RECONFIGURABLE RADIO SYSTEMS FOR PUBLIC SAFETY: NEW GENERATION PUBLIC SAFETY ICT

2011 Wireless Innovation Forum European Conference on Communication Technologies and Software Defined Radio

22-24 June 2011 • Brussels

Fabrizio Vergari - Selex Communications
Gianmarco Baldini – EC JRC (*)

JRC
EUROPEAN COMMISSION

SELEX
Communications
A Finmeccanica Company

* *Disclaimer: the views expressed are those of the author and cannot be regarded as stating an official position of the European Commission*

Overall target

A summary of PS operational contexts and relevant functional needs.

To highlight the benefits of RRS for PS first responders including the current trend of ICT applications with particular reference to European situation.

To highlight the potential technical and economic capabilities moving around the corner.

PS = Public Safety

RRS = Reconfigurable Radio Systems

ICT = Information Communication Technology

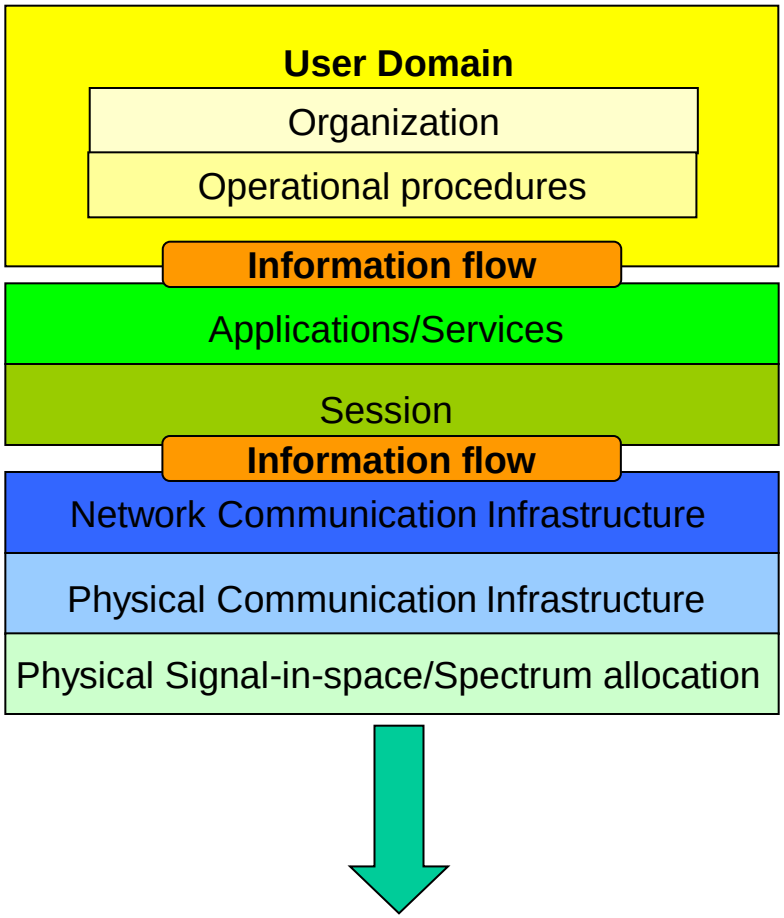
OUTLINE

- INTRODUCTION
- OPERATIONAL CONTEXTS
- BENEFITS OF RECONFIGURABILITY IN PUBLIC SAFETY DOMAIN
- BUSINESS AND LIFE CYCLE CONSIDERATIONS

INTRODUCTION

Information Flow

Reconfiguration involves different domains through the information flow.



Procedures, Policies, Network configurations, RATs are the subjects of reconfigurations.

Software Defined Radio is the main subject for the radio communication infrastructure domain

RAT = Radio Access Technology

SDR relevant programs

USA

JTRS Program

Thales's Liberty Multiband Land Mobile Radio, analog FM and Project 25

Harris's XG-100P Multiband Portable Radio

Harris's Falcon III RF-310M-HH Suite B Compatible Multiband Handheld Radio

Radio Frequency Spectrum for PS

	United States		Europe		
Frequency Band	**Tuning Range (MHz)**	**Available Bandwidth (MHz)**	**Frequency Band**	**Tuning Range (MHz)**	**Available Bandwidth (MHz)**
VHF Low band*	25 - 50	6.3			
VHF High band*	150 - 174	3.6	68 MHz to 87,5 MHz , 146 MHz to174 MHz VHF band		****
220 MHz band*	220 - 222	0.1			
UHF band*	450 - 470	3.7	UHF band	380 - 385 390 - 395	5 5
700 MHz band	764 - 776 794 - 806	12 12		*410 - 430* *450 470*	*20*** *20***
800 MHz band*	806 - 821 851 - 866	1.75 1.75			
NPSPAC band	821 - 824 866 - 869	3 3			
5 GHz band	4940 - 4990	50	5 GHz band	*5150 5250* alternatively: 4940 - 4990	*50****
Total available bandwidth		**97.2**			**10**

NOTE 1: (* denotes approximate available bandwidth)

NOTE 2: (** shows non-dedicated bands in Europe, hence not included in the total available bandwidth)

NOTE 3: (*** for local and temporary usage (PP2 and DR) only, hence not included in the total available bandwidth)

NOTE 4: (**** many European countries have national frequency designations for PPDR in the VHF frequency range which are not harmonized troughout Europe, hence not included in the total available bandwidth).

EUROPE

EC: WINTSEC, EULER

EDA: ETARE, WOLF, CORASMA, ESSOR, SCORED

Military national programs

SDR for Public Safety market?

...reasons of lack.....

EC = European Commision EDA = European Defence Agency

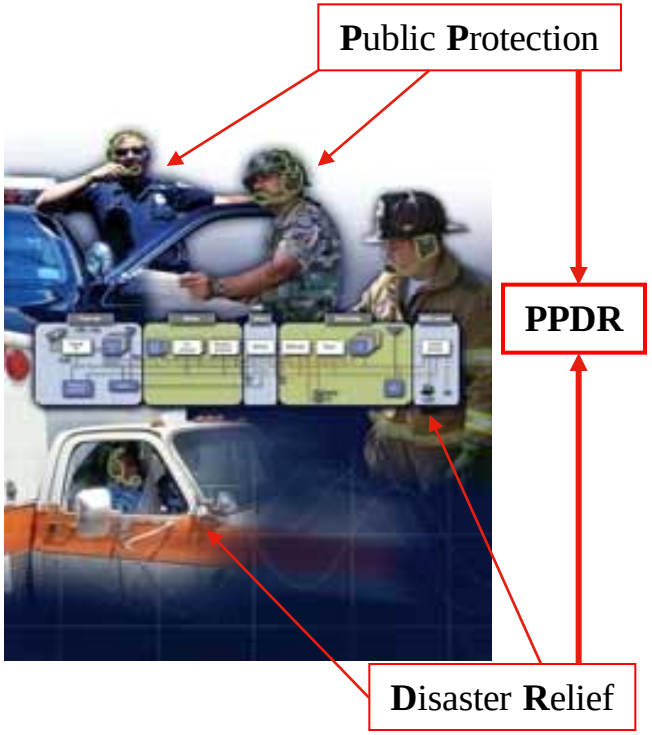
...Reason of Public Safety
SDR market lack

The deployment of dedicated Public Safety networks is usually very demanding for Public Safety organizations from an economic point of view and its national funding and private investment deserve a suitable support until now not verified.

Technological innovation like SDR and the Cognitive Radio (CR) should help to minimize the impact of design, development, deployment and functional updating on infrastructures and terminals.

An additional reason of this situation is the lack of a real demonstration of the benefits which a RRS can provide so as to allow PS End Users to effectively use ICT infrastructures and services to perform their duties.....

Benefits which a RRS can provide so as to allow PS End Users to effectively use ICT infrastructures and services to perform their duties



Benefits relevant for

Different operational contexts (scenarios)

User Applications and relevant policies

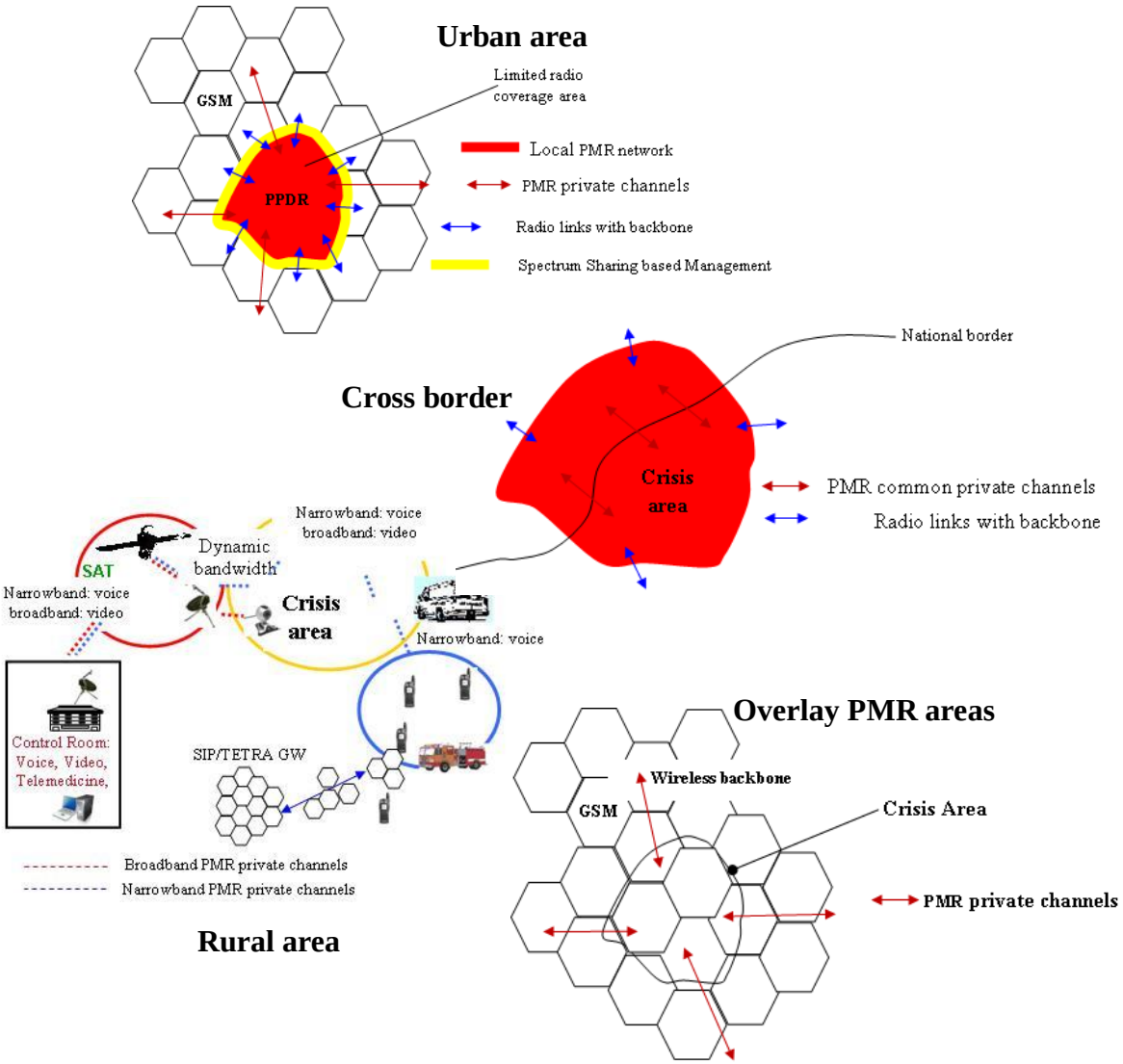
Different RATs

Technical and economic potential capabilities

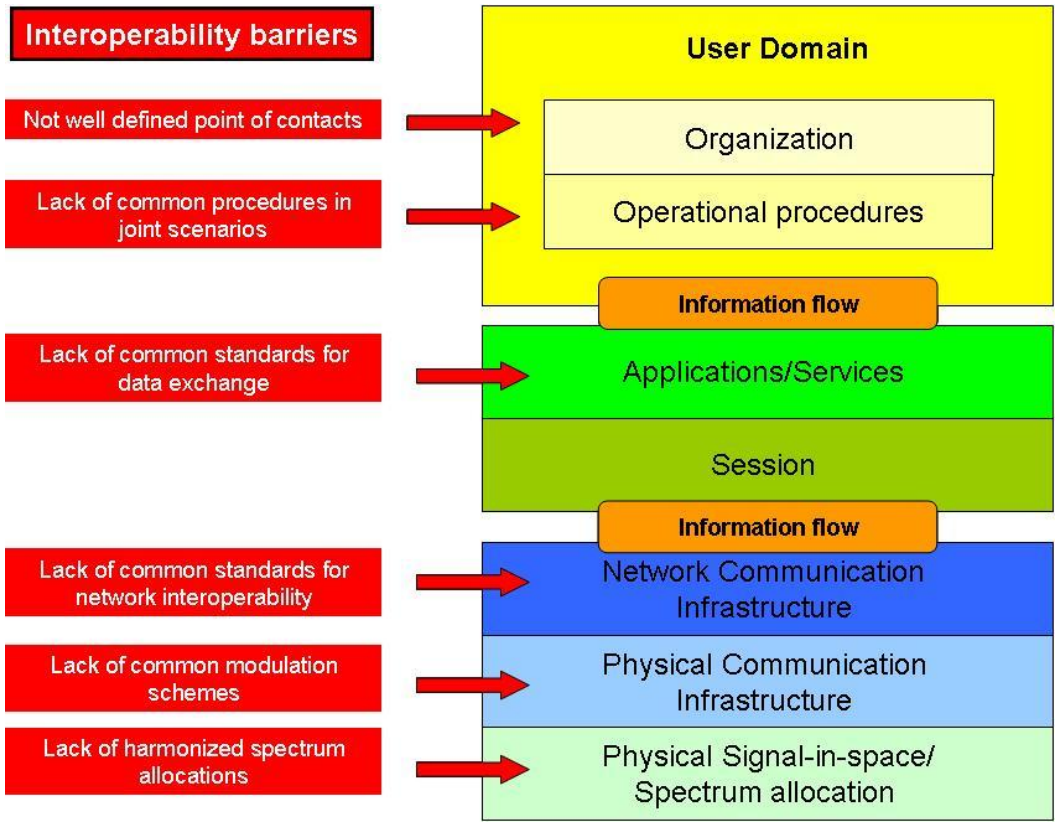
OPERATIONAL CONTEXTS

Public Safety operational contexts

Operational Context	Description	Features
Urban Area	Emergency crisis in urban environment like large cities or metropolis.	High density of population, different types of PPDR organizations, fast reaction times, network often overloaded.
Cross-Border	Law enforcement activities in border areas among nations or geopolitical regions. This scenario can be based on a blue border (e.g, sea, lake) or green border (e.g., land)	PPDR organizations from different countries and presence of interoperability barriers
Rural Area	Natural disasters in Isolated areas outside towns	Lack of network coverage.
Overlay PMR areas	Crisis and areas where heterogeneous commercial and dedicated networks coexist but security issues require the adoption of private networks	Presence of heterogenous networks with different security levels.



Interoperability



"Who talks Who"

data format providing the information managed by the Application/Service Domain

CAP Protocol provides a consistent situation picture.

PS RATs: TETRA/TEDS TETRAPOL, DMR, P25, Analog V/UHF, ...

CAP = Common Alerting Protocol approved by the OASIS organization.

Interoperability and User needs

PS users need to collect, analyze, distribute and store information among various entities and different contexts. This task requires a set of capabilities, which includes resource management, supply chain management and access to relevant data and communication.

First responders have to coordinate the relief efforts and to improve the situational awareness of the environment.

There is a trend to require access to the same range of applications, services and referenced data bases while in the field as an officer would have while in command centre.

Main topic first to continue...

While commercial networks may be present in the disaster area, Public Safety users are reluctant to use them for a number of reasons including:

Public networks do not offer sufficient connection for the involved users. Trusted voice and data transfer and the need to avoid traffic constraints make not suitable commercial networks adoption (high levels of network availability and low latency).

Public networks do not offer sufficient security level. Information protection is required both in the crisis area and for interaction with external users.

Public networks in the crisis area may be compromised.

Public Safety organizations use various communications systems based on different standards (mainly TETRA + TETRAPOL in Europe, APCO P25 in USA/Canada and DMR across Asia, the Middle East, Europe, North and Latin America, Africa and Australasia).

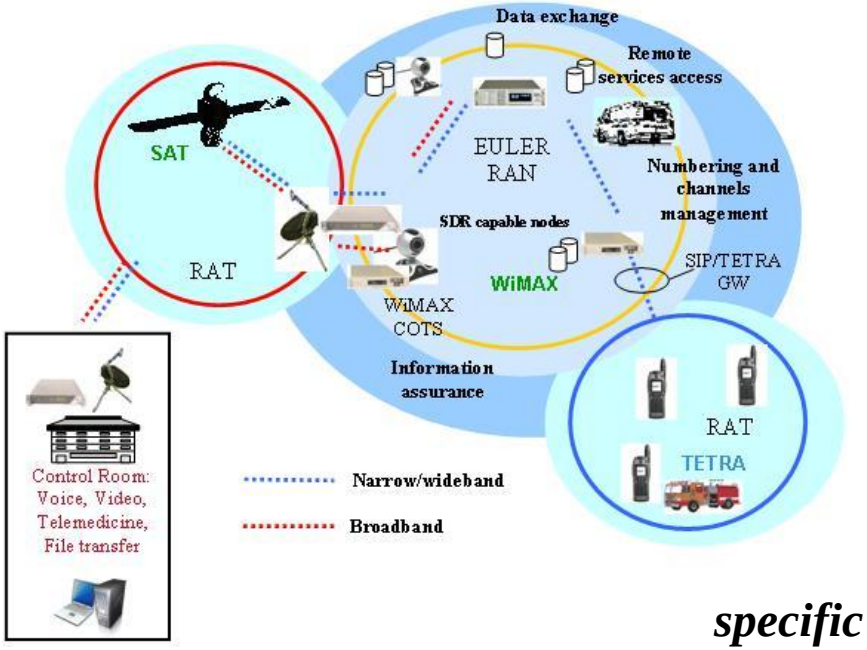
Direct mode (terminal-to-terminal capability) is not provided nor foreseen by commercial network.

There is no provision in current commercial networks for pre-emption capabilities or preferential measures which are necessary to provide guarantee services for PS.

BENEFITS OF RECONFIGURABILITY IN PUBLIC SAFETY DOMAIN

Real exploitation of the SDR capability and relevant knowledge acquired by many companies already involved in military programs, both in US and Europe and other regions.

EC funded EULER program



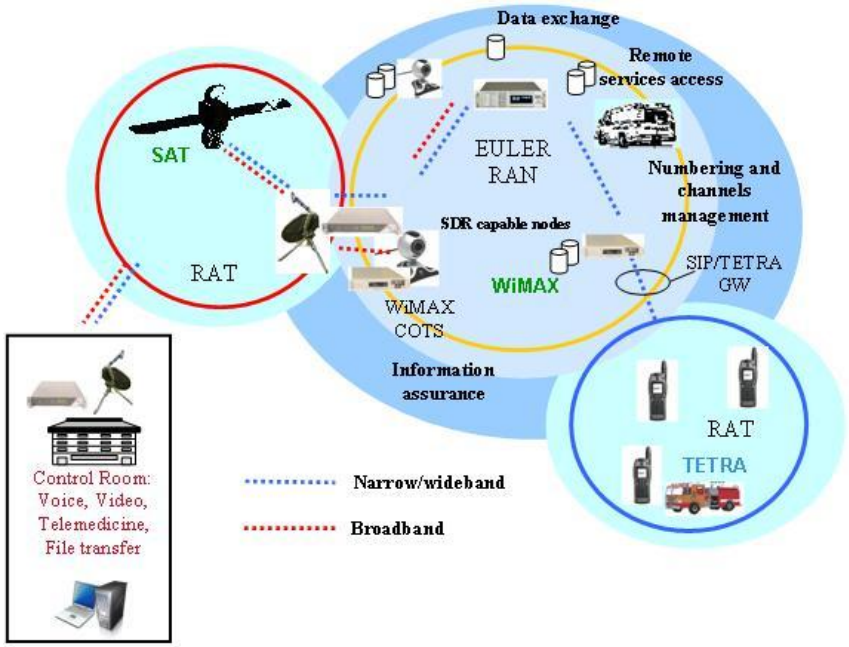
We have to address also international cooperation.

The requirement of interoperability between military and not-military forces increases within crisis situation caused by terrorist attack and the necessary countermeasures that have to be established

specific security profiles for specific operations

EULER PS network deployment is going to face the following inter-working aspect:

EC funded EULER program



- Physical layer and protocols characteristics matched between the systems (RATs and RAN), including conversion of physical and electrical states, rate adaptation and transmission attributes, in-band signalling conversion, codec and encryption issues, PTT (Push-To-Talk) mode vs. duplexing mode.

- IP/TETRA Gateway;

- Mapping service data units with an inter-working protocol, including conversion, filtering and discarding.

  - Handle compatibility information and service agreement.

  - Provide conversion between numbering or channel allocation plans.

  - Information assurance.

"Best effective adaptation to radio frequency spectrum policies and technologies evolution"

Spectrum Rules fragmentation and delay at European level.

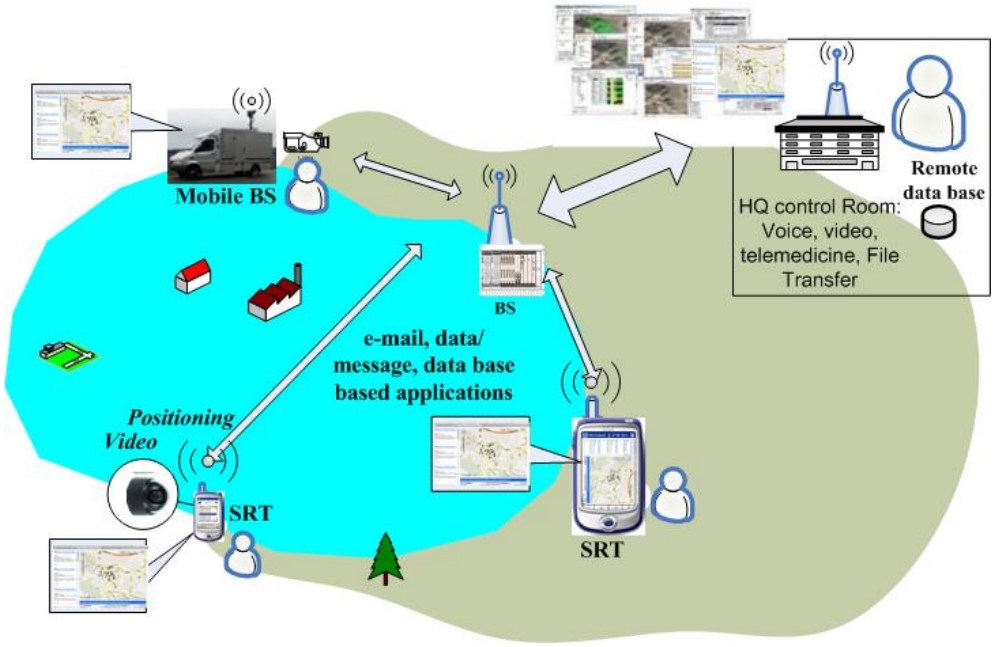
A period of multi RATs including legacy will occur and in order to be ready to face this technology insertion the current interoperability limitation should have to be overcome.

There are many candidate broadband technologies but not yet a specific one has been considered as a preferred standard (ex. WiMAX Vs LTE) therefore stressing investments decisions that could be effectively overcome by RRS adoption.

The current technology already enables incident reporting applications to be integrated into the radio terminal, then reducing the responder need to return to HQ/command centre to access office applications.

Now we can already consider and design Smart Radio Terminal(s) (SRT) capable of hosting computer applications.

Then, already now logical interfaces and protocols have to be applied at waveform and radio services level so as to adapt to new applications, typically designed as web applications.



We can suppose an applications set will be gradually deployed, then the SRT capabilities will be gradually update.

Application	Description
Verification of biometric data	Public Safety officers may check the biometric data of potential criminals (i.e. fingerprints) during their patrolling duty. The biometric data could be transmitted in real-time to the headquarters or a center with the biometric archives and the response could be sent back to the Public Safety officers. This would be a positive method of identification during field interrogation stops.
Wireless video surveillance and remote monitoring	In these types of applications, a sensor (fixed or mobile) can record and distribute data in video-streaming format, which is then collected and distributed to public safety responders and command & control centers.
Automatic number plate recognition	A camera captures license plates and transmits the image to headquarters or a center with the plate data to verify that the vehicles have not been stolen or the owner is a crime offender.
Documents scan	In patrolling or border security operations, public safety officers can verify a document like a driving license in a more efficient way. Documents scan is also useful in border security operations where people, who cross the borders, may have documents in bad condition or falsified.
Database checks	This application area includes all the activities where public safety officers must retrieve data from the headquarters to support their work.

...the list is not completed...

Specific user applications for specific users

Application	Description
Location/ Tracking for Automatic Vehicle/Officer Location. Situation Awareness.	The public safety officer has a GNSS position localizer on the handheld terminal or the vehicular terminal. The positions are sent periodically to the headquarters so that the command centre can organized and execute the operations in a more efficient way.
Transmission of Building/Floor plans	In case of an emergency crisis or a natural disaster, Public Safety responders may have the need to access the layout of the buildings where people may be trapped. Building or floor plans can be requested to the headquarters and transmitted to the public safety responders.
Monitoring of Public Safety officer	Vital signs of Public Safety officers could be monitored in real-time to verify their real condition. This is particularly important for firefighters and officers involved in search & rescue operations.
Remote emergency medical service	Through transmission of video and data, medical personnel may intervene or support the team in the field for an emergency patient.
Sensor networks	Sensors networks could be deployed in a specific area and transmit images or data to the Public Safety responders operating in the area or to the command centre at the headquarters. This application does not include video-surveillance, which is described above.

...probably some items will be added in the list...

It is an "application centric" approach!

This approach, already experienced on PC based solutions and recently in smart phones seized applications, is the main issue of ICT based new generation Public Safety interoperability.

An applications set will be gradually deployed, then the SRT capabilities will be gradually update.

These applications will adopt "web-based" like mechanisms and will have to rely on the services framework in turn adopting standard protocols using a common markup language suitable to exchange heterogeneous information.

It's a matter of SW architectures

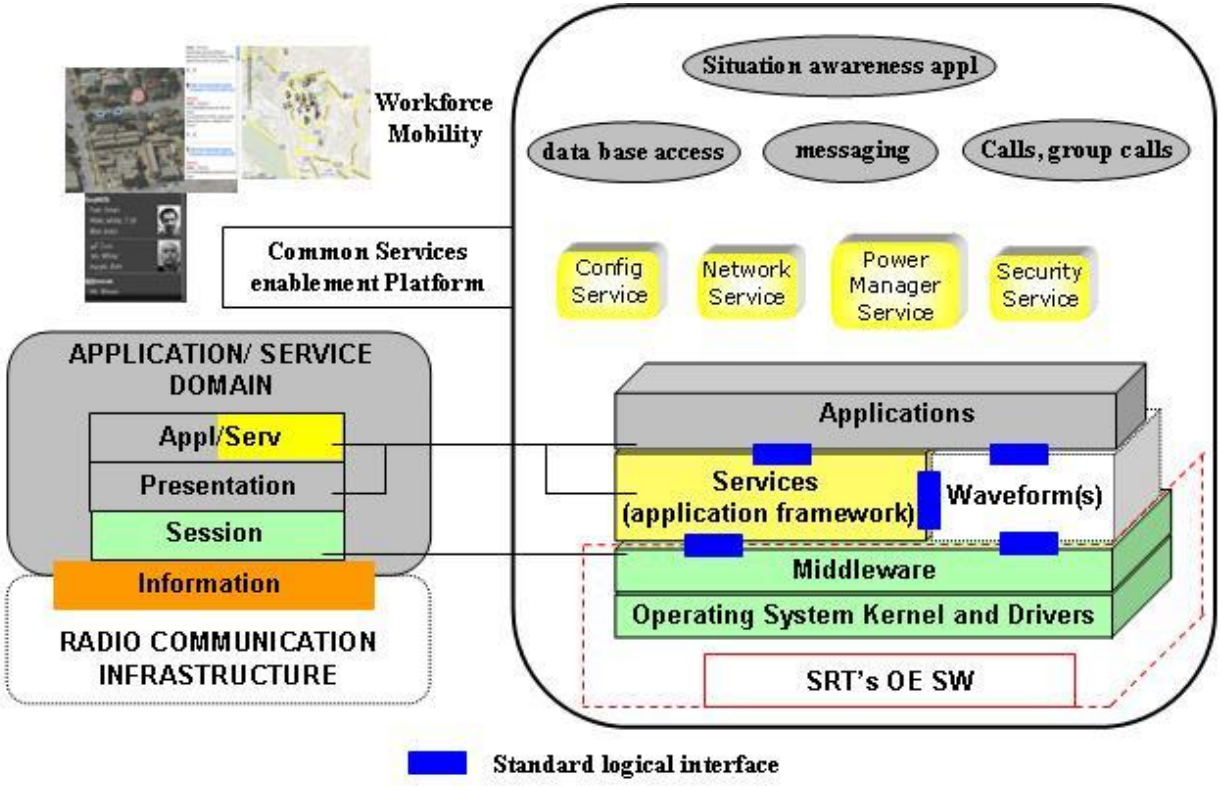
User applications

Services

Policies

Protocols

RATs

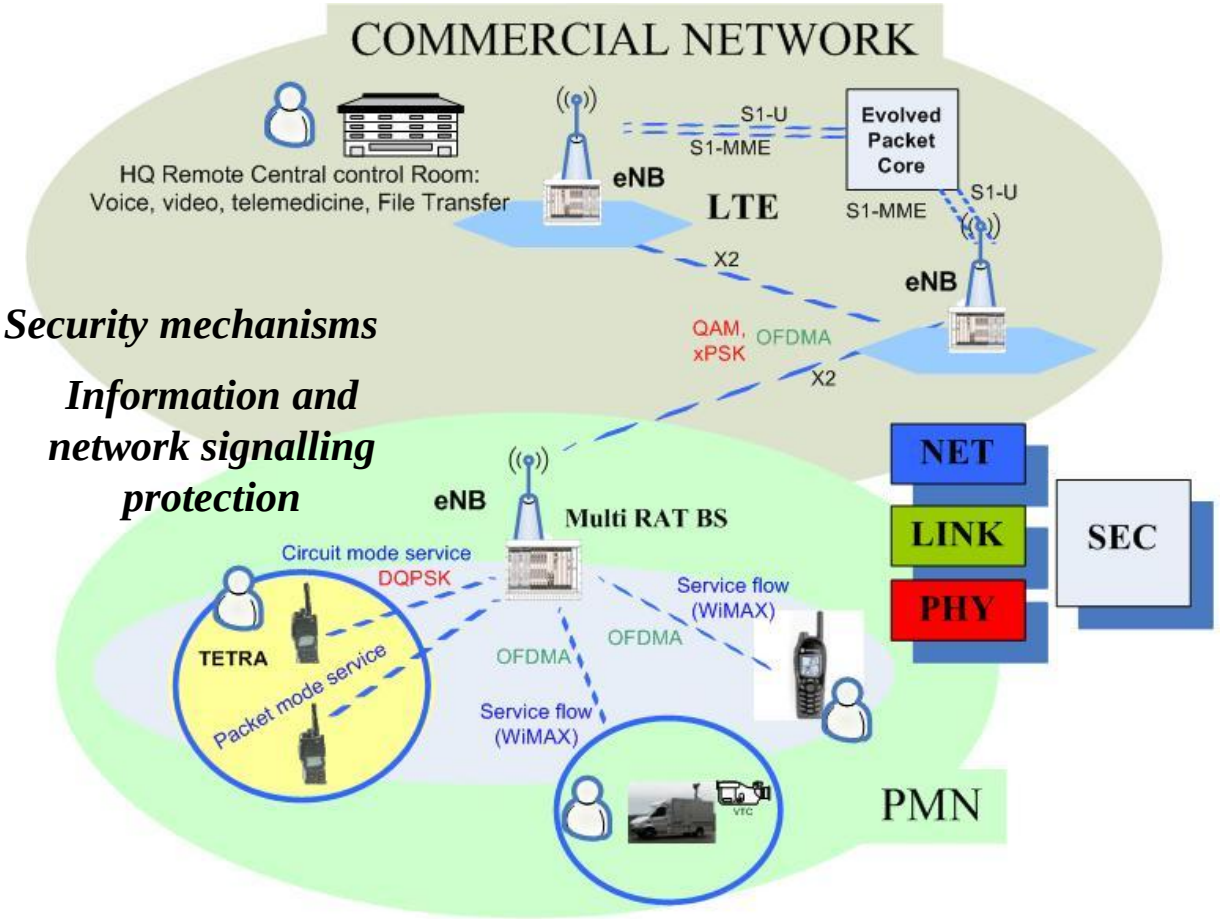


Interfaces standardisation in order to make technology independent new applications installation

Interoperability

Application centric

Technology independence



eNB: E-UTRAN NodeB
MME: Mobility Management Entity
S-GW: Serving Gateway
P-GW: PDN (Packet Data Network) Gateway
S1-MME = S1 for the control plane
S1-U = S1 for the user plane
X2 = Interface between eNBs
PMN = Professional Mobile Network

Group services across multiple networks .....

Interoperability for cross border cooperations

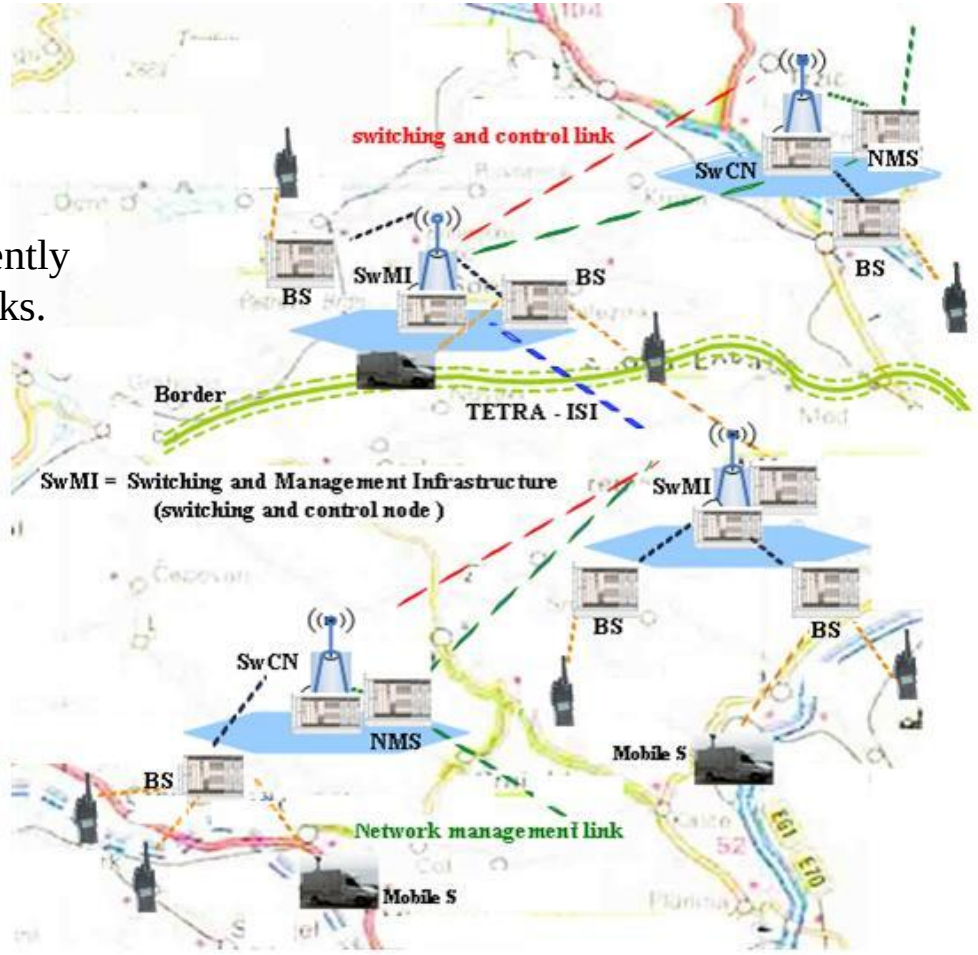
TETRA ISI addresses cross-border communications between independently owned and operated TETRA networks.

Cross border roaming

Inter networks group calls

Different national level end-to-end encryptions

Spectrum Management



ISI = Inter system Interface

This is a chance to integrate new services and to allow new suppliers to be involved in the business and relevant value chain ……...

BUSINESS AND LIFE CYCLE CONSIDERATIONS

The environment of PS is a fertile area where to apply an application-centric approach being it not concentrated and limited on the cost optimisation of fixed functions and RATs related devices.

Initial R&D investment in Europe

EC funded FP6/7 programs, with respect relevant themes named Security, ICT and IST.

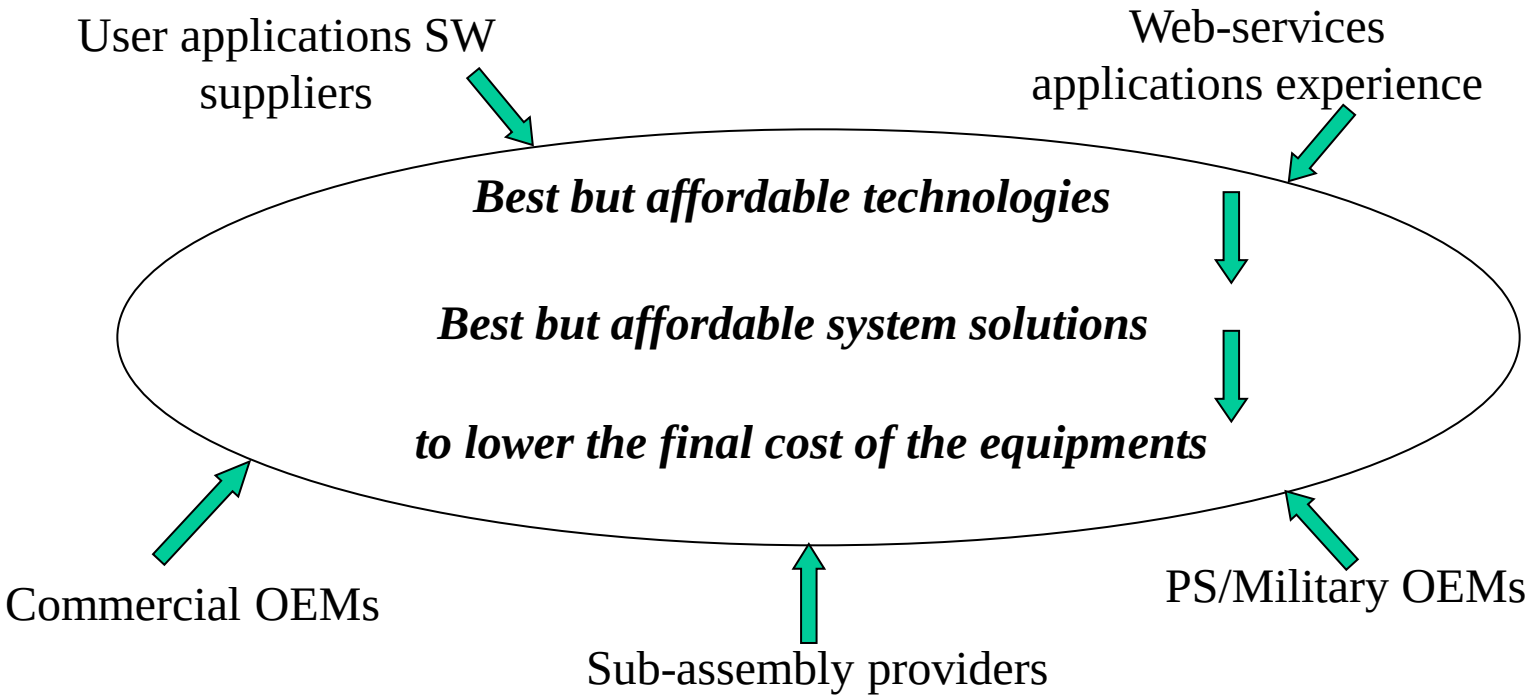
The ideal target is to fund projects able to output user applications prototypes fielded, tested and **validated by first responders**.

TETRA ISI concerns a strategy at European level.

There is a chance to take in the PS market new stakeholders, currently aimed mainly in commercial or military markets.

IST = Information Society Technologies

Reconfigurable solutions for the network components offer an effective way to allow additional services and additional suppliers to be integrated in the business model and relevant value chain.



OEM = Original Equipment Manufacturer

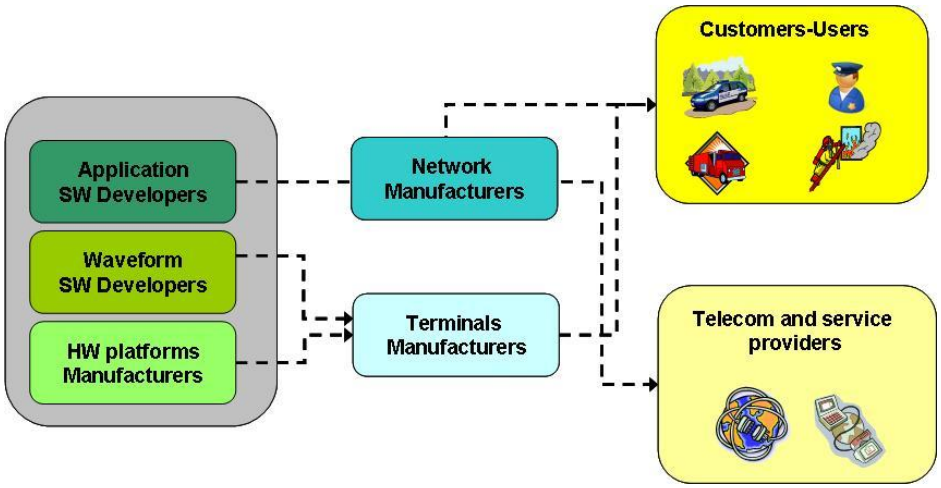
The RRS concept moves the lifecycle concept application from the overall terminal or base station down to the single subassembly, application and waveform.

Modular processing enhancement

Manage the obsolescence

Partnerships among OEMs, user applications developers and sub-assembly providers

Modular value chain



to design RRSs able to effectively reduce the operational life costs including the user training, the maintenance and the upgrading.

CONCLUSIONS

A lot of publications, among which some references mentioned in this paper, consider the public safety sector a niche market. This is the current situation. But if we think about all the natural disasters occurred in the last ten or more years, also including the terrorist attacks, then we would think about the number of first responders involved all over the world.

First responders for L'Aquila earthquake (*)

	24 hours	48 hours
Fire fighters	2010	2400
Armed forces	1520	1650
Police	1500	2000
Red Cross	800	800
Volunteers	2000	4300
K9 (rescue dogs unit)	108	134
TOTAL	**7938**	**11284**

(*) S. Wells, A. Miozzo, "Catastrophic Events Management: Katrina and L'Aquila experiences", AOS, December 2010.

CONCLUSIONS

...last news in Europe

The EU Internal Security Strategy in Action: Five steps towards a more secure Europe, Brussels, 22.11.2010;

Research and Energy (ITRE) discussed the "Proposal for a decision establishing the first radio spectrum policy program" (RSPP), adopted by the European Commission in September 2010;

On 9 December 2010, the European Council highlighted the potential benefits of developing civil-military synergies in capability development and the added-value of dual use capabilities. In this regards, it emphasized the need for further cooperation between the European Defense Agency and the European Commission, notably in research and technology;

PSCE General Assembly approved the proposal for the creation of a new working group called "Open Safety and Security Architecture Framework" (OSSAF): to coordinate the perspectives of different types of stakeholders within a Public Safety and Security organization (Strategic, Operational, Functional and Technical).

PSCE = Public Safety Communication Europe (Forum)

- Contact
  - Fabrizio Vergari
    - Selex Communications, Pomezia, Italy
    - email: fabrizio.vergari@selex-comms.com
  - Gianmarco Baldini
    - Joint Research Centre – European Commission, Ispra, Italy
    - email: gianmarco.baldini@jrc.ec.europa.eu