Use of Software Defined Radio to support interoperability

JRC Interoperability Conference Ispra (IT)

Olivier SAGNES Bruno CALVET, 29th June, 2010
Summary

• Euler in brief

• Interoperability : main outcomes consideration

• SDR model

• Euler and SDR
EULER

European software defined radio for wireless in joint security operations

Project Details

Start Date: 2009-03-01   End Date: 2012-02-29   Duration: 36 months

Project Reference: 218133
Project Cost: 15.47 million euro
Programme Acronym: FP7-SECURITY
Subprogramme Area: SEC-2007-4.2-04 Wireless communication for EU crisis management

Contract Type: Collaborative project
Project Funding: 8.72 million euro
Programme Type: 7th FWP (Seventh Framework Programme)
Project URL: www.euler-project.eu
# EULER End Users committee

under the JRC ISPRA coordination

<table>
<thead>
<tr>
<th>Nation</th>
<th>Committee member national P&amp;GS agencies (end users)</th>
<th>Partner ensuring liaison</th>
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</thead>
<tbody>
<tr>
<td>ES</td>
<td>Spanish Mol (Telecom Area / Emergency Radio System)</td>
<td>INDRA</td>
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<td>FR</td>
<td>French Mol (Group of Police Cooperation)</td>
<td>EADS, THALES</td>
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<td>ENSOSP (Ecole Nationale des Officiers Sapeurs Pompiers)</td>
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<td>French MoD - CELAR (Centre Electronique de l’Armement)</td>
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<td>IT</td>
<td>Protezione Civile Nazionale</td>
<td>SELEX, ELSAG- DATAMAT</td>
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<td>Fondation Ugo Bordoni</td>
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<td>SE</td>
<td>MSB (Swedish Civil Contingencies Agency)</td>
<td>SAAB</td>
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<td>UK</td>
<td>NPIA (National Policing Improvement Agency)</td>
<td>EADS Astrium</td>
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<td>NL</td>
<td>Royal Marechaussee (Gendarmerie)</td>
<td>TNO</td>
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<td>Brandweer (Firebrigade)</td>
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<td>DARES (Radio amateurs)</td>
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**Legend:**
- Law Enforcement
- Fire & Rescue
- Civil Protection
- Military
Public Safety agencies & Interoperability issue

What is Interoperability?
- Interoperability is the ability for first responders from different agencies to communicate among themselves, to exchange voice and/or data on demand and in real time, whenever necessary.

Why Interoperability remains a challenge?
- The reasons include both:
  - Technical (Inadequate means for first responder communication due to different and incompatible radio systems or
  - Technical operational performances (infrastructures, field cond ...)
  - Non-technical issues (e.g., governance, policies, procedures, and training).

The EULER-project aims to demonstrate what benefits SDR (Software Defined Radio) should provide for interoperability in case of national and international joint emergency service operations.
Several forum / standard bodies (MESA, P. 25, TETRA, ETSI RSS...) are addressing future communications user requirements.

The key items to be considered:

- Improving the interoperability between public safety communications systems
- Improving the efficiency of the existing spectrum usage
- Improving the crisis management operations through services enabled by new technology
- Voice predominant demand but not only
- Collect and share / access to imagery / video localisation indoor outdoor / weather ..
- Harmonized spectrum band in Europe cross border and decrease cost.

**MESA Statement of Requirements v3.3.1(March 2008)**

- Anticipates that convergence will be a natural progression within the public safety community as **new rate-intensive technologies**
- The gross data rates involve capabilities to be supported by the next generation of public safety **wireless, high-speed, digital** transport systems (at least 1.5 -> 2 Mbps)
- **Dynamic bandwidth and Self-healing Network**
- Transparent seamless applications, includ **multiple levels of security and encryptions**
- For public safety organisations, but also vehicle tracking, environmental monitoring, traffic surveillance, hazardous areas, prisons ... including scenarios
- **Request certainly waveforms in addition to study Networks**
A complex paradigm: Interoperability Mission and Business models

The main Complexity is correlated to 3 models

- **Defence**: crucial issues re-configurability. Coalition joint operation, for which security, QOS and resilience are critical. Unpredictable environment and Jamming coexistence with legacy radios and networks (retrofit).

- **PMR**: faces predictable and unpredictable events for which Resilience, QOS and security are critical (and for now + 40 Mhz bandwidth will help)

- **Commercial**: predictable processes QOS and resilience are important versus Customer average quality
  
  Key issue Average Revenue per Unit.

**Model of shared spectrum proposed by ETSI RSS is interesting.**

Fixed spectrum management for basic services voice security critical mission and Shared spectrum with commercial Ntw and operators extended services high data rate Video / data / messaging
EULER : New capabilities with SDR

Operational requirements

- **Joint Operations** with different agencies (possibly from different Countries)
- Public safety organizations operate in **unpredictable conditions** also from the point of view of spectrum availability (interferences)
- Public safety operations are usually **unplanned** and communications infrastructures may not be available.
- Public Safety operators may not have the **interoperable terminals** with the wireless networks existing in the emergency area.
- **Evolving Technologies and standards** may cause the existing wireless equipment to become obsolete.
- **Limited budget** for infrastructure/equipment upgrade
- Different levels of **security** among agencies

Required capabilities

- **Interoperability**
- Flexible Spectrum Management
- Reconfigurability
- Backward compatibility with legacy equipment
- Software upgrade vs. hardware upgrade.
- Support for multilevel security.
SDR EULAR - What is targeted:

- A Software Defined Radio Standard shared at European level for security services
- An open public safety wireless communication system architecture
- A reference high-data-rate waveform for security

End-users needs Driven definitions

standardisation

Transition industry from vertical to horizontal model

System integrators
SDR platforms provider
Waveform & protocol providers
Applications providers
EULER & Interoperability

EULER addresses interop “at the equipments scale” by:

- Proposing a high-data-rate waveform supporting the complex requirements of security forces (joint) operations

- Defining precisely how SDR capabilities can be best integrated in a security (P&GS) communication system architecture

- Implementing the SDR open business model, with separation of roles between SDR platform and SDR waveform providers

The EULER -project aims provide proof-of-concept waveform implementation and portability on several software defined radio platforms and realize an integrated demonstrator targeted towards end-users.
Portability: a step for interoperability

Portability requires:
- Waveform functionality realized in GPPs, DSPs and FPGAs
- Standards such as Standard Software Communication Architecture (SCA) for implementing SDR

The SCA defines standard interfaces that allow waveform applications to run on multiple hardware sets. The SCA defines a Core Framework (providing a standard Operating Environment) that must be implemented for all SCA capable hardware environments.

The use of SCA provides two main advantages:
- It enables software elements or modules to be written by different organisations and to be brought together.
- It enables the re-use of some modules, improving interoperability and cost savings.
EULER : radio waveform(s)

Providing complete interoperability may request the use of a particular waveform being used across the equipment from several manufacturers

• High-speed data waveform principles
  – Identify Wimax (802.16e 2005) suitable subset targeting both wireless infrastructure and terminals

  • Reuse state of the art radio techniques (notably PHY layer)
  • Implement IP network functionality atop waveform
  • Good reception quality in multi-path environment (e.g. urban environment)
  • Revisit Wimax Security (security threats analysis)
  • Support for dynamic coexistence (w.r.t spectrum) of networks,
  • Support for PMR-services
    • e.g call setup, fast communication establishment, group comms
  • Impact of operation in PMR relevant frequency bands

• Investigation of Satcom waveform for crisis management in SDR
  – Complementary to land-waveform
EULER : Collaborative R&D project

- Euler Waveform
  - Waveform functionality realized in GPPs, DSPs and FPGAs
  - Different layers providers:
    - Phy layer (OFDMA)
    - (Wimax) security layer
    - MAC
    - IP-Convergence
    - Fault mngt
    - Network mngt
    - Spectrum Access mngt
    - Control

SDR Platforms

- Different providers
- OE implementation
  - The OE implements a basic set of core services and standardized component interfaces for waveform execution and portability.
  - As defined by the SCA standard, this OE consists of:
    - POSIX conformant operating system
    - TCP/IP stack
    - CORBA
    - SCA core framework

Transceiver Facility

- The Transceiver API (v1.0 version) has been selected as the interface between the WF and the Platforms, enabling the separated PF/WF providers business model
- EULER SDR Platforms implement a Transceiver compliant interface on top of which the EULER WF will be ported
- Since one of the main goals of EULER is to demonstrate portability for an SDR WF, this makes the Transceiver API a fundamental pillar for the success of the project
EULER : Possible Technical Demonstration

Interoperability Between SDR HDR WF and Satcom WF

Interoperability between SDR (High data rate WF)

Interoperability Between SDR and Legacy networks (IP Based)
EULER & Stakeholders

• One EULER specific objective is to approach in a systematic way the Operational stakeholders community, to identify, operational needs and requirements.

  Sp Fr Nl Sw Fi Uk ...

This is an on going action.

• comments advices recommendations are always welcomed

  www.euler-project.eu

And join SCG IMGS community