



**GENERAL SECRETARIAT
OF DEFENSE**



**NATIONAL ARMAMENTS
DIRECTORATE**

VI Department (former TELEDIFE)

The Future Of Global SDR Battlefield Capability (SDR'11 – WInnComm – Europe)

Rome, 23rd June 2011

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Scope



The aim of this presentation is to share with you some thoughts regarding the use of **Software Defined Radio** technology in the military environment





Contents



Modern operational Scenario

Operational performance of SDR

Italian SDR program

Standardization and certification

Cognitive radio



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Defense function of Italian Armed Forces **— Macro operational scenarios —**

- **Security of National Space**
 - Conventional/Terrorist attack
- **Participation to coalition operations**
- **Decisive operations**
 - Nation territorial integrity or collective defense, (NATO Art. 5)
including also the conduct of CRO-Crisis Response Operations

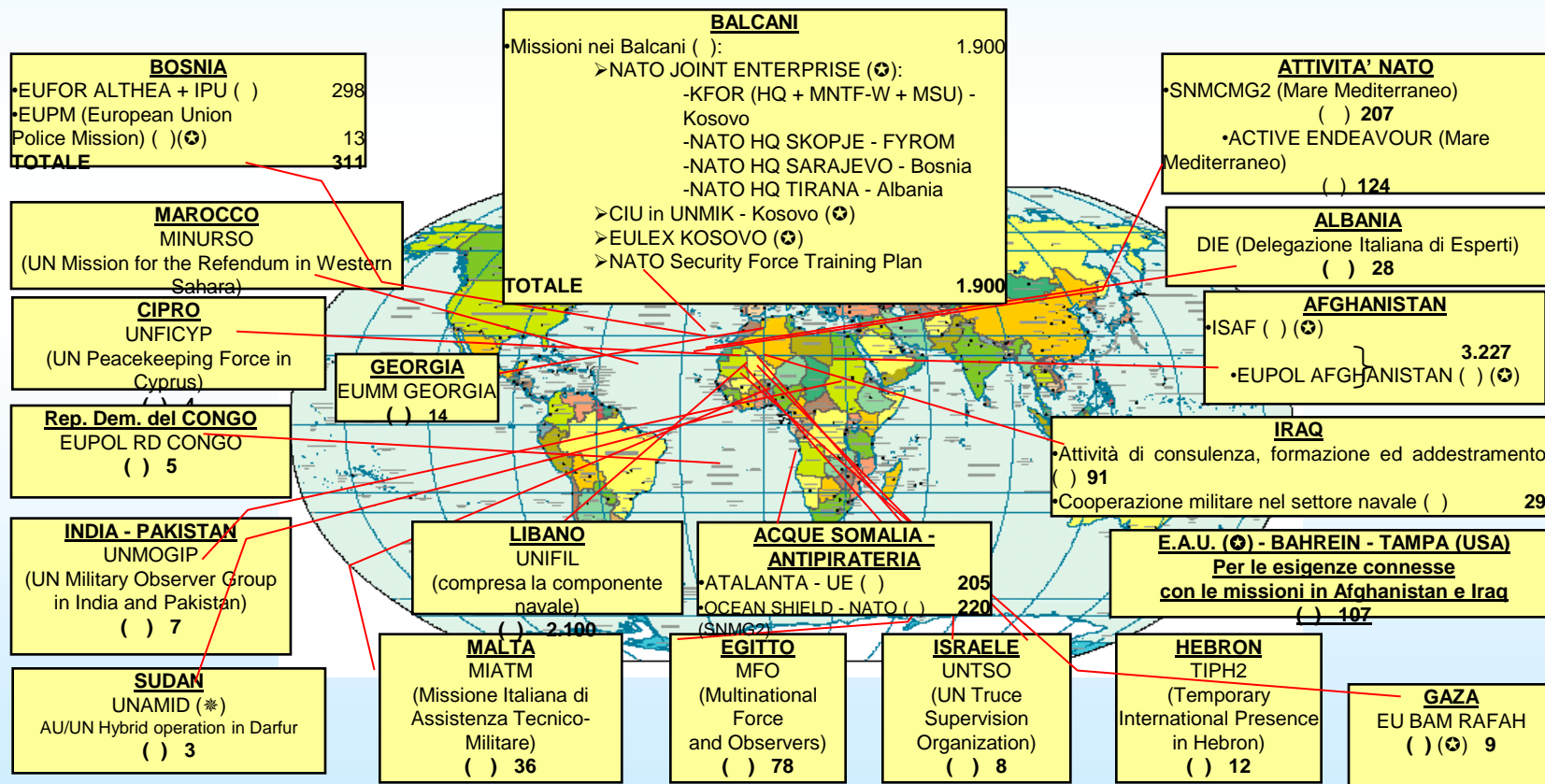


Modern operational scenario



Complex geopolitical environment

33 missions in 21 Countries plus 2 geographical areas - Total: n. 9.295 soldiers

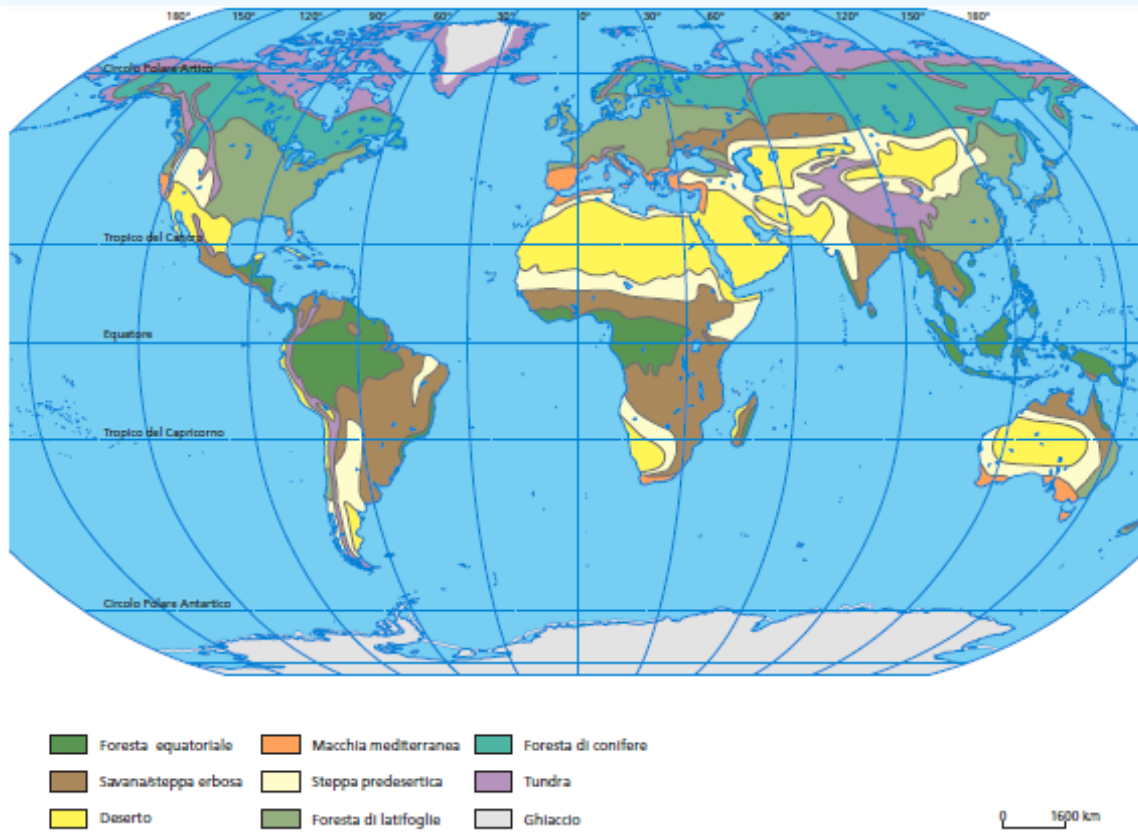




Modern operational scenario



Differentiated geographic environment



- Morphology of the land
- Climate
- Temperature
- Large spaces (e.g. desert)
- Human facilities included in the environment (e.g. city)
- Extra-national territories





Modern operational scenario



Operational environment characteristics

- Large variety of multinational forces projected from their national territories
- Need for multiple communications
- Interoperability and integrability of systems
- Use of many and varied legacy systems
- Flexible and light logistic
- Exchange of large amounts of data (e.g. video) qualitatively appreciable (bandwidth)
- Timeliness of information (real time)
- Adaptability to changing circumstances





Modern operational scenario



Security of operational environment

THREAT

In the current international context the national Armed Forces are requested to intervene in every geographical region of the globe, including those special places where, also due to poor environmental conditions, maybe difficult to ensure, within reasonable time with the development of the operation, the necessary support connectivity

To the **signal**

interception, intentional jamming/deception, directional detection

To the **information**

interference or signal tampering: virus, malware, ..

Sophisticated capability to attack systems: frequency hopping, spread spectrum and fixed (no wireless) for information transfer



Modern operational scenario



Complex geopolitical environment

33 missions in 21 Countries plus 2 geographical areas

Geographic environment differentiated

- Morphology of the land
- Climate
- Temperature
- Large spaces (e.g. desert)
- Human facilities included in the environment

Provide appropriate communication services (radio) to the **warfighters to operate in the **modern scenario****

- ... from ...
- No ...
- Inter ...
- Use of many a ...
- Flexible and lean logistic
- Exchange of large amounts of data (eg video) qualitatively appreciable (bandwidth)
- Timeliness of information (real time)
- Adaptability to changing circumstances

Limit
... the
... communications
... limitations to the electromagnetic spectrum



Modern operational scenario



Limitations of legacy radio systems

Single radio channel	No routing no networking
Low/medium data rate	Logistic support: complex, dedicated and expensive
No simultaneous data, voice and video services	No open system architecture
Fixed waveforms and relative bandwidth	No modularity
Significant additional costs for improving and modifying platform capabilities	No simultaneous operations with multiple systems in multiple domains
No use of flexible frequency (operating in narrow portions of the band)	No automatic reconfiguration (operator intervention)



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Performance classification of SDR

- General
- Security
- Networking
- Logistic
- Non-conventional environment



Operational performance of SDR



General system performance

Secure and non secure communications in both NB and WB (interoperability with legacy systems)	Open system architecture for HW and SW upgrades to technology evolution
Modes and capabilities configurable via software (flexibility)	Modularity for HW reconfiguration
Frequency range 2 MHz e 2 GHz (HF, VHF, UHF)	Multichannel to use multiple WFs in multiple networks with routing capability and legacy system interoperability
Remote update trough the network with proper authentication	Self-diagnostic for HW and SW faults
Anti jamming	Non detectable



Operational performance of SDR



Security performance

Crypto Embedded and scalable to interface with various radio networks

Manage crypto information and not on every channel from unclassified to secret

Support EKMS (electronic key management system)

Remote identification in order to manage remote network platform

Interface and support functions of the crypto systems in service

Support for PKI to satisfy the requirements of integrity, identification and authentication



Operational performance of SDR



Networking performance

Networking services for the interoperability between the networks (data routing, bridging, switching, network management, etc.).

Scalable and interoperable to connect users and/or nodes in various ways (point to point, multipoint, multicast, broadcast)

Capability to dynamically insert in networks operating in theater to support user mobility

To be tracked automatically in order to report the position to update the situation on the battlefield.

Internet Protocol (IP) support



Operational performance of SDR



Logistic performance

Radio standard and modular in order to exchange spare parts within the family (hand-held, man-pack, vehicular, marine, avionics)

Miniaturization (space and weight).
Radio must adapt to the platforms (vehicles, aircraft and ships) and not vice versa

Self-diagnostics and able to send reports to the logistics network for the monitoring of faults and spare parts

Man Machine Interface easy to use and standard

Working with fixed and mobile power supply



Operational performance of SDR



Performance in non-conventional environment

Protection against detection and localization by the enemy

Work in CBR environment

Work in different geographic environments (e.g. desert, forests, mountains ..) and different environmental condition (e.g. urban ...)

Efficient use the bandwidth with data compression techniques, voice and video to dynamically use the frequency spectrum / use the same frequency in neighboring wireless networks calibrating the signal strength



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Italian SDR program



REQUIREMENT

In 2002 Italian MoD started a national R&D program for a family of Software Defined Radio

GOAL

Build the **National Software Defined Radio** family as evolution of the advanced wireless connectivity concept to have a **single radio system** capable to operate in different operation modalities. One reconfigurable radio equipment (multifunction/multichannel) able to replace more traditional radios.



Italian SDR program



National Software Defined Radio

- Very complex program
- National activities
- Participation to different international programs



**SDR is the wireless communication pillar of
DII (Defense Information Infrastructure)**



Italian SDR program

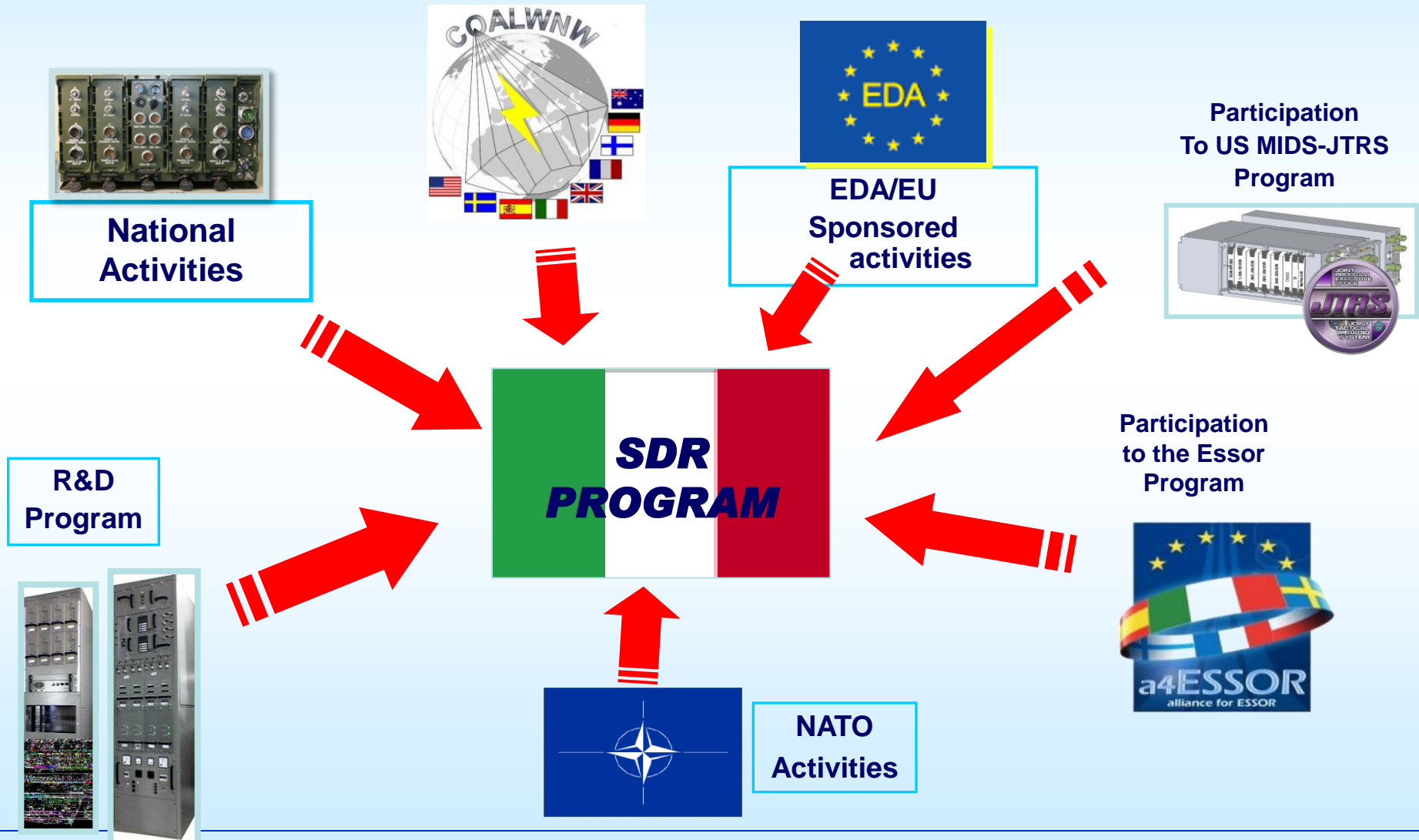


National SDR Program Office

- **Leadership:** IT MoD Joint General Staff – C4I Systems and Transformation
- **Representatives:** Armed Forces General Staffs, National Armament Directorate, Procurement Agencies, NSA and national experts.
- **Main duties:**
 - Define national operational requirements
 - Coordinate national SDR projects
 - Coordinate IT MoD participation to SDR international projects



Italian SDR program





Italian SDR program



National Activities

2007: FIRST CONTRACT AWARDED TO SELEX Comms:

- **Development of a SDR vehicular prototype**
- **Development of an Operating Environment based on SCA architecture**
- **Development of a National Crypto**



Italian SDR program



SDR ORD approved by the Chief of the Joint Staff in July 2010. It includes:

- Development of 5 SDR prototypes: Vehicular, Hand-held, Avionic, Manpack, Maritime/fixed installation
- Development of 3 legacy waveforms: SINCGARS, HAVE-QUICK I/II, HF (STANAG 4285, 5066, 4538, Mil-Std188-110B)



Italian SDR program



❖ Different types of HW platforms:

- Vehicular
- Hand-held
- Manpack
- Infrastructural/Naval
- Avionic

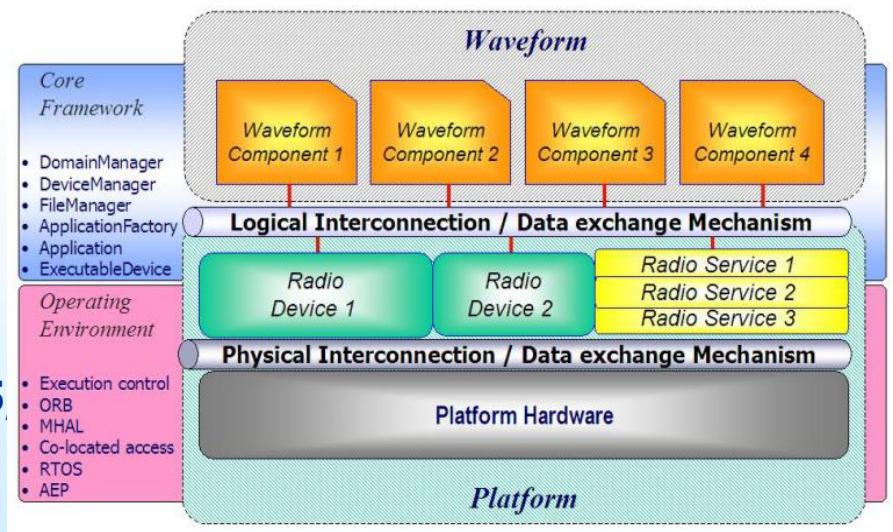
❖ New Generation networking WFs

- SBW (Soldier Broadband WF)
- WB Waveforms from international programs

❖ Legacy waveforms:

- SINCGARS
- Have Quick I/II
- MIL STD 188 220 C
- HF suite (STANAG 4538, 5066, 4285 MIL STD 188 110 B)

❖ Other target waveforms are further options

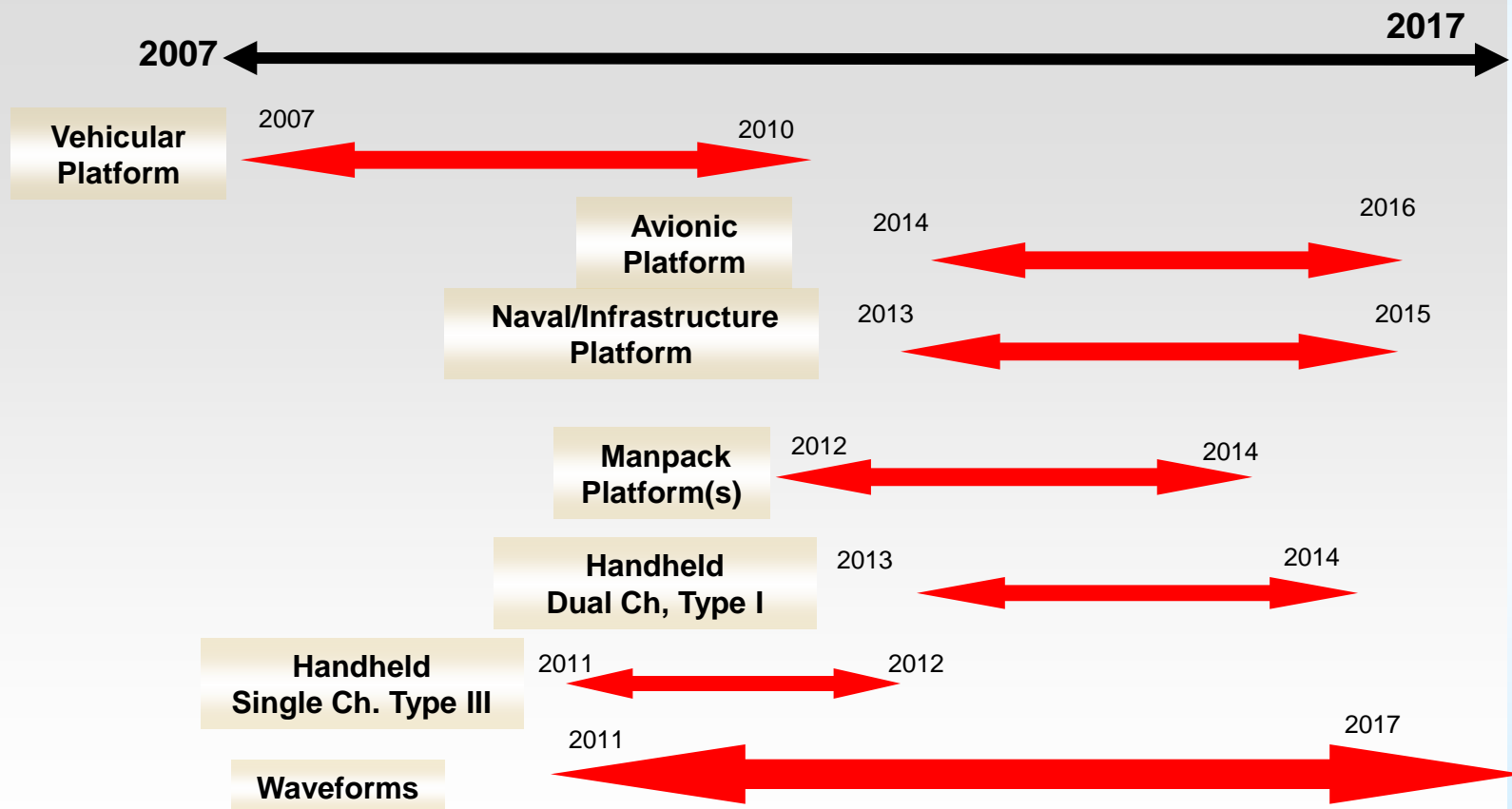




Italian SDR program



SDR Family RoadMap





Where we are today:

- ✓ Development of the vehicular prototype of the SDR family completed.
- ✓ Vehicular prototype is going to be upgraded with the ESSOR Architecture
- ✓ Hand-held prototype under development



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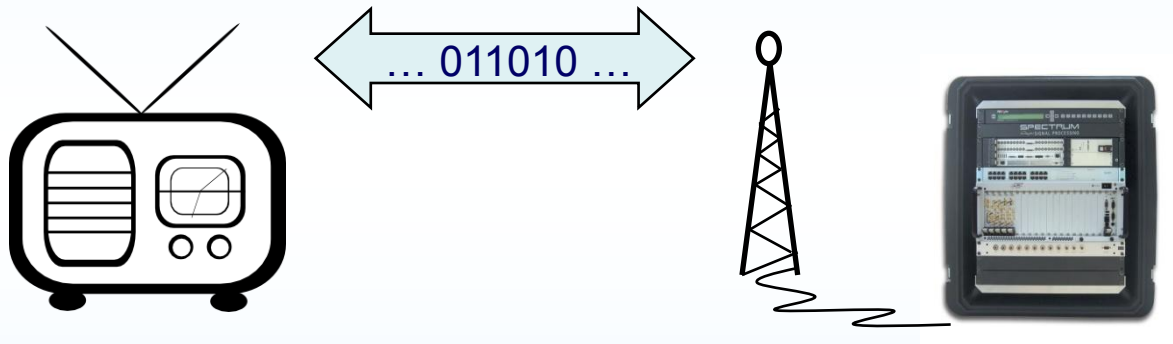
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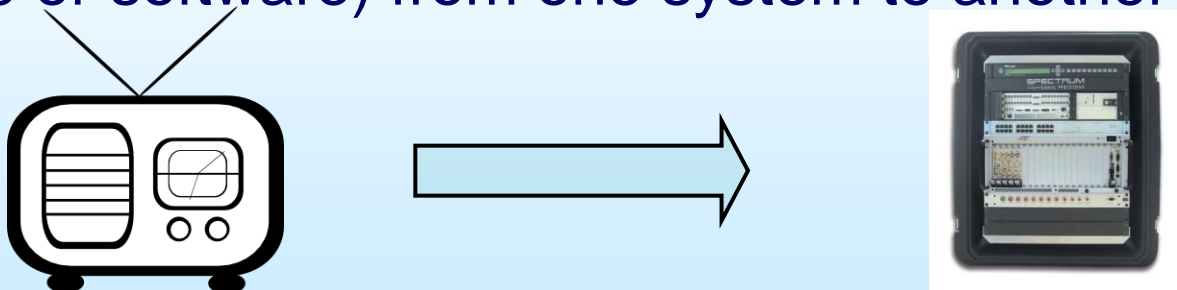


Some definitions

Interoperability: the ability of two or more systems to exchange information and use the information exchanged



Portability: the ability to easily transfer a component (hardware or software) from one system to another





Interoperability of radio systems

Interoperability has an immediate feedback from the operational point of view, two radio systems to exchange information must be interoperable

To achieve the interoperability it is sufficient to define common specifications of the signal at the antenna level (in air, both at radio and protocol level)



Portability of waveforms

The **portability of WFs** has an impact on the development of a system and on its operational use.

It is the driver for a successful experience during operations in the battlefield. WF Portability issue affects both design of SDR Platform and of Waveform.

The **portability allows to share the development of the WF** among different countries by reducing the national costs, too. In addition, the portability of the WFs boosts the chance to experience interoperability between systems in the battlefield



Portability of waveforms

SDR Standardization

- SDR Architecture Standardization in order to make possible WF portability among the different SDR Platforms (JTRS SCA, SCA for ESSOR)
- SDR Waveform Standardization in order to prepare the WF software, since the beginning, with the proper feature to be easily (in a shorter time and cheaper) for being migrated on the SDR Platform

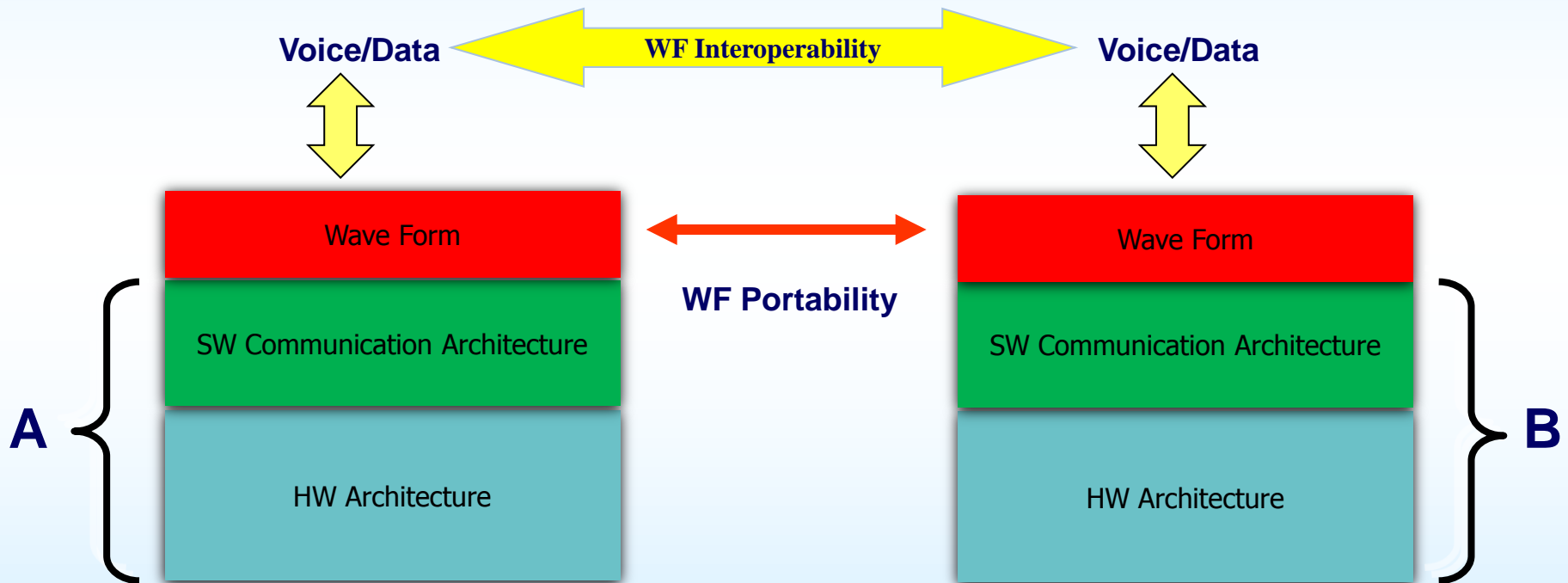
SDR Certification

- Definition of Certification Tests versus the SDR Standard Architecture previously standardized
- Verification, by Accredited Test Labs, of compliance to the standards “Stamp”

Additionally, standardization of waveform needs also to be pushed in order to achieve interoperability between the coalition forces (legacy WFs, ESSOR-HDR, COALWNW)



SDR Standard Architecture





SDR Architecture standard

- JTRS SCA had been, since the beginning, a “de facto” standard for SDR in the military environment
- The currently published part of JTRS SCA is not sufficient to develop a military SDR and grant WF portability among the different radio equipment
- ESSOR Program was started by EU countries to extend the JTRS SCA on the non published parts in order to achieve WF portability among the participating nations, maximising the commonality to the open parts of the JTRS SCA.



Ongoing international activities to reach convergence of the SCA Specs

- ESSOR Program released some contributions complementing characteristics and features related to lightweight environments
- Such information was submitted within the Wireless Innovation Forum in order to accelerate and facilitate its circulation and endorsement
- Italian MOD encourages and supports a smooth convergence and harmonization between the JTRS SCA and ESSOR specifications on the issued material
- ESSOR Program, by its side, is promoting these contributions to maximize the harmonization between the two specifications, without affecting the current contents and allowing for smooth compatibility.



Waveform standards

- Legacy WFs already standardized in STANAGs, MIL-STD documents. It is needed to develop them on SCA to have interoperability with legacy radios
- New WFs (high data rate, networking, ...) to be standardized in order to have interoperability among countries.

ESSOR – HRD WF



COALWNW



NATO – WBWF, NBWF

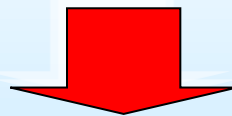




SDR Certification

Each standard needs, for becoming real, a Certification Process (organization, procedures, tools)

- ✓ **Identification of certification organization/authority** considering a possible network of Certification Labs
- ✓ **Definition of the Certification Tests** to be carried out versus the chosen reference standard and in cooperation with the Specification/Standard Body Organization
- ✓ **Definition of processes, tasks, methods and tools** dependant also by the admitted profiles of certification to provide WF portability
- ✓ **Identification of solutions related with security certification** taking into account national accreditation rules



Governments agreement to establish the certification process for SDR

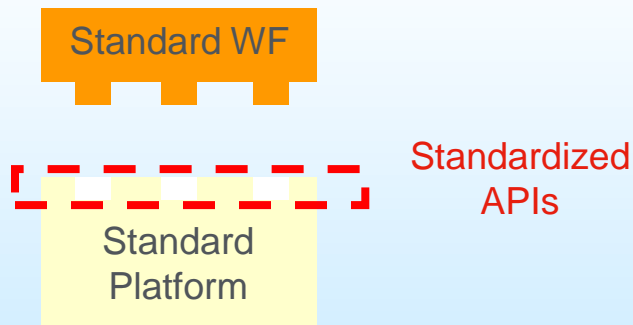


Standardization and certification



Benefits of Standardization and Certification on SDR

Standardization/Certification on SDRs will lead to both **acquisition and operational costs reduction** due to a strategic and technologically regulated access to the experience of the **interoperability amongst systems** in multinational & coalition level scenarios



Certification Lab





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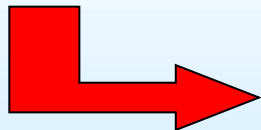


Intelligent Spectrum Management **through implementation of Cognitive Radio paradigms**

Spectrum management today:

- fixed, based upon “command and control” concept;
- frequency plans are computed and assigned for long periods of time.

More demanding applications and services require larger instantaneous bandwidth than before. Since the spectrum frequency resource is finite, it will be more and more difficult to accommodate new systems along with existing legacy systems.



Dynamic Spectrum Management

adapt to changes that may occur during operations, especially in multinational context



Thank you for the attention

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