



(Coordination and Support Action)

Cognitive Radio Standardization-initiative: from FP7 research to global standards



UNIVERSITY OF
SURREY



Motivation and context

- Standards are needed to close the gap between research outcomes and commercial exploitation. Standardization creates customer confidence, market growth and technological evolution.
- **Digital Agenda for Europe:** *“Europe's standard-setting framework must catch up with fast-moving technology markets because standards are vital for interoperability”.*
- Despite ten years of research in Cognitive Radio, wide adoption of Cognitive Radio technology is not there yet, and the lack of widely approved standard is a major reason to this situation.
- **Standardisation Mandate on Reconfigurable Radio Systems:** *“To ensure that standardisation of CRS technologies happens timely in Europe in order to lead or keep pace with global developments”.*

Standardization mandate to CEN, CENELEC and ETSI for Reconfigurable Radio Systems (M/512)

- **Objective A (Commercial domain)**
 - to deploy and operate cognitive radio systems (CRSs) including white space devices and devices under Licensed Shared Access regime, dependent for their use of radio spectrum on information obtained from geo-location databases
- **Objective B (Civil security and military domains)**
 - to ensure standardization of suitable SDR architecture(s) for the military domain
- **Objective C (Synergies, commercial/civil/military)**
 - to explore potential areas of synergy among commercial, civil security and military applications



The R&S environment in FP7 (2010-2012)

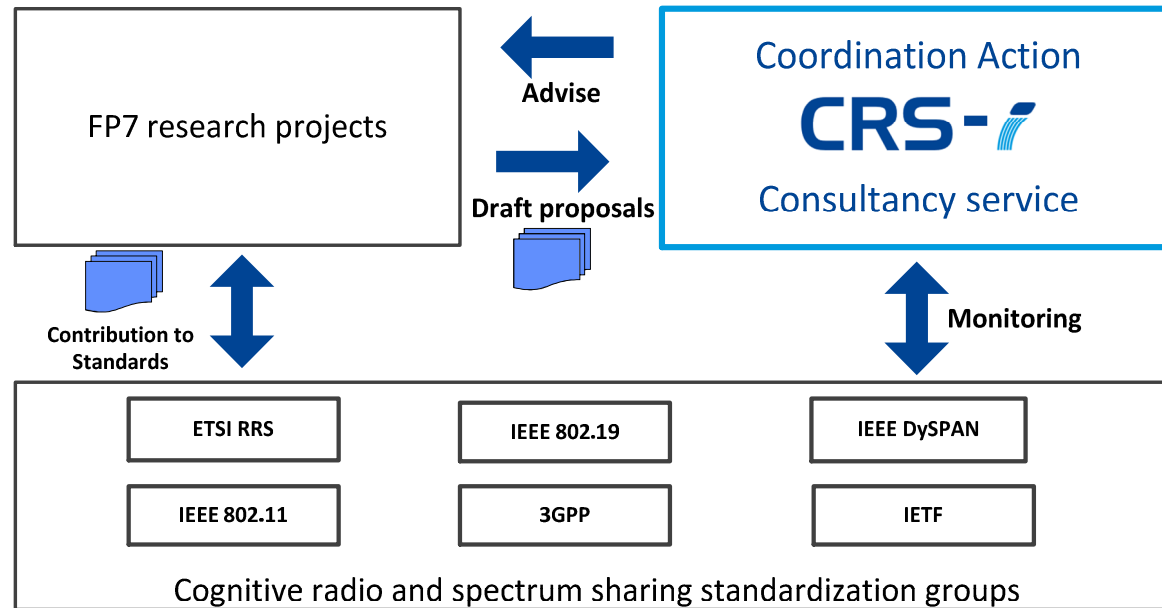
- **QoS**MOS (Quality of Service and MObility driven cognitive radio Systems)
- **SAPHYRE** (Sharing Physical Resources – Mechanisms and Implementations for Wireless Networks)
- **COGEU** (COgnitive radio systems for efficient sharing of TV white spaces in EUropean context)
- **SACRA** (Spectrum and energy efficiency through multi-band cognitive radio)
- **FARAMIR** (Flexible and spectrum-Aware Radio Access through Measurements and modeling In cognitive Radio systems)
- **SAMURAI** (Spectrum Aggregation and Multi-User MIMO: Real-world Impact)
- **QUASAR** (Quantitative Assessment of Secondary Spectrum Access)
- **OneFit** (Opportunistic networks and Cognitive Management Systems)
- **ACROPOLIS** (Advanced coexistence technologies for radio optimization in licensed and unlicensed spectrum)

CRS-i objective

- The main objective of CRS-i is to stimulate, facilitate and ease cooperation and exchange between current as well as future FP7 research projects on cognitive radio systems and ICT standard organizations.
- The proposed Coordination Action has the following specific three objectives:
 1. Offer a **consultancy service on standardization to FP7 projects** addressing Cognitive Radio, Dynamic Spectrum Access and Coexistence issues;
 2. **Extend standardization activities of the ongoing FP7 projects** beyond the projects' lifetime, namely QoSMOS , COGEU, SACRA and OneFIT will end in December 2012;
 3. Reinforce the collaboration of FP7 projects with **US and Japan** 's “cognitive radio stakeholders” and ensure that Europe will be able to turn the research outcomes into standard compliant products.

Objective 1

Standardization consultancy service



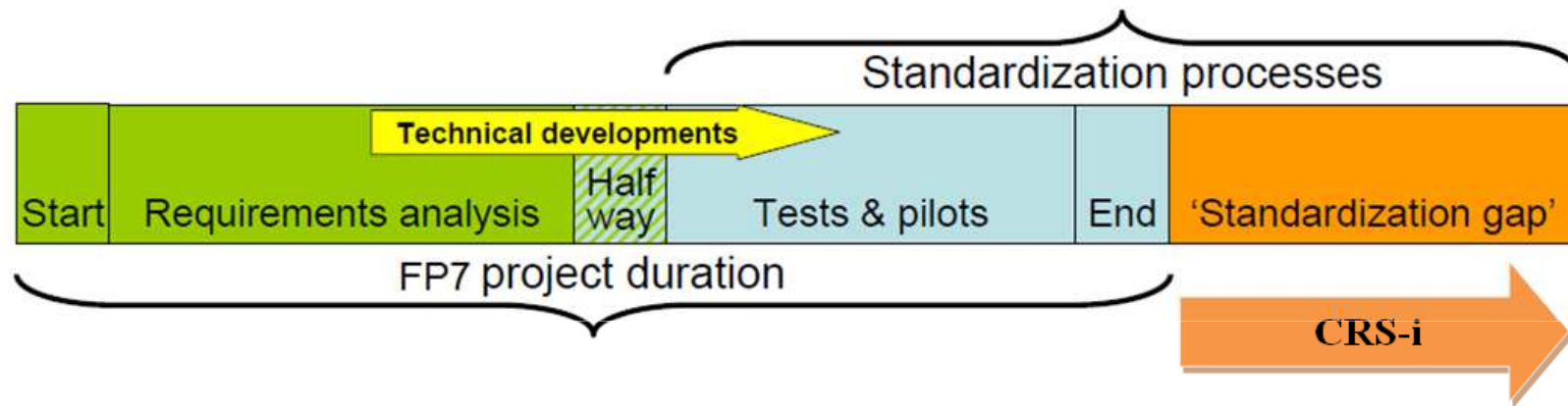
- CRS-i will pro-actively suggest potential convergence points between FP7 projects with potential for standardization, avoiding effort fragmentation.
- The Consultancy Service will identify and concentrate on the most promising standard developments and standardization groups, it will make the research projects aware about forthcoming standardization opportunities.

Standardization consultancy service

- Create a CRS-cluster and the legal basis for communication with the CRS-i
- Offer a coherent consultancy service for cognitive radio standardization to any related FP7 project
- Provide to FP7 CR projects state-of-the-art information on standards available or under development
- Drive the formation of new standardization proposals that address the missing research priorities in a coordinated manner

Objective 2

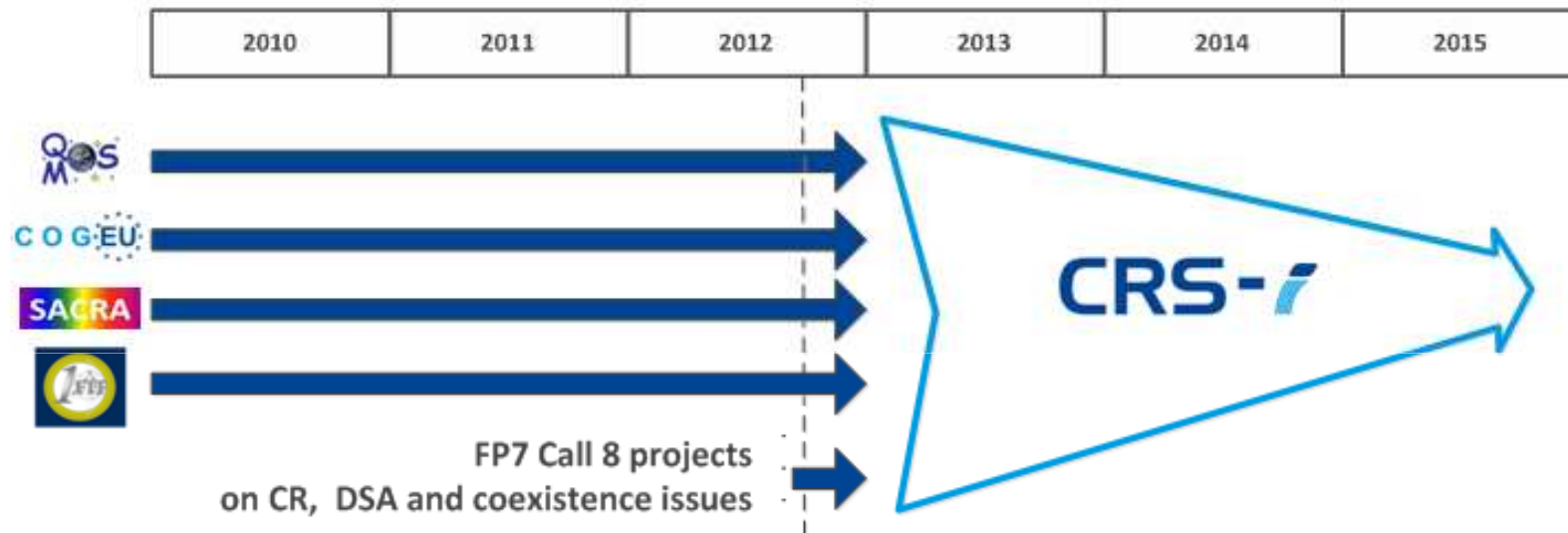
Closing the standardization gap



- Standardization is a process with low speed reaction and does need more continuous engagement than a 36 month project can provide.
- Projects face the fact that it is difficult to achieve impact during the rather short (typically 2-3 years) life time of an FP7 project.

Objective 2

Closing the standardization gap



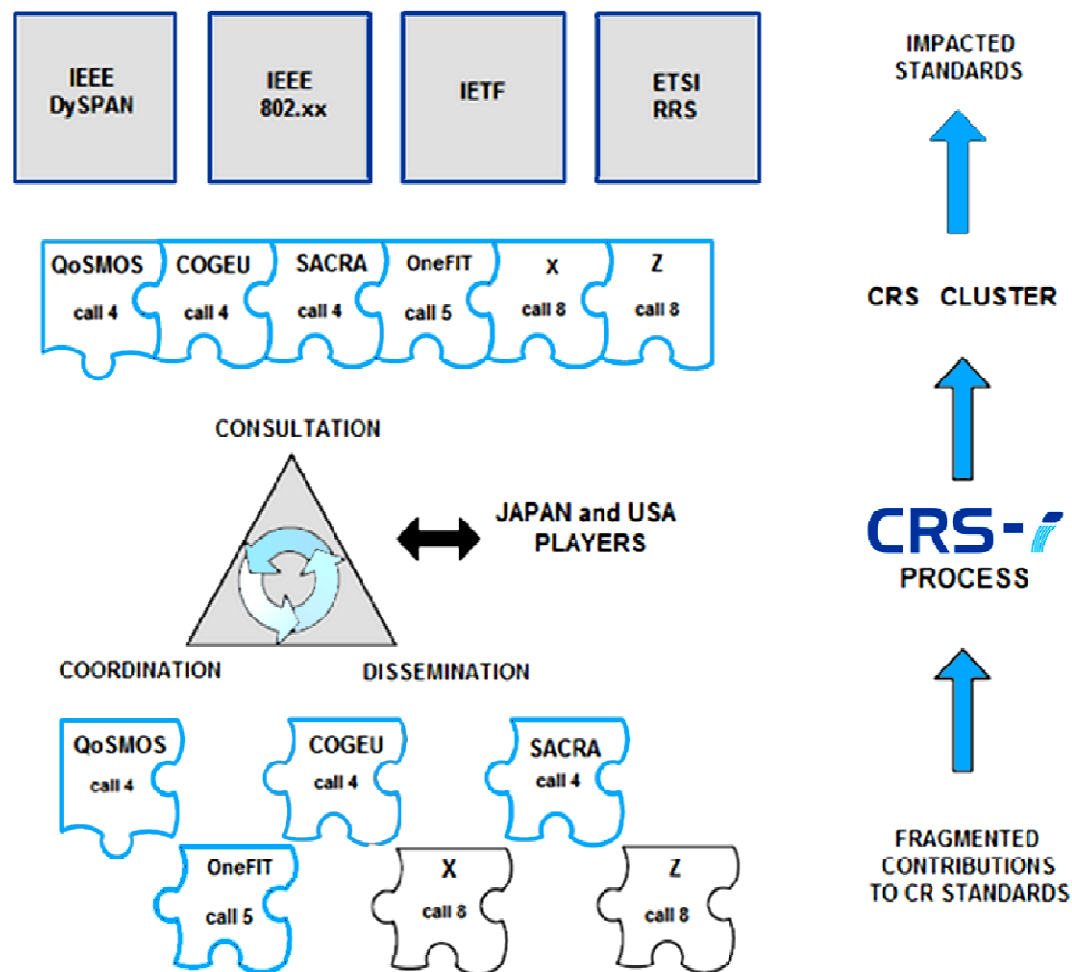
- CRS-i will allocate extra resources to extend standardization activities of the FP7 projects QoSMOS, COGEU, SACRA and OneFIT after the project ends (Dec. 2012).

Objective 3

Cooperation with US and Japan on CR standardization

- Japan and US are leading the standardization activities on cognitive radio, they drive the development in the IEEE 802.xx and IEEE 1900.x families
- A strategic objective of CRS-i is reinforce the collaboration of FP7 projects with USA and Japan's "cognitive radio stakeholders" and ensure that Europe will be able to turn the research outcomes into standard compliant products
- CRS-i will establish an International Advisory Board (EU, USA and Japan)
- CRS-i will identify gaps, where existing CR standards do not fulfil the European requirements, and suggest further standardization activities to fill those gaps

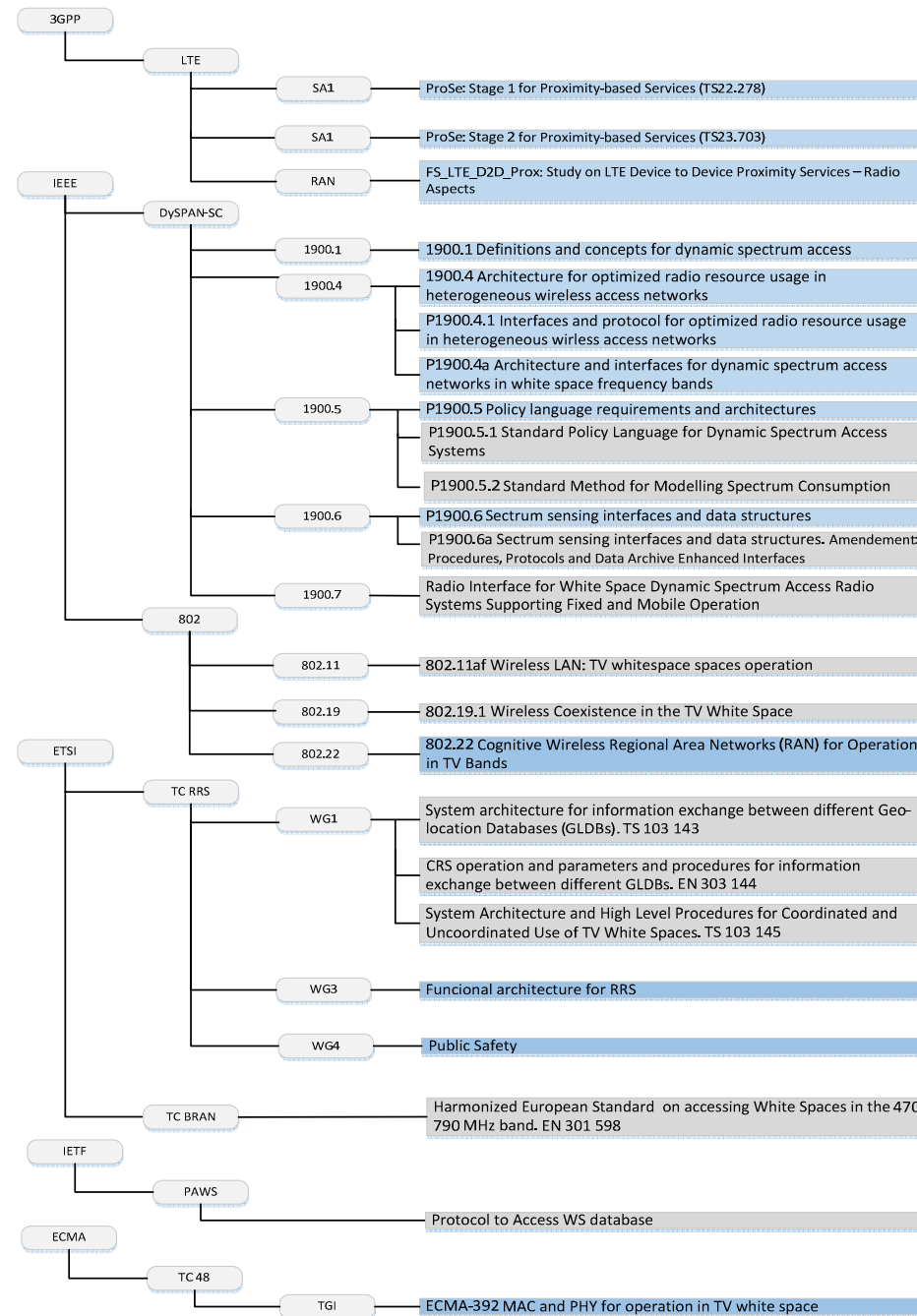
The overall Coordination Action concept



Coordination of FP7 projects contributions to CR standards

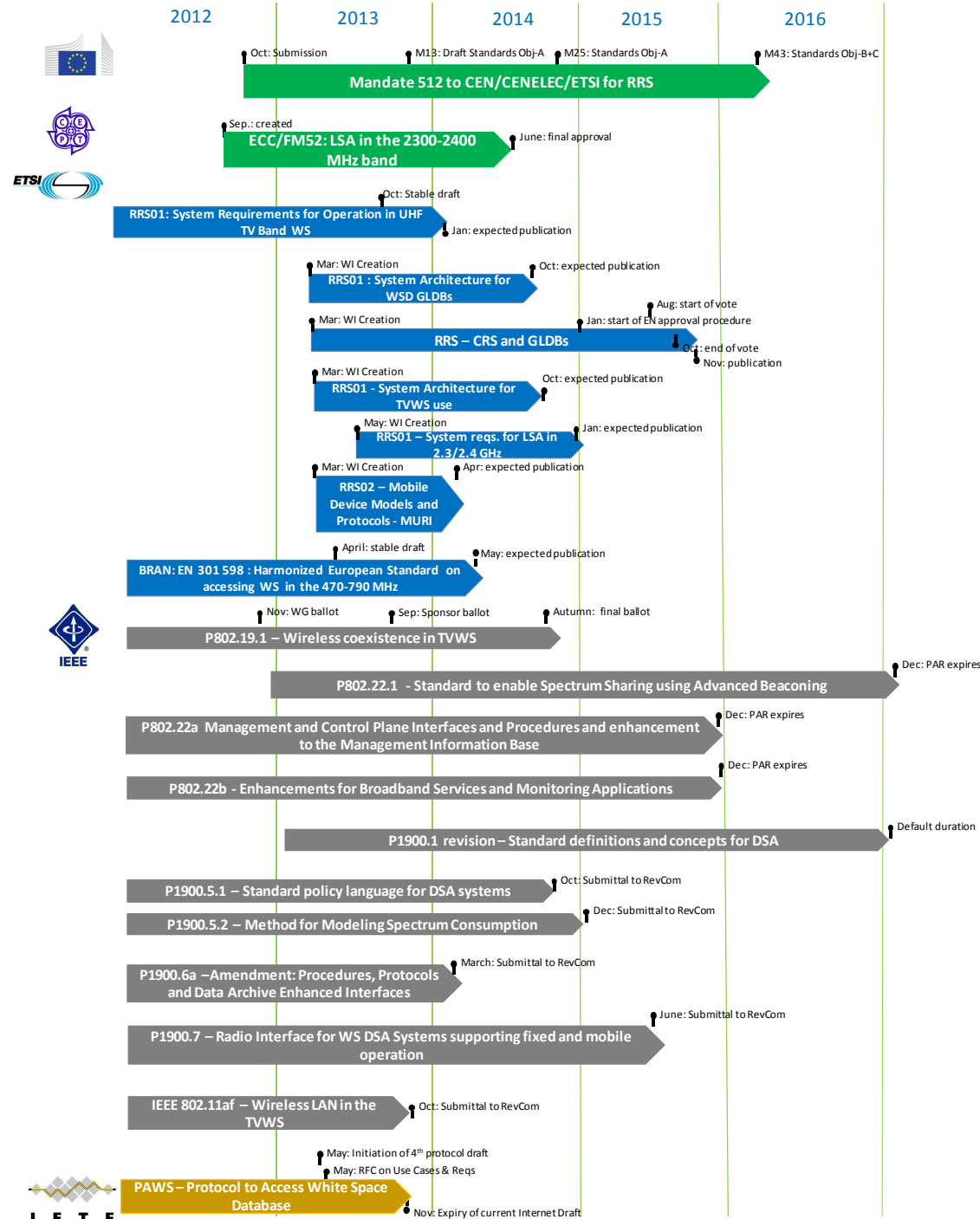
- Derive a coherent standardization approach exploiting results from FP7 projects on cognitive radio and DSA, avoid fragmentation of standardization efforts through specific task forces
- Strengthen the position of FP7 projects in standardization efforts on cognitive radio at a global level and to facilitate the pull through of European project outcomes

The complexity of the CR standardization



- Finished - Ongoing

CR standardization roadmap



“new” FP7 projects with potential for cooperation towards CR standardization

| Project | Full title, duration and coordinator | Rational to be part of CRS cluster |
|-------------------------------------|--|---|
| EMPHATIC (STREP) | Enhanced Multicarrier Techniques for Professional Ad-Hoc and Cell-Based Communications 01/09/2012 to 01/03/2015 (CTTC) | Coexistence with existing networks in the same bands. Highly adjustable characteristics (SDR-model). New waveform for Public safety. Potential interest in opportunistic Device-to-Device communications in 3GPP where OneFIT is active. |
| 5G NOW (STREP) | 5th Generation Non-Orthogonal Waveforms for Asynchronous Signaling 1/9/2012 to 28/2/2015 (FRAUNHOFER HEINRICH-HERTZ-INSTITUT) | Fragmented Spectrum and Carrier aggregation scenario , including white spaces, coexistence aspects. New waveform for LTE-A and M2M. Interest in contribute to IEEE P1900.x, a standardization group where CRS-i members from QoS MOS project are also active. |
| CREW (IP-FIRE) | Cognitive Radio Experimentation World 01/10/2010 to 30/9/2014 (iMinds) | CREW is interested in cooperate with CRS-i through the provision of CR experimentation facilities for testing and verification of CR standards. CREW has requested support from CRS-i to disseminate its experimentation facilities within the RAS cluster. |
| ABSOLUTE (IP) | Aerial Base Stations with Opportunistic Links For Unexpected & Temporary Events 2012-10-1 to 2015-09-30 (THALES) | Considers the possibility of dynamic use of spectrum resources between commercial and public safety users for disaster relief. Working Group 4 for Public Safety in the ETSI Technical Committee (TC) for Reconfigurable Radio Systems (ETSI RRS). |
| CORASAT (STREP) | COgnitive RAdio for SATellite Communications 01/10/2012 to 30/09/2015 (University of Bologna) | Exploit CR concepts developed by terrestrial communications in the satellite context (e.g. spectrum geo-location database). |
| ACROPOLIS (NoE) | Advanced coexistence technologies for radio optimisation in licensed and unlicensed spectrum 2010-10-1 to 2013-9-30 (Kings College London) | ACROPOLIS is very active in standardization and is a good case study of a project with high impact on standardization. |
| METIS (IP) | Mobile and wireless communications Enablers for the Twenty-twenty Information Society 1/11/2012 to 30/4/2015 (Ericsson) | METIS has a Work Package fully dedicated to Spectrum and is interested in contributing to Licensed Shared Access (LSA) standardisation, which is also an important standardization stream in CRS-i. |
| COST Action IC0902 | Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless Networks 01/12/2009 to 31/12/2013 (Sapienza University of Rome) | COST IC0902 is the first example of the standardization consultancy service provided by CRS-i. It was identified a potential contribution to IEEE 802.11 on self-coordination of channel assignment in adjacent Wi-Fi Access Points. |



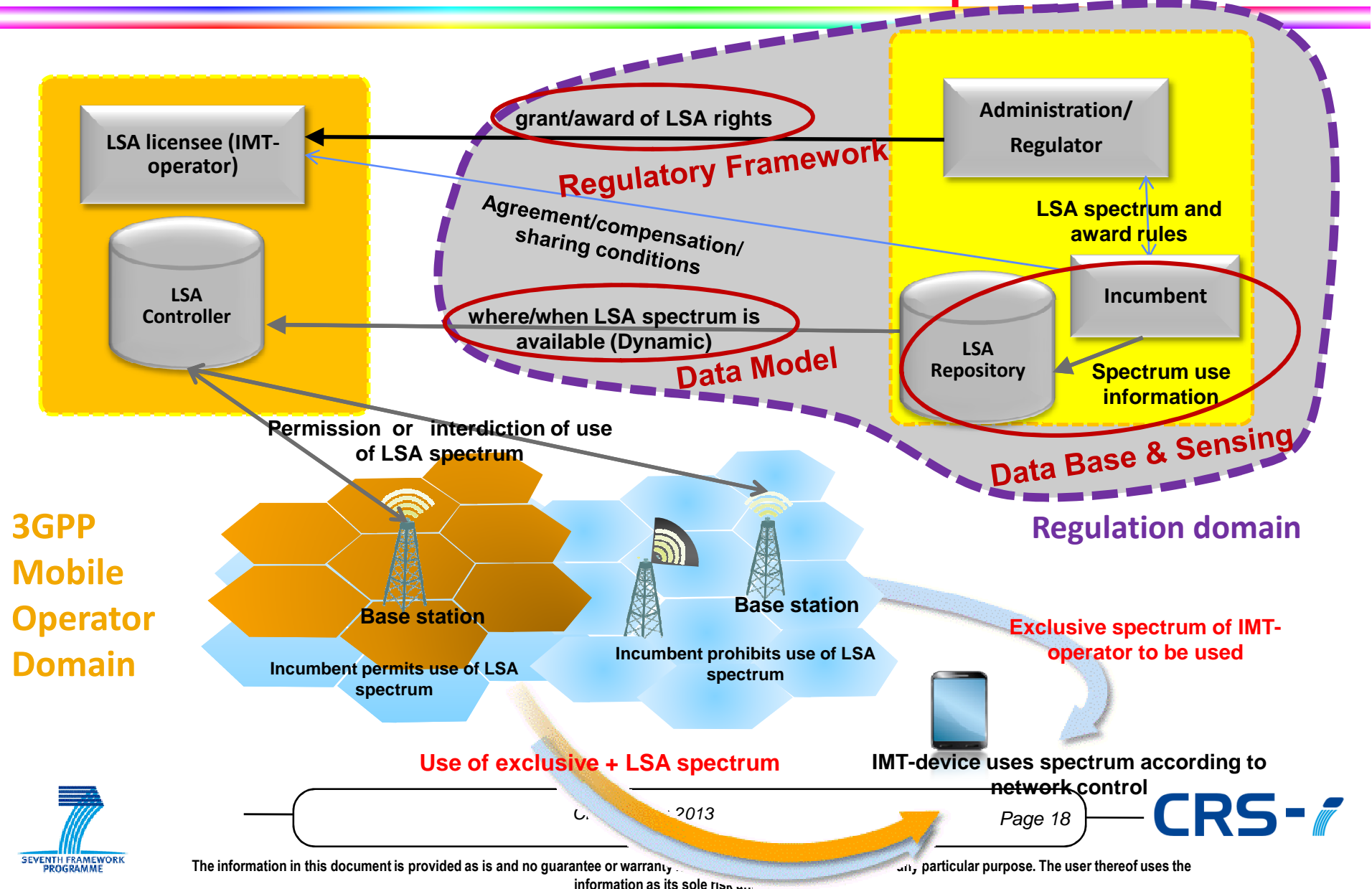
Innovative Approach: Licensed Shared Access (LSA)

Concept, example architecture, relevant bodies, status

Licensed Shared Access (LSA) Concept

- The LSA (licensed shared access) concept is a framework to share spectrum between limited numbers of users.
- Under this concept, the initial users (the “incumbents”) share their spectrum with one or several new users (the “incoming users”) in accordance with a set of conditions to be defined by the regulation.
- A key feature of LSA is to ensure a predictable quality of service for all spectrum use rights holders, network operators and for consumers.
- The LSA concept is primarily about granting “individual authorisations” to terrestrial mobile operators in bands used by other type of primary incumbent users.

Licensed Shared Access (LSA) Example Architecture



Licensed Shared Access (LSA) Involved Bodies

- ETSI TC RRS: Reconfigurable Radio Systems
- ETSI TC ERM: Electromagnetic Compatibility (EMC) and Radio Spectrum Matters)
- ECC/CEPT (PT 52 and PT 53)
- Potential: IEEE DySPAN-SC, 3GPP, EU project METIS, ...

LSA Standardization in ETSI TC RRS

Status

- RRS Chair: Markus Mueck, Intel
- TR 103 113 “System Reference Document; Mobile broadband services in the 2300 MHz – 2400 MHz frequency band under Licensed Shared Access regime” finalized and forwarded to ETSI ERM
- New Work Item “System Requirements for Operation of Mobile Broadband Systems in the 2300 MHz – 2400 MHz band under Licensed Shared Access Regime” started



IEEE DySPAN-SC

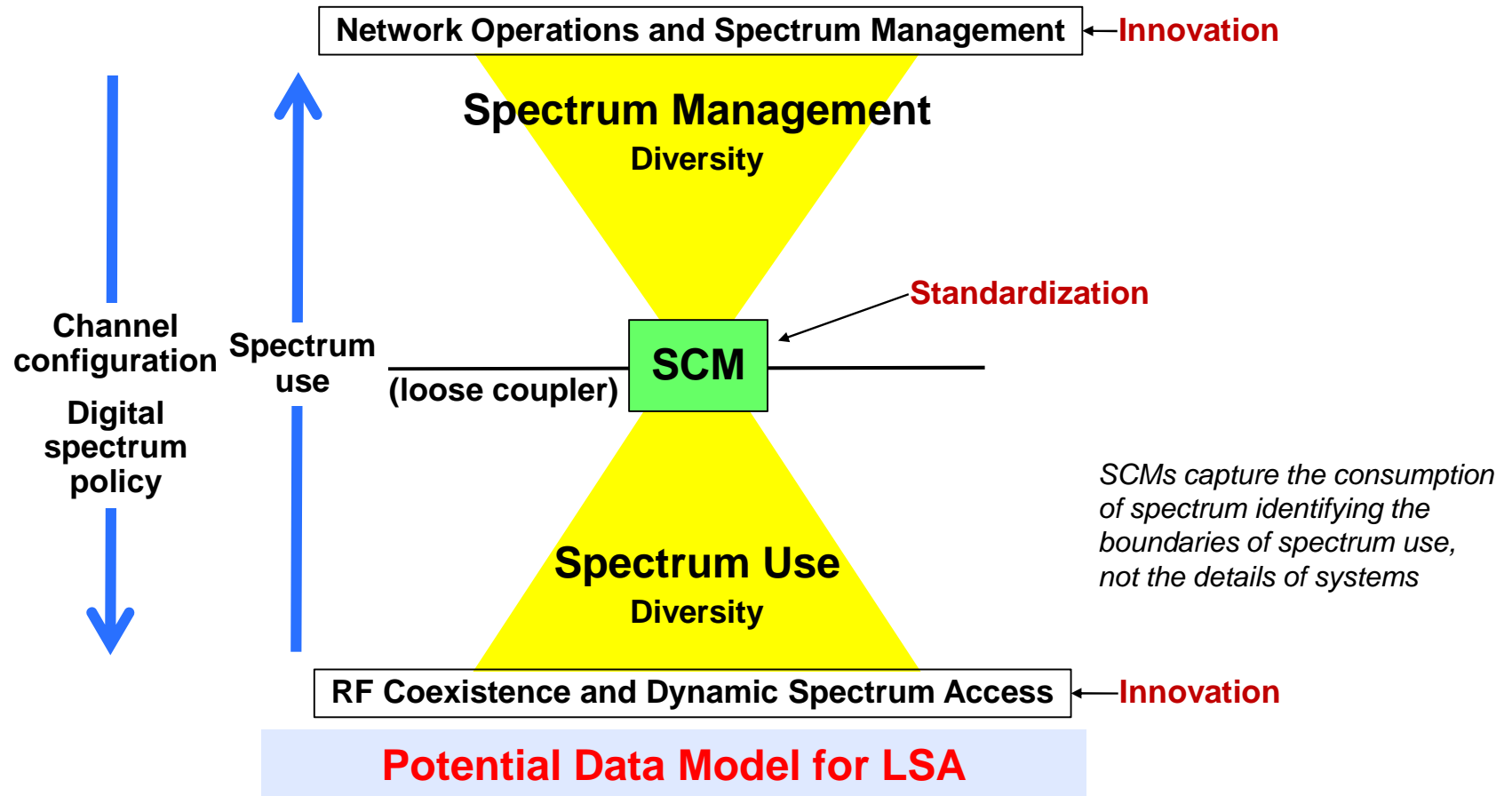
Overview and potential relevance for LSA

IEEE DySPAN-SC Overview

- Standards development projects in the areas of dynamic spectrum access, cognitive radio, interference management, coordination of wireless systems, advanced spectrum management, and policy languages and ontologies for next generation radio systems (chair: Hiroshi Harada, NICT)
- 1900.1: Definitions and Concepts
- 1900.4: Architecture
- 1900.5: Policy Language
- 1900.6: Spectrum Sensing Interfaces and Data Structures
- 1900.7: White Space Radio Working Group

IEEE1900.5.1 (chair: Lynn Grande, General Dynamics):

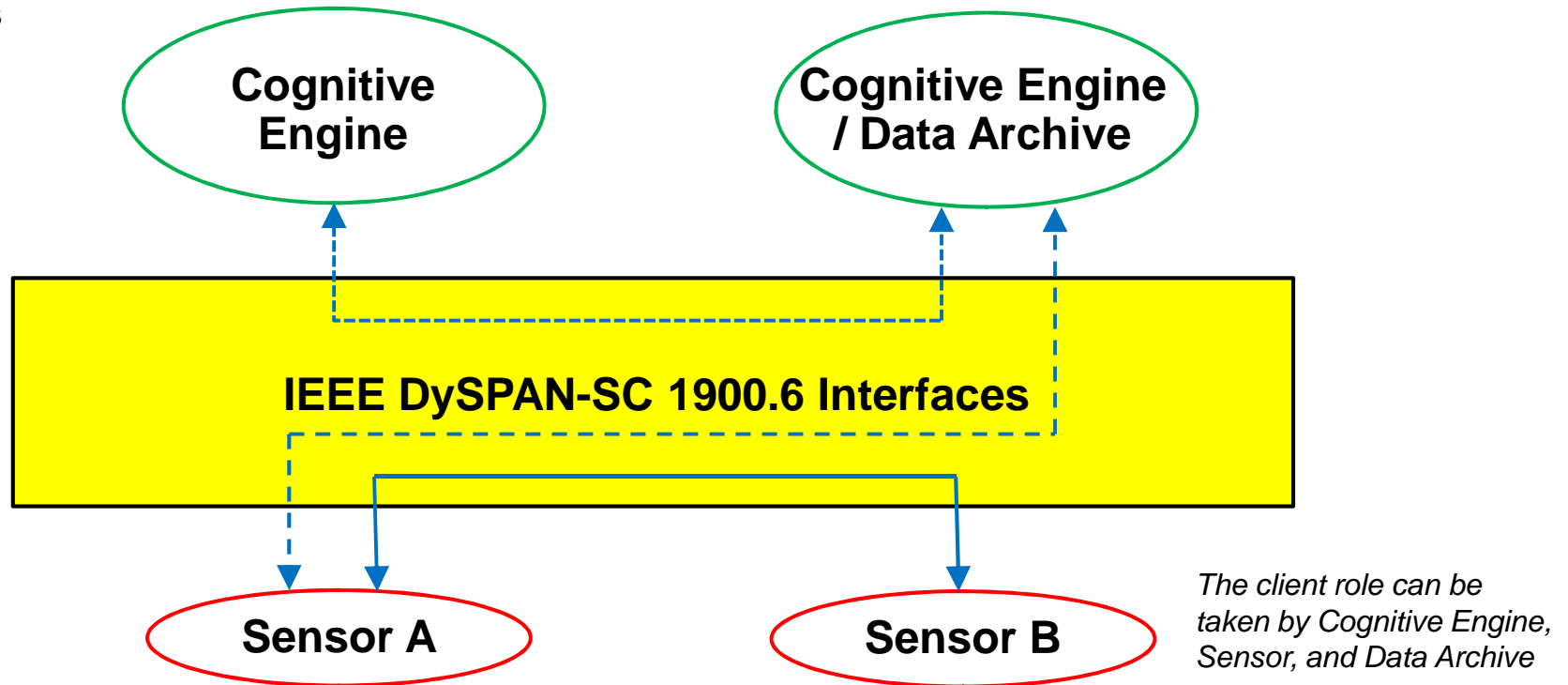
Standard for a vendor-independent policy language for managing the functionality and behavior of dynamic spectrum access networks based on Spectrum Consumption Model (SCM)



IEEE DySPAN-SC 1900.6

IEEE1900.6a (chair: Michael Gundlach, NSN):

Standard for Spectrum Sensing Interfaces and Data Structures for Dynamic Spectrum Access and other Advanced Radio Communication Systems Amendment: Procedures, Protocols and Data Archive Enhanced Interfaces



Potential Data Base & Sensing for LSA

- CRS-i is aiming to promote cooperation between FP7 research projects on cognitive radio systems and related standard organizations
- This will facilitate and accelerate the deployment of cognitive radio systems (CRSs) and suitable SDR architecture(s)
- For these purposes, CRS-i participants participate and keep contact to European research projects and worldwide standardization bodies
- First deliverables finalized, first results in consultancy achieved
- Ongoing work (project from 1st November 2012 to 31st October 2015)
- Regular workshops with participants in research and standardization area
- Presentations at conferences and workshops

Contacts



www.ict-crsi.eu