Innovation for public safety communications

PSCE, Warsaw, 1st December 2011

- Joint Research Centre – European Commission
- Public Safety Communications today
- Innovation for Public Safety communications

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The Mission of the Joint Research Centre

… is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies.

As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union.

Close to the policy-making process, it serves the common interest of the Member States, while being **independent** of special interests, whether private or national.

Our Structure: 7 Institutes in 5 Member States

IRMM - *Geel, Belgium*
Institute for Reference Materials and Measurements

ITU - *Karlsruhe, Germany*
Institute for Transuranium Elements

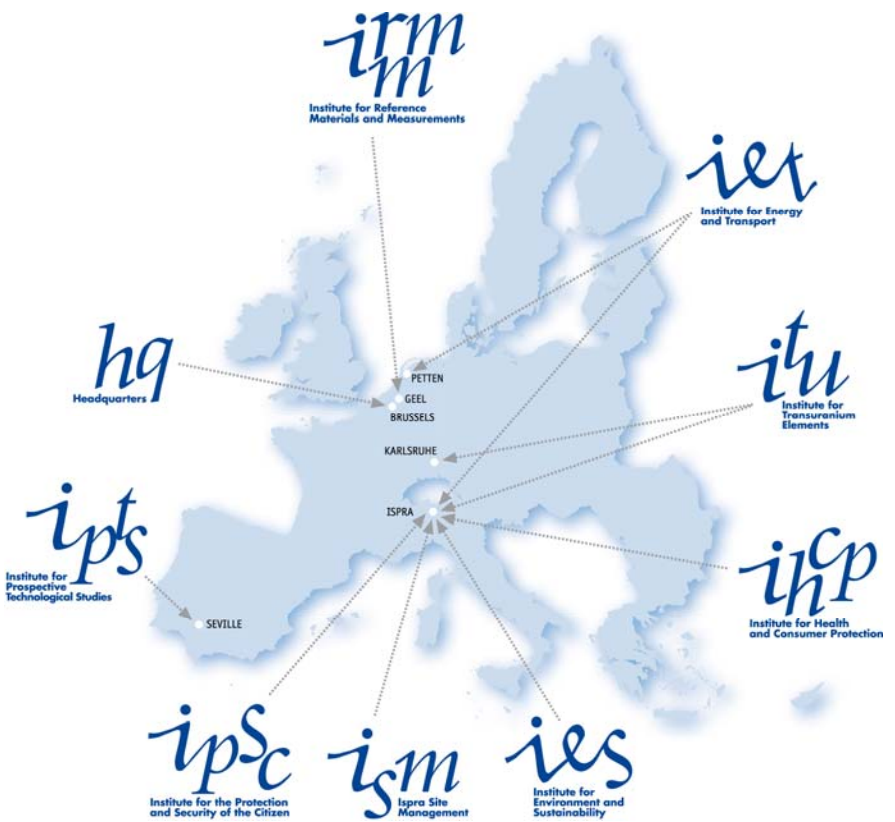
IET - *Petten, The Netherlands – Ispra, Italy*
Institute for Energy and Transport

IPSC - *Ispra, Italy*
Institute for the Protection and Security of the Citizen

IES - *Ispra, Italy*
Institute for Environment and Sustainability

IHCP - *Ispra, Italy*
Institute for Health and Consumer Protection

IPTS - *Seville, Spain*
Institute for Prospective Technological Studies



~ 2750 staff
~ 330 M€/y budget (+ 40 M€/y competitive income)

Mission

The mission of the IPSC is to provide research results and to support EU policy-makers in their effort towards global **security** and towards **protection** of European citizens from **accidents, deliberate attacks, fraud** and **illegal actions against EU policies**

EUROPE 2020

Five measurable EU targets for 2020 in order to steer the process:

- for employment
- for research & innovation
- for climate change and energy
- for education
- for combating poverty

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Public Safety communications challenges

- Interoperability barriers among the wireless equipment and systems of the various public safety organizations.
- Public Safety responders need high communication bandwidth to transmit images and video.
- Public safety organizations must operate in uncertain conditions and difficult environments both at physical and spectrum perspective (interferences)
- Public safety operations are usually unplanned and communications facilities are not guaranteed.
- Public Safety users may not have the terminals related to the wireless networks existing in the emergency area.
- Evolving Technologies and standards may cause the existing wireless equipment to become obsolete. Equipment lifecycle can be a problem.

FP7 Security Call Theme 10 - WORK PROGRAMME 2012
Area: 10.5.3 Interoperability

Topic SEC-2012.5.3-4 Global solution for interoperability between first responder communication systems - Integration Project.

It has been recognised by the Council Recommendation on improving radio communication between operational units in cross-border areas of the 4-5 June 2009 that interoperability between communications systems used by different first responder organisations is currently a key issue for the success of the cooperation within the EU, and requests the development of TETRA-TETRA and TETRA-TETRAPOL Inter System Interfaces (ISI), allowing PPDR services to roam with their own equipment from one country to another one.

Topic SEC-2012.5.3-2 Establishment of a first responders platform for interoperability - Coordination and Support Action

The task is to establish an End Users Forum in order to stimulate the cooperation between providers and users (police, fire brigades, emergency services…) at each level of interoperability.

Topic SEC-2012.5.3-3 Establishment of a interoperability platform/centre for testing and validating security innovations - Network of Excellence

The task is to create a design process and methodology for testing and validation of security innovations in order to create shared platforms/centres for selected segments of the security Market.

Spectrum Management

CEPT FM38 (completed) - collect information on the existing and planned spectrum usage for PMR/PAMR and follow the developments of PMR/PAMR, including Public Protection (PP) and Disaster Relief (DR).

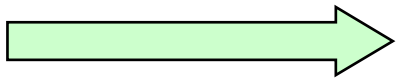
CEPT FM49 (started September 2011) - work on radio spectrum issues concerning PPDR applications and scenarios, in particular concerning the broadband high speed communications as requested by PPDR organisations;
identify and evaluate suitable bands for European-wide harmonisation of spectrum (both below and above 1 GHz), by taking into account cross-border-communication issues and PPDR application requirements;

ETSI TR 102 628 "Additional spectrum requirements for future Public Safety and Security (PSS) wireless communication systems in the UHF frequency range"

Still discussing on harmonized and available spectral bands for Public Safety…

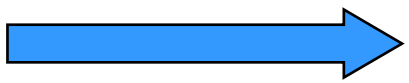
Potential new technologies and approaches

Lack of Interoperability



- ISI standardization
- IP Gateways
- Multi-Mode or SDR terminals
- Service Oriented Architecture
- Evolution of TETRA/TETRAPOL

Lack of wireless broadband connectivity



- Long Term Evolution (LTE)
- Harmonized spectrum bands
- Multi-band terminals
- Improved spectral efficiency
- Spectrum sharing
- Evolution of TETRA/TETRAPOL

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Innovation in civil security

Innovation helps companies conquer new markets or stave off competition. It comes in many different forms, ranging from an invention arising from R&D to efforts to adapt production procedures, tap new markets, use new organisational approaches or create new marketing concepts.

(from Innovation and the Lisbon strategy)

The Security Research & Innovation programme's primary goal is to protect Europe's citizens and society from harm, while enabling its economy to recover from man-made or natural disasters.

Security R&D also has a clear economic dimension. The programme's research projects are complemented by industrial policy measures, ranging from the support of **technical standards** to efforts to overcome fragmentation in Europe's security market. The main goal here is to strengthen the sector and Europe's competitive position in the global marketplace for security products and services.

(from DG ENTR (http://ec.europa.eu/enterprise/policies/security/index_en.htm))

Innovation also means investigating new technologies, which could be promising for civil security

The European Telecommunications Standards Institute (ETSI) produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies.

ETSI Technical Committee for Reconfigurable Radio Systems investigates Software Defined Radio and Cognitive Radio wireless communication technologies.

TC RRS shall have responsibility:

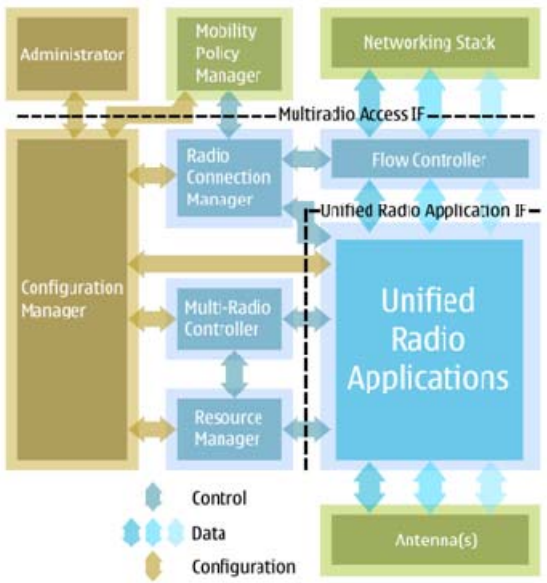
- of standardization activities related to Reconfigurable Radio Systems encompassing system solutions related to Software Defined Radio (SDR) and Cognitive Radio (CR);
- to collect and define the related Reconfigurable Radio Systems requirements from relevant stakeholders;
- to identify gaps, where existing ETSI standards do not fulfil the requirements, and suggest further standardization activities to fill those gaps;
- to deliver its findings in the form of ETSI deliverables as appropriate;
- to provide ETSI with a major centre of expertise in the area of Reconfigurable Radio Systems.

ETSI TC RRS

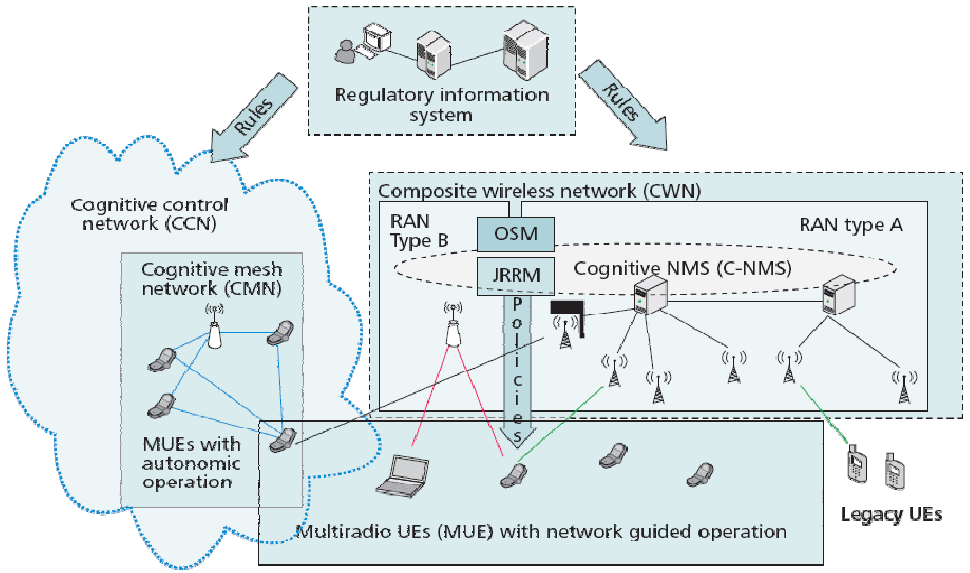
TC Chairman (Markus Mueck, Infineon)

- **WG 1, System Aspects (Paivi Ruuska, Nokia)**
  - **coordination of reconfigurable technologies**
- **WG 2, Equipment Architecture (Markus Mueck, Infineon)**
  - **focused on SDR**
- **WG 3, Functional Architecture (Jens Geber, Alcatel-Lucent)**
  - **focus on CR**
- **WG 4, Public Safety (Gianmarco Baldini, JRC-EC)**
  - **Public Safety, defence, bluelight, …**

Composed by representatives from more than 30 organizations (industry, government and research)



Focusing on system aspects and multi-standard terminals



What we are talking about ?

Software Defined Radio: radio in which the RF operating parameters including, but not limited to, frequency range, modulation type, or output power can be set or altered by software, and/or the technique by which this is achieved. **ETSI**

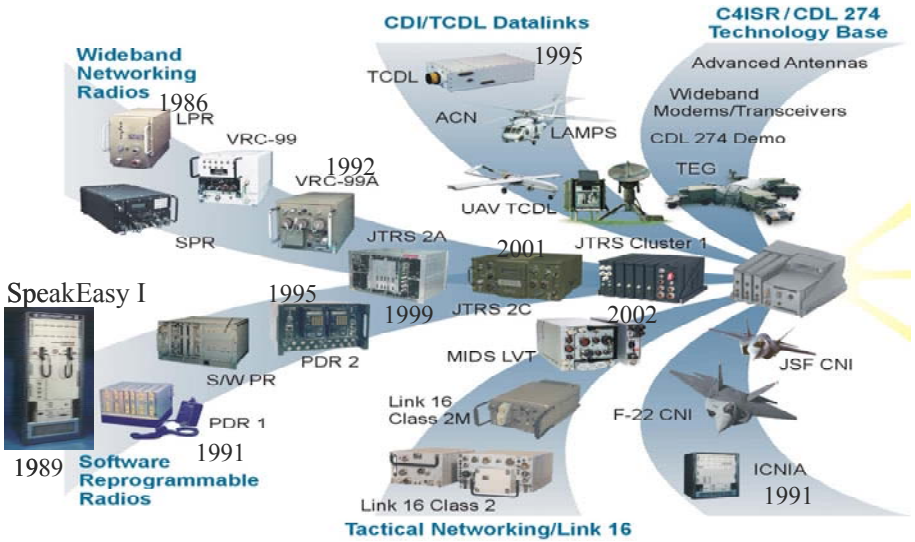
SDRs might simplify the implementation of multi-modal devices and bring additional flexibility by allowing patches and enhanced functionality to be downloaded to the terminal. We also noted that SDR might be an enabling technology for cognitive radios and perhaps other advances in spectrum usage. **OFCOM**

- Tier 0 – Hardware Radio, which is a baseline radio with fixed functionality.
- Tier 1 – Software-Controlled Radio, where the radio's signal path is implemented using application specific hardware.
- Tier 2 – Software Defined Radio, where most of the radio functions are performed in software. For example, the signal path can be reconfigured in software without requiring hardware modifications.
- Tier 3 – Ideal Software Radio, where software programmability extends to entire system.
- Tier 4 – Ultimate Software Radio, which has full programmability, may operate in a broad range of frequencies and can switch from one air interface/application to another in a limited time (e.g., milliseconds).

Wireless Innovation Forum

SDR history

SDR has its Roots in Military Domain, back in the 1980s
"Software Defined Radio" Concept was introduced by J. Mitola in the early 1990s



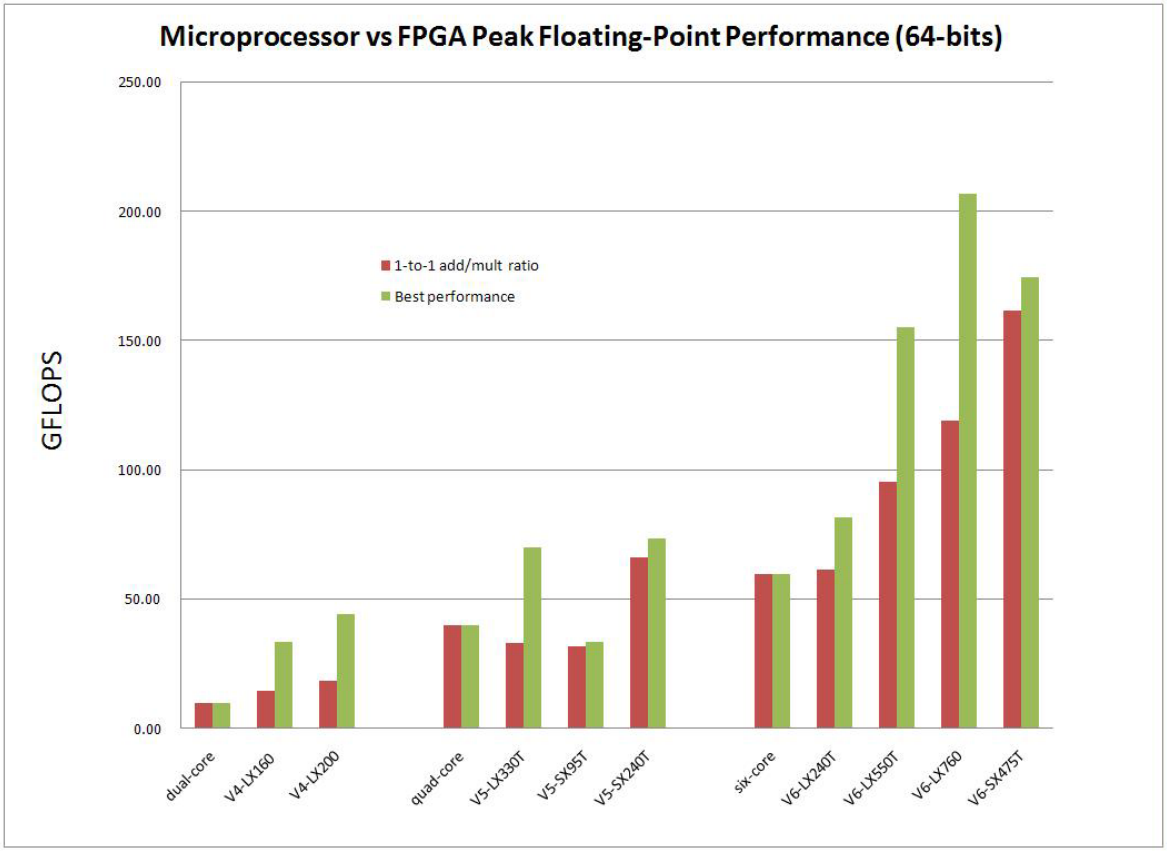
From JTRS program

	Conventional Radio	Software Defined Radio	Advantages
Modulation/ Demodulation Signal Processing Digital Up Conversion (DUC) Digital Down Conversion (DDC) Speech Coding Voice/Data Extraction	Does all with HW components (inductors, capacitors, amplifiers)	Most of processing is done in software.	To change the way the radio works: • Change the Software • Change channel assignments or the whole waveform • Provide interoperability. • Simple upgrades. • May improve data handling, security, error correction.

SDR is a consequence of Moore's law

FPGA are becoming increasingly powerful

We **now** have the computing power to process most of the function for wireless communications (FFT, FIR, Modulation schemes),
At least for narrowband communication.



From Xilinx

This power can be used to improve reconfigurability and move functions from design (hardware) to deployment and operations

Potential benefits of RRS in Public Safety

- Multi-Modal terminals to interface various technologies
- Adaptive network and equipment to the operational context
- Improved lifecycle of the network equipment (upgradeable base stations)
- Multi-band networks and terminals (no need of harmonization)
- Improved spectrum utilization
- Dynamic reconfiguration to address unpredictable events.

SDR is not alternative to TETRA/TETRAPOL/LTE but it is complementary to radio access technologies

Is SDR a futuristic technology ?

Radio Access Technologies

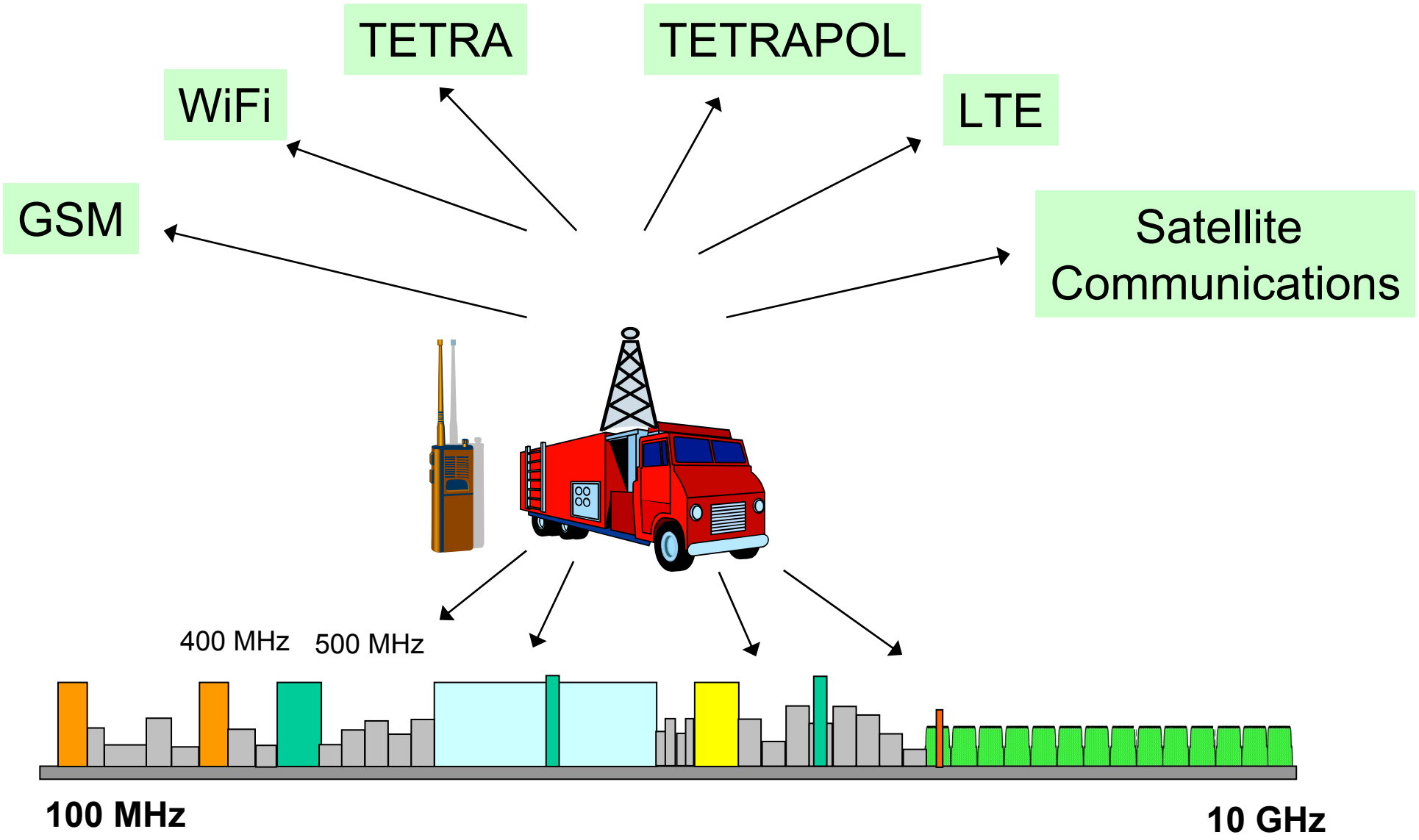
GSM
GPRS
EGPRS
WCDMA
Bluetooth

Frequency Bands

GSM 850
GSM 900
GSM 1800
GSM 1900
WCDMA Band V (850)
WCDMA Band I (2100)
WCDMA Band II (1900)
WCDMA Band VIII (900)

Is this a Software Defined Radio ?

Is SDR a futuristic technology ?



Is SDR a futuristic technology ?

Past

➢ **Tier 0** – Hardware Radio, which is a baseline radio with fixed functionality.

Now

➢ **Tier 1** – Software-Controlled Radio, where the radio's signal path is implemented using application specific hardware.

2-3 years

➢ **Tier 2** – Software Defined Radio, where most of the radio functions are performed in software. For example, the signal path can be reconfigured in software without requiring hardware modifications.

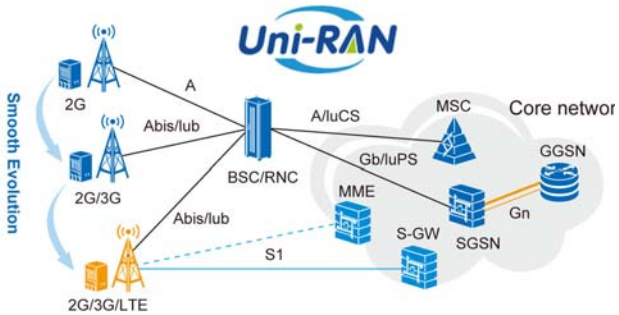
5-10 years

➢ **Tier 3** – Ideal Software Radio, where software programmability extends to entire system.

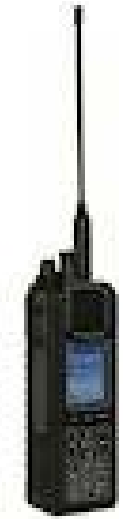
Maybe never

➢ **Tier 4** – Ultimate Software Radio, which has full programmability, may operate in a broad range of frequencies and can switch from one air interface/application to another in a limited time (e.g., milliseconds).

Is SDR a futuristic technology ?



SDR ZTE



Thales Liberty

Harris Unity XG-100

Tadiran 7200-HH

and others…

Prediction on Communication Space Satellites

T. Craven, FCC Commissioner in 1961 stated that

"There is practically no chance communications space satellites will be used to provide better telephone, telegraph, television, or radio service inside the United States."

Why weak support for SDR in Public Safety domain ?

- "Software Defined Radio" Concept was introduced by J. Mitola in the early 1990s. Almost 20 years passed. Industry is skeptical and they have to ensure profits in 2-3 years timeframe.
- Conflicting interests: some stakeholders would prefer to keep things as they are. Some aspects of the SDR technology are "disruptive": change of business models, business "food" chains. But these changes also happened in the past and now: TETRA, WiFi and LTE. Progress does not stop…
- Price could be an issue. Prices can be acceptable in the defense domain, but in the public safety domain ? Benefits of the new technology should be justified by the price increase. Mass scale market for terminals (both handheld and vehicular) could decrease the price.
- Public Safety users want to be sure that the new technology is usable and reliable like TETRA/TETRAPOL.
- Still perceived as futuristic Tier 4 – Software Defined Radio
- Stakeholders still prefer to address public safety challenges with political/conventional means.

What we can do ?

- Support standardization, especially at European level.
- Get Public Safety users more involved in the process and work together with industry and government. ESSOR is a valid example in the Military domain.
- Create economies of scale by creating synergies with the commercial and military domain.
- Invest in research projects to support this technology.
- Create a technological roadmap for the various SDR tiers.
- Support European security industry

Workshop on

"Software Defined Radio and Cognitive Radio standardization"

DG JRC facilities, Ispra, Italy
November 17 & 18, 2011

The purpose of this workshop is to identify the main steps needed to drive the development and use of SDR and CR technologies in Europe, including the elements of a future standardization mandate as well as related regulatory and certification issues.
The final outcome of the workshop will be a roadmap to that purpose.

Jointly organized by DG ENTR, EDA and DG JRC with the support of ETSI

European Commission Enterprise and Industry

EDA

JRC EUROPEAN COMMISSION

Objectives of the workshop

To identify the key elements of a standardization mandate for SDR and CR in the commercial domain.

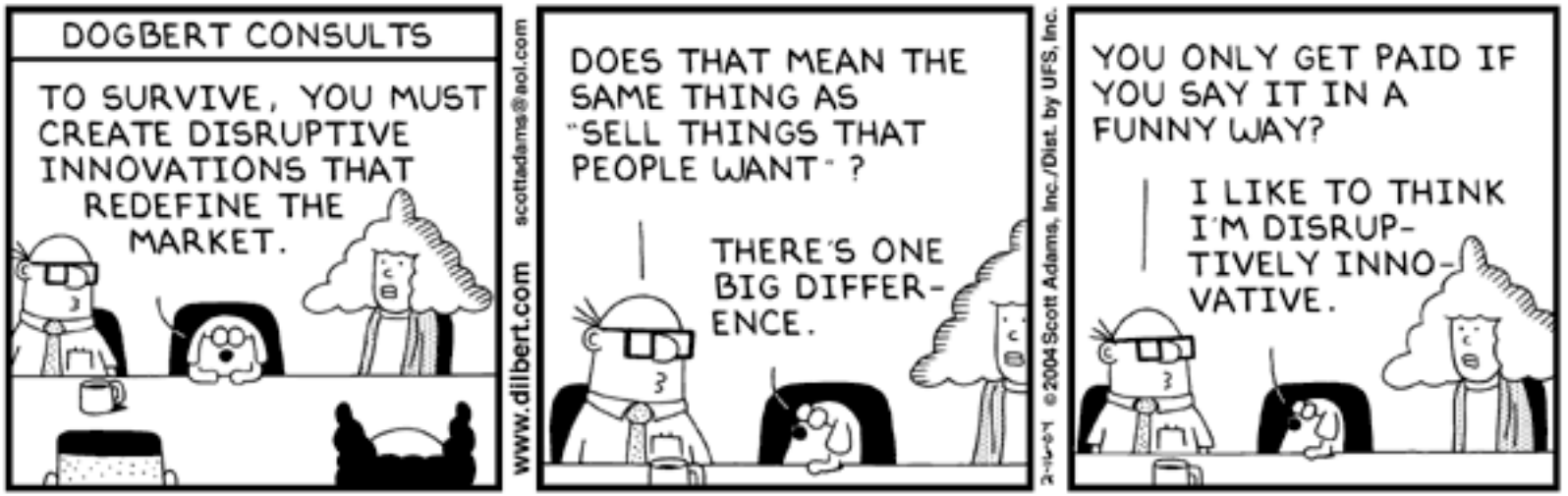
To identify the key elements of a standardization mandate for SDR and CR in the civil security and military domains.

To identify the main priorities in standardization: what standards are needed ?

To receive input from the stakeholders on a potential roadmap for standardization.

To identify the potential regulatory impacts from SDR standardization

To receive input from stakeholders on the potential challenges to an European standardization of SDR and CR



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From www.dilbert.com

On the other side, disruptive innovation is sometimes successful (examples of US products/standards):

Questions ?

From www.dilbert.com