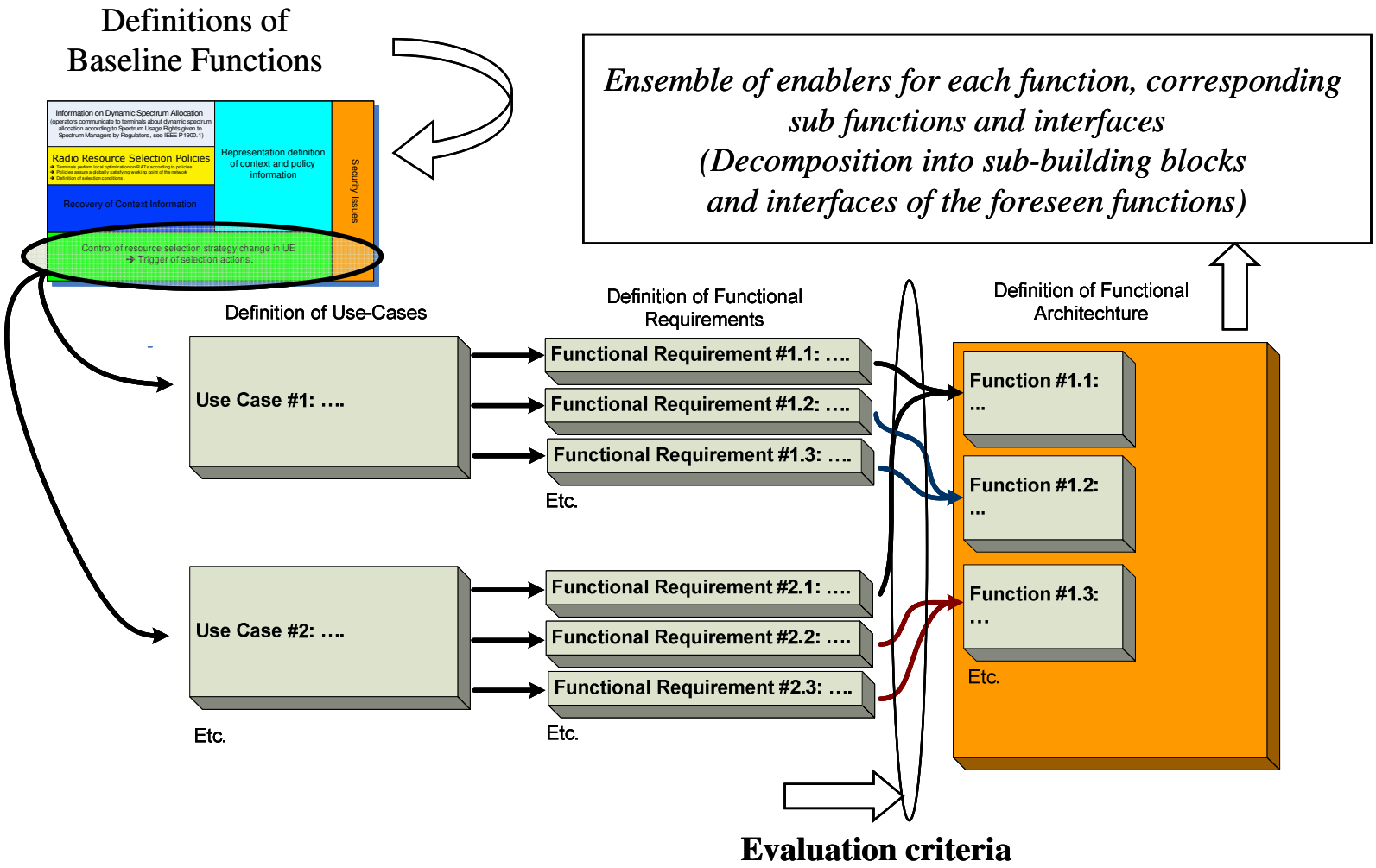
C/ Emilio Vargas 6, 28043 Madrid

Please **register** on https://icm3.ieee.org/eventmanager/onlineregistration.asp?eventcode=eff

See **Call for Contributions**: All interested parties are invited to submit corresponding presentations (format: MS-Powerpoint), combined with explanatory text documents (format: MS-WORD), by **30th-January-2007**, 6pm CEST. Note that you should **request a document number** by providing the **title and brief scope description** of your contributions by **23rd January 2007** to the following recipients:

Soodesh Buljore (Soodesh.Buljore@motorola.com),
Patricia Martigne (patricia.martigne@orange-ftgroup.com)
& Stephen Berger (Stephen.Berger@ieee.org)

IEEE P1900.4 Methodology for definition of Functional Architecture



Back-up-slides

IEEE P1900.4 – Usage Scenarios (1/3)

Why a Distributed Resource Usage Optimization?

When the number of users/devices increases, **centralized** decision

= Many feedback information to send

= Long computation time

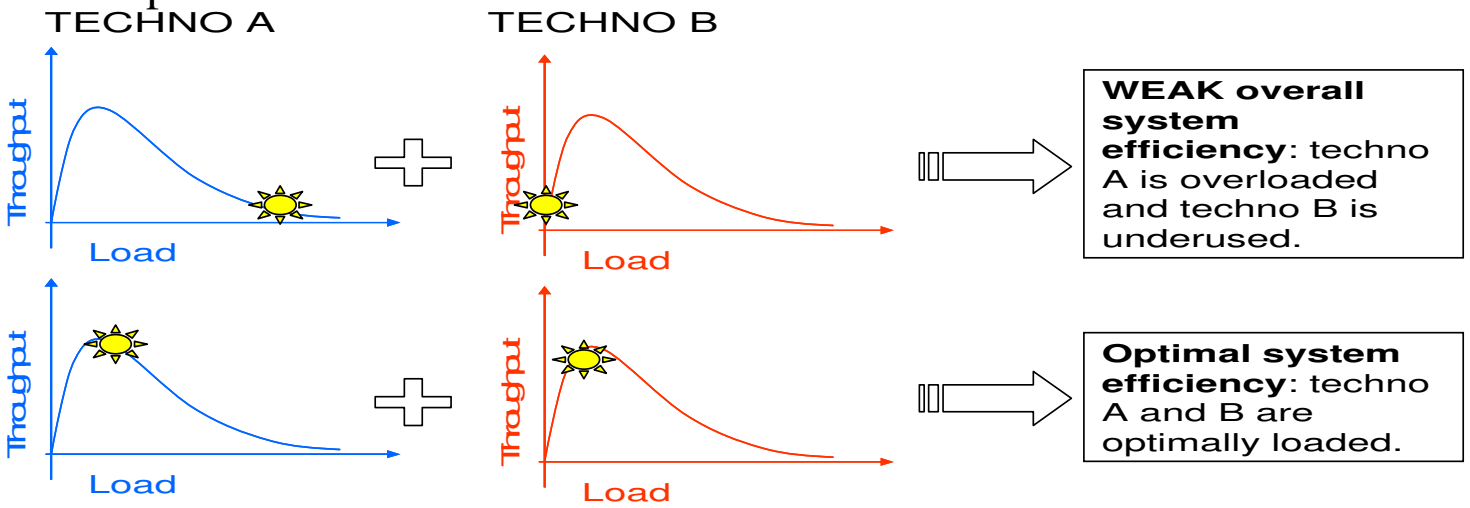
➡ Transfer a part of the task of making decisions to individual terminals (and/or other network elements), which considerably increases network scalability

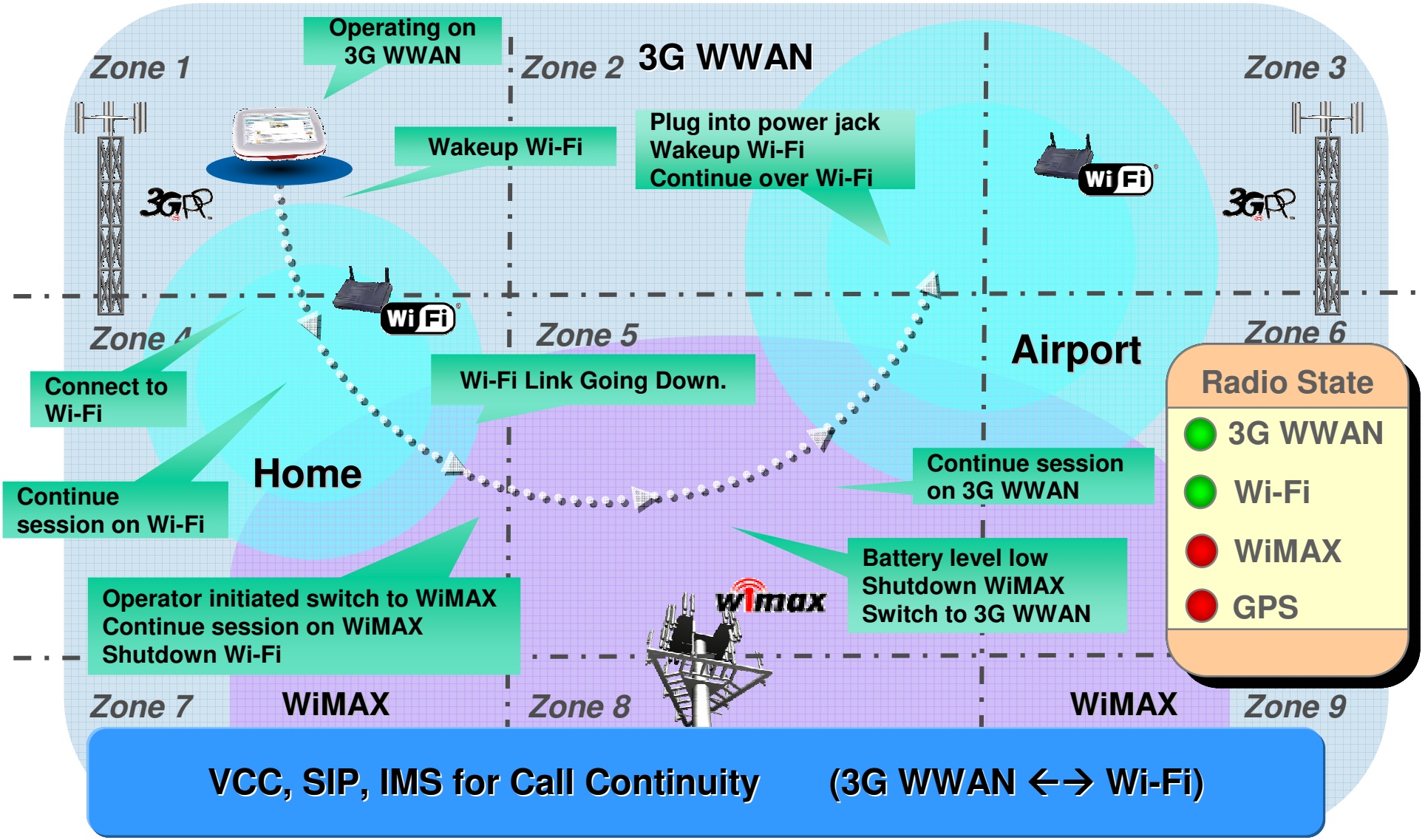
Why not completely decentralized?

➡ minimum control is required so that final operating point is optimal for the global network, which leads to global optimization of each user

IEEE P1900.4 – Usage Scenarios (2/3)

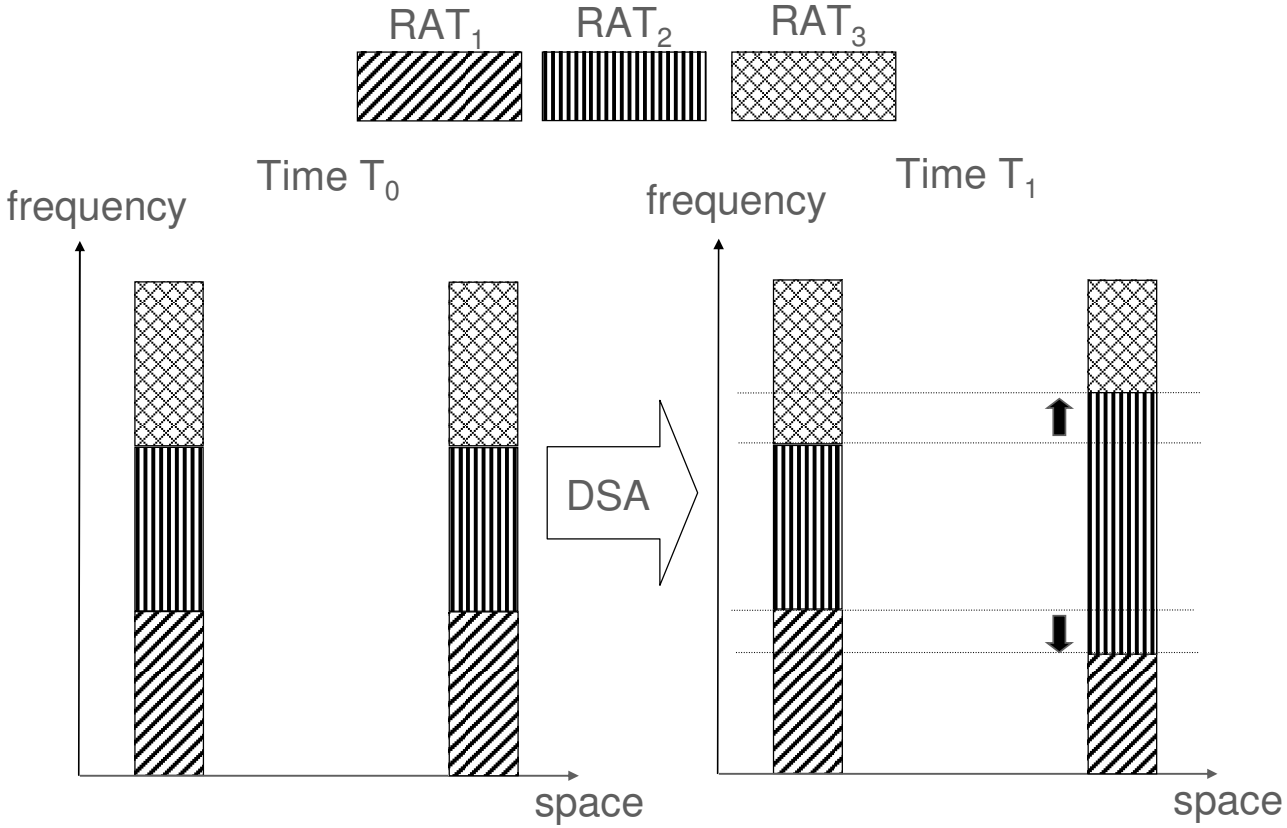
- Example 1: Use of policies for "rough" optimization
  - If few users are present, let everyone use all resources i.e., policies won't impose any constraints on resource selection strategies of users.
  - If many users are present, limit number of RAT connections per user
    - ⇒ From a network capacity usage point of view, assuming a large number of users "N → ∞" it is better to have "N" users accessing only one system (in particular CSMA, CDMA) compared to "M*N" users accessing "M" systems in parallel.




Zone 1
Operating on 3G WWAN
Zone 2
3G WWAN
Zone 3
Wakeup Wi-Fi
Plug into power jack
Wakeup Wi-Fi
Continue over Wi-Fi
Zone 4
Zone 5
Airport
Zone 6
Connect to Wi-Fi
Wi-Fi Link Going Down.
Home
Continue session on Wi-Fi
Continue session on 3G WWAN
Radio State
3G WWAN
Wi-Fi
WiMAX
GPS
Operator initiated switch to WiMAX
Continue session on WiMAX
Shutdown Wi-Fi
Battery level low
Shutdown WiMAX
Switch to 3G WWAN
Zone 7
WiMAX
Zone 8
WiMAX
Zone 9
VCC, SIP, IMS for Call Continuity (3G WWAN ←→ Wi-Fi)

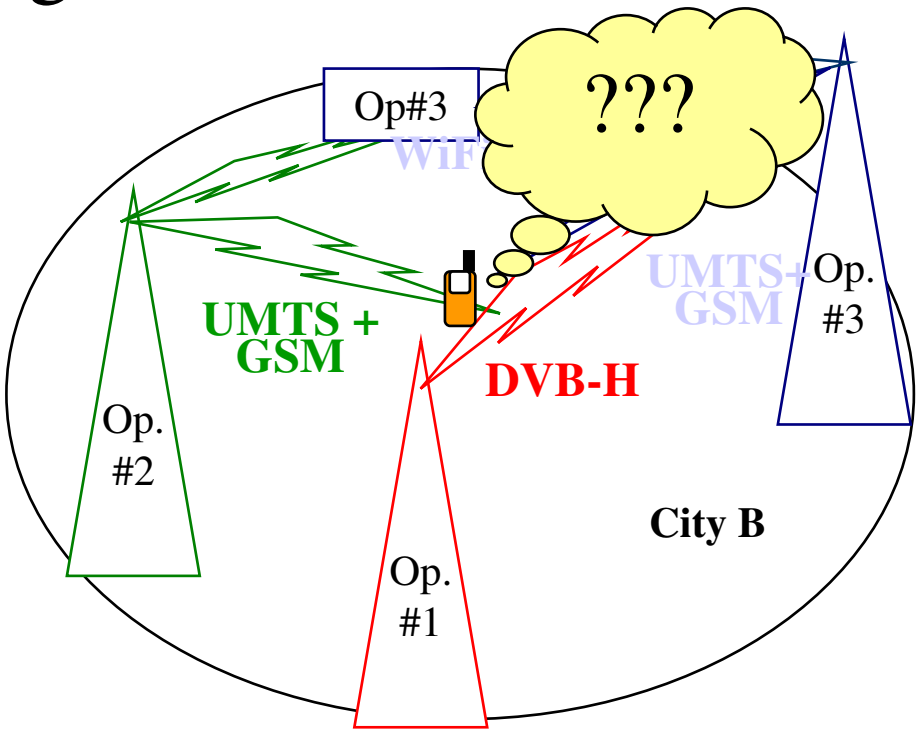
IEEE P1900.4 – Usage Scenarios (3/3)

- Dynamic spectrum Allocation : to allow frequency bands to be allocated to different RATs, depending on time/space.



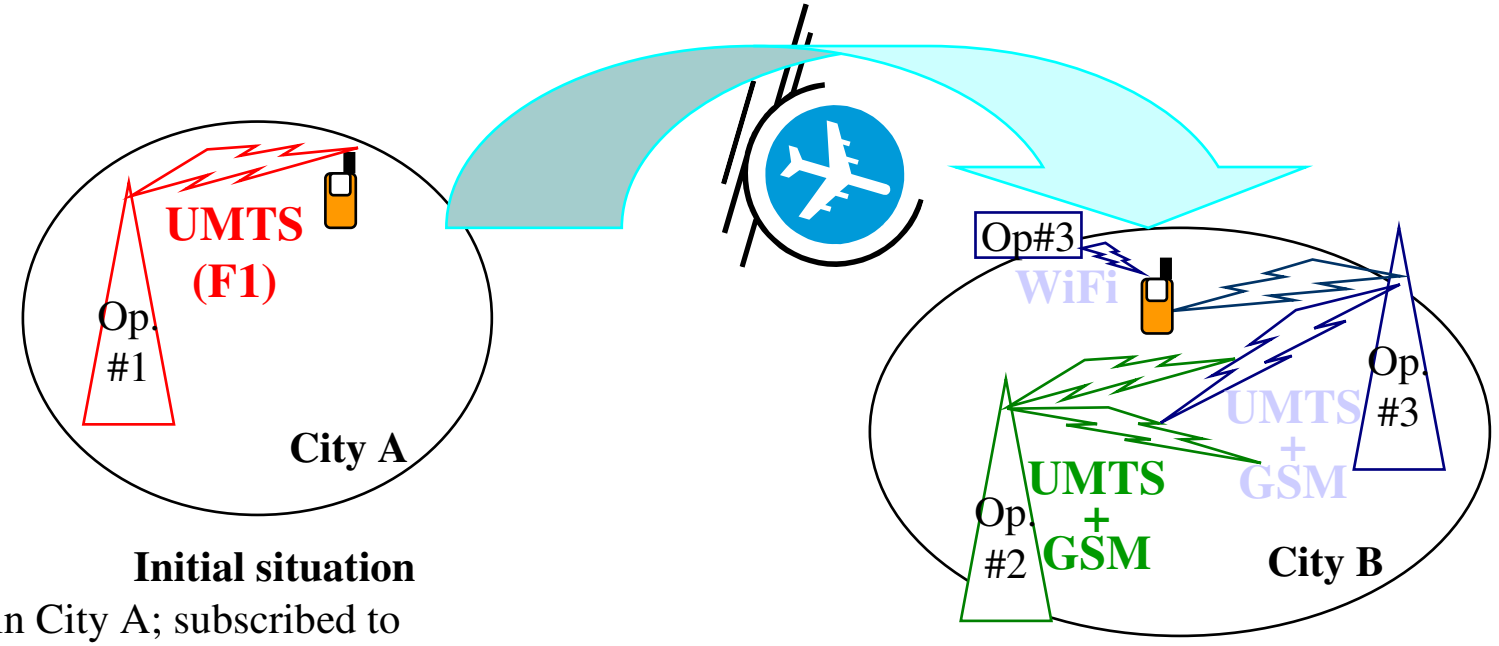
Use case for dedicated Radio Enabler "Outband CPC"-Cognitive Pilot Channel

At switch on:
the terminal does not know the "current" configurations of the various networks, in particular the frequency bands associated to the Radio Access Technologies (RAT)



Outband CPC solution:
To broadcast data allowing a terminal to select a network in this heterogeneous RATs environment

Scenario 1 for "Outband CPC"



Initial situation

Mobile: in City A; subscribed to operator # 1.

Operator #1 in City A: UMTS network on a frequency band centred on F1.

Situation 1

After a trip to a foreign country, the mobile arrives in a city B.

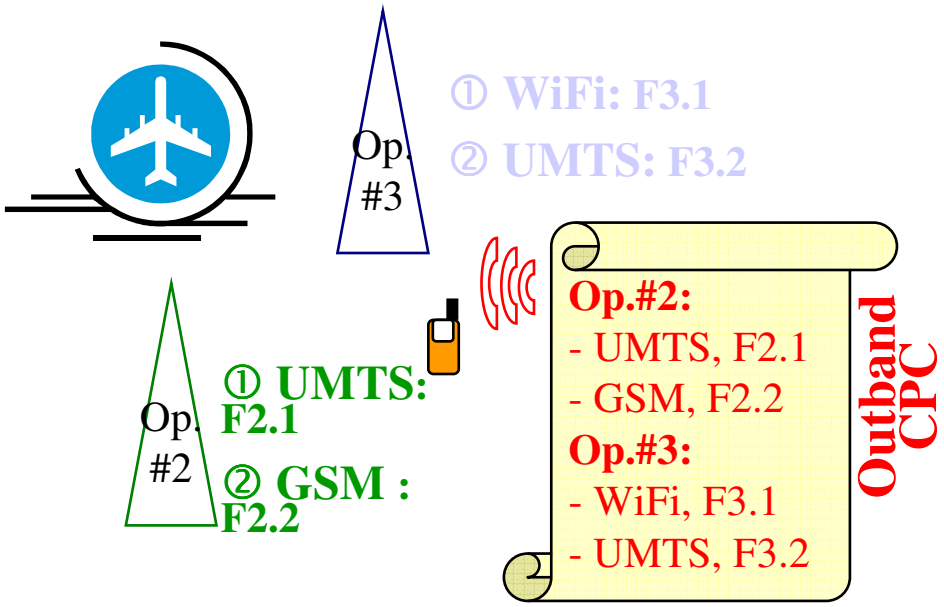
City B: operators #2 and #3 coexist.

Operator #2 network: UMTS and GSM.

Operator #3 network: UMTS and GSM + WLAN coverage in some hot spots (e.g. airports, railway stations).

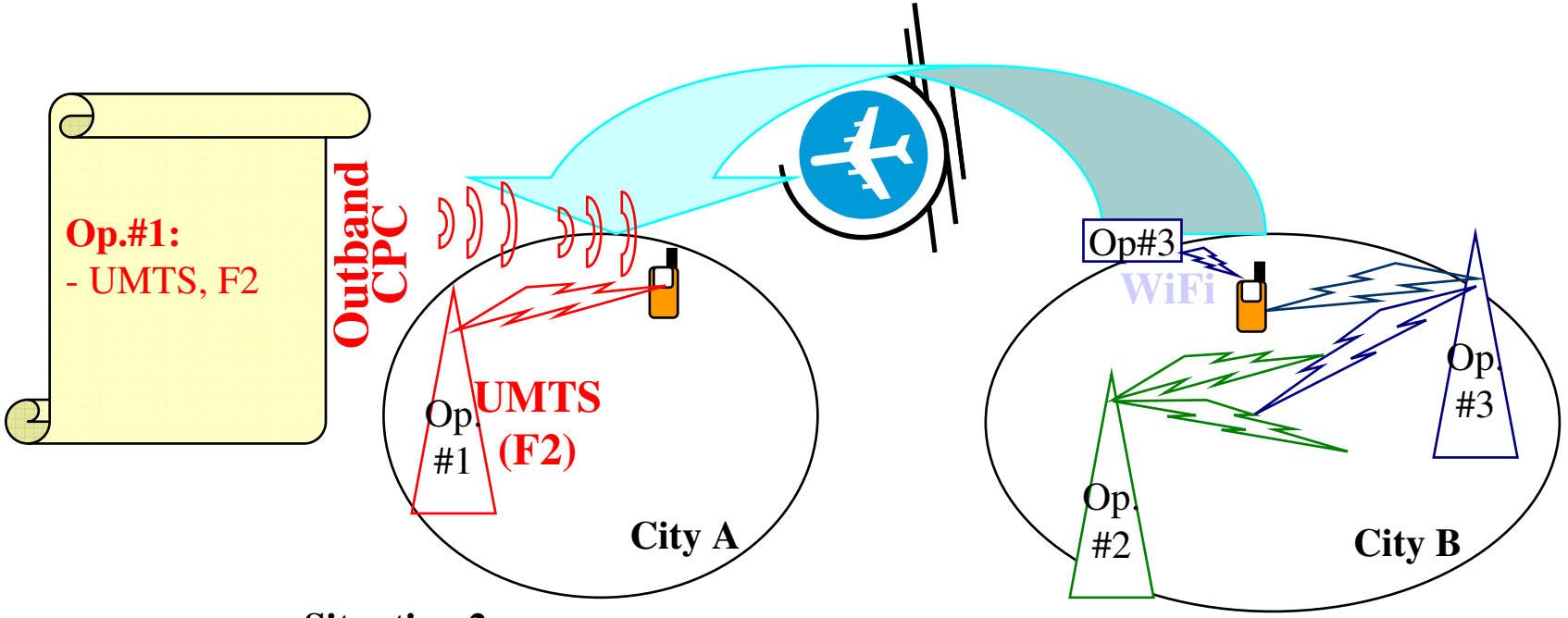
Scenario 1 for "Outband CPC"

At the airport,
the mobile is switched on.
Operator #2 list of the 2 preferred RATs, with frequencies F2.1 and F2.2 respectively
Operator #3 list of the 2 preferred RATs, with frequencies F3.1 and F3.2 respectively



RAT selection procedure at the airport in city B
Mobile is switched on → it listens to the CPC.
The mobile, taking into account its user profile for example, chooses the operator #3 and the WLAN technology.
It starts its connection on the corresponding frequency indicated by the CPC.

Scenario 2 for "Outband CPC"



Situation 2

The user returns to the city A.

Mobile is switched on; consulting the Outband CPC → informed that Op.#1 is now operating UMTS on F2.