



ESSOR

European **S**ecure **S**oftware defined **R**adio

PROGRAMME STATUS & PERSPECTIVES

WInnComm Europe – Roma - 05 November 2014





Agenda



1. ESSOR Programme Overview
2. ESSOR Contributions to WF Portability and Interoperability
3. ESSOR HDRWF Development and Validation
4. Status, Perspectives and Conclusions



1. ESSOR Programme Overview



ESSOR Programme – Stakeholders



ESSOR Participating States

Contracting Authority:

- OCCAR



Program Decision established between: (*)

- Finland



- France



- Italy



- Poland



- Spain



- Sweden



(*) Under the umbrella of European Defense Agency (EDA)



ESSOR Industries

Prime Contractor:

- a4ESSOR SAS



Joint Venture established between:

- Elektrobit



- Thales Communications & Security



- Selex ES



- Radmor



- Indra

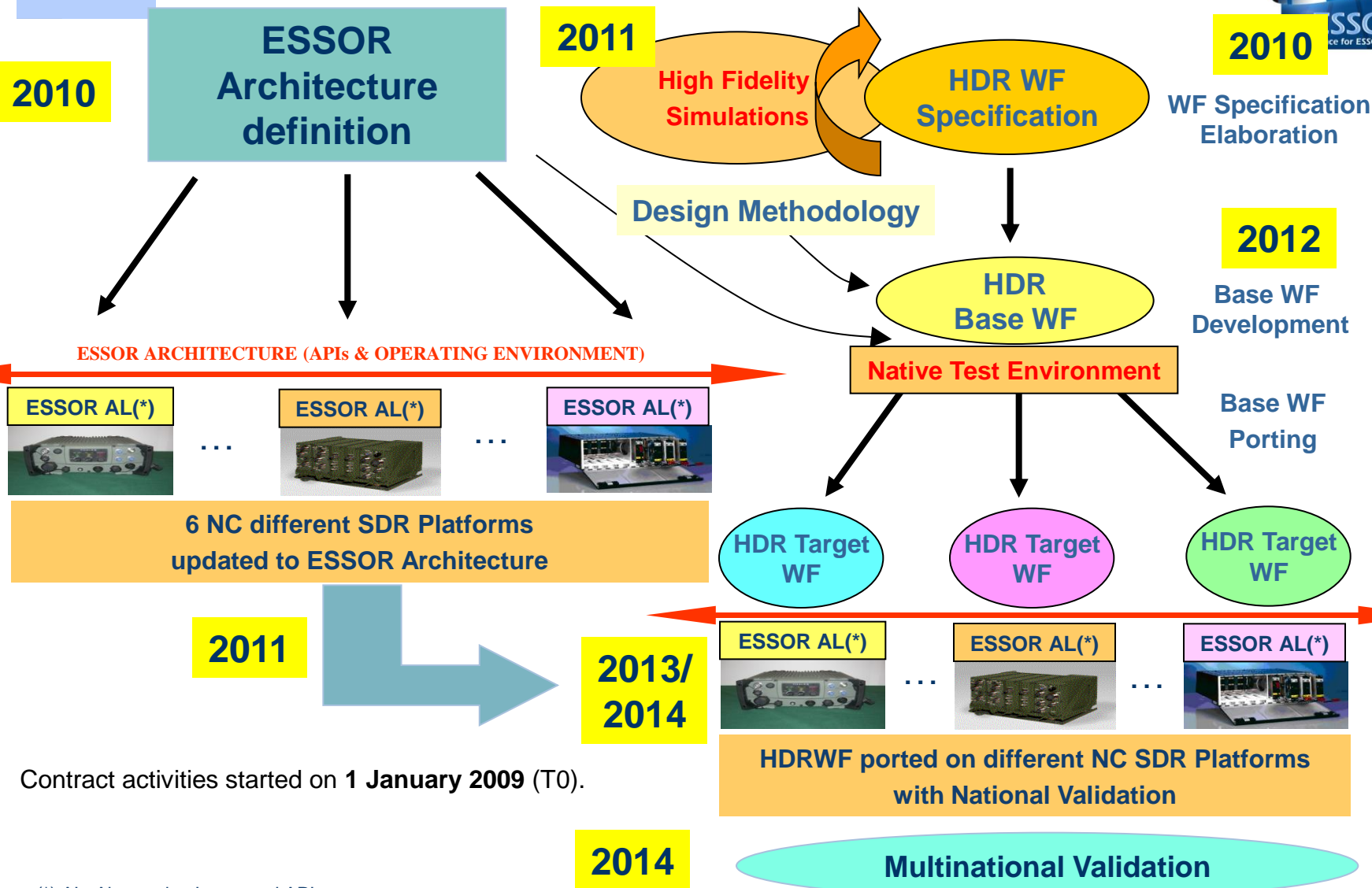


- Saab





Contract overview



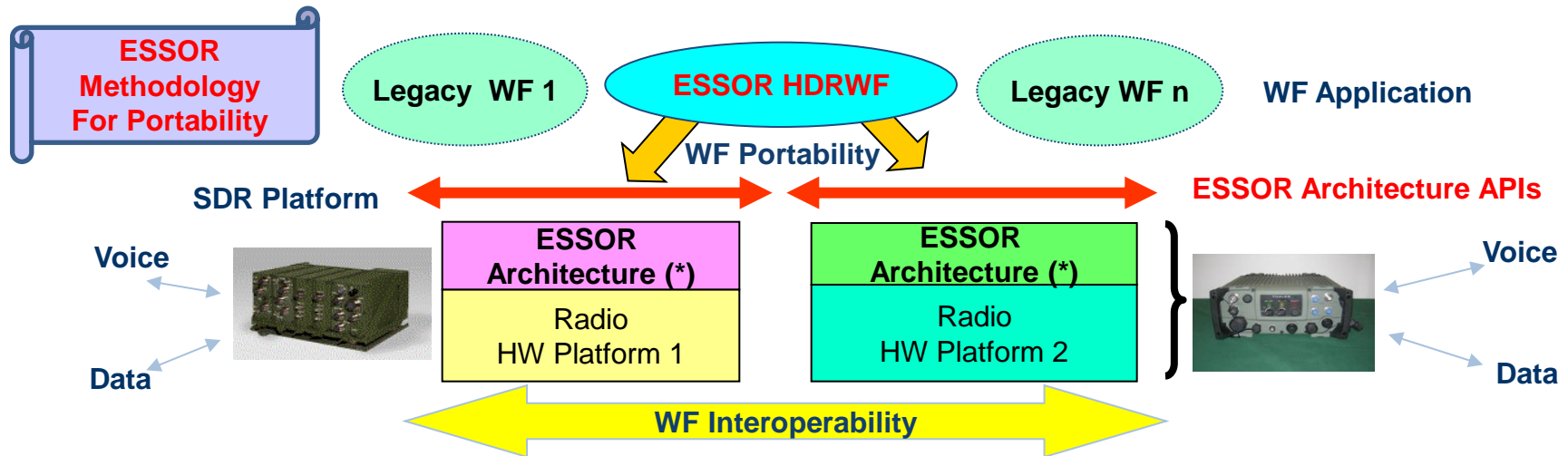
Contract activities started on **1 January 2009** (T0).

(*) AL: Abstraction Layer and APIs



2. ESSOR Contributions to WF Portability and Interoperability

- Definition and implementation of the **ESSOR Architecture**, which isolates WF features from PTF features thanks to relevant APIs.
- Definition of a new **Secure Coalition** High Data Rate WF (**ESSOR HDRWF**) for Ad-Hoc mobile tactical radio-network for Land Applications.
- Definition and implementation of the **ESSOR Methodology for WF Portability (HDR Base WF ported on Heterogeneous PTFs)**.

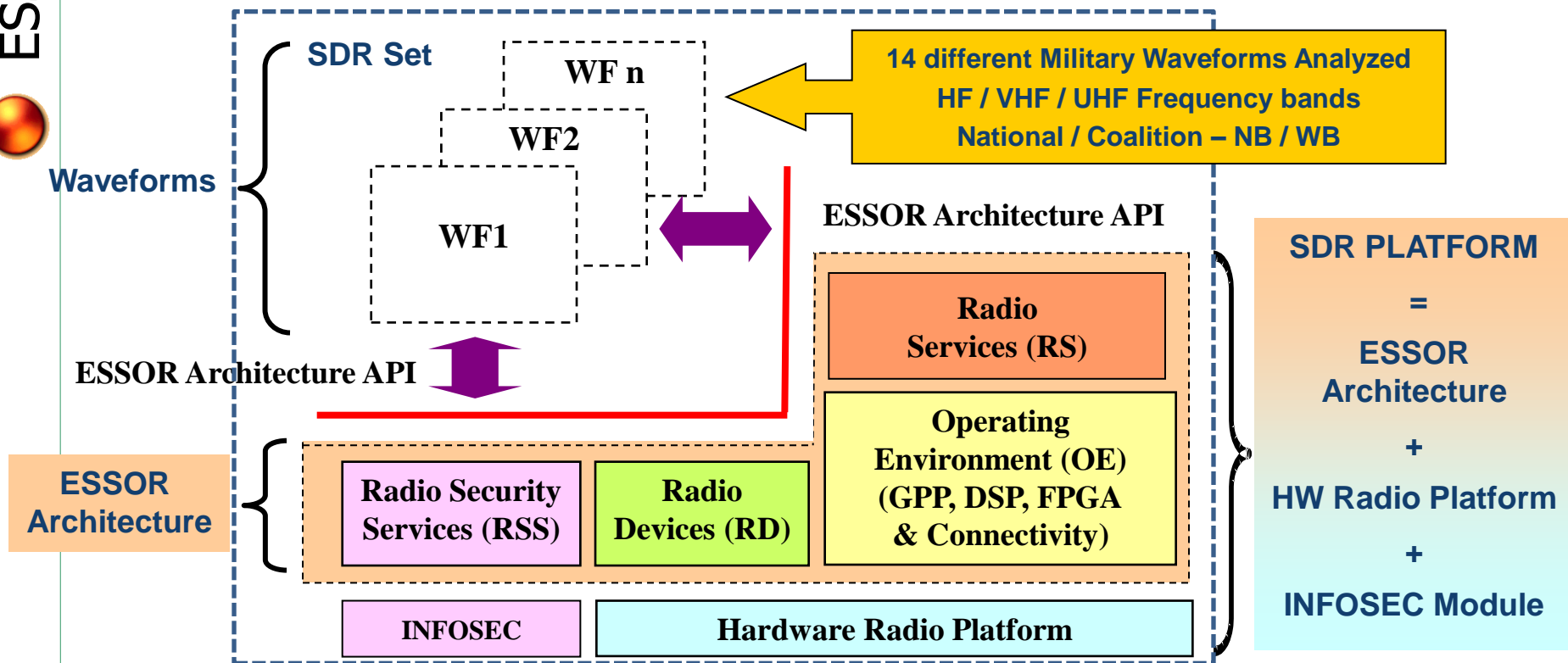


(*) ESSOR Architecture: OE (Execution Environment, Connectivity) and APIs (RD, RS, RSS)



ESSOR Architecture Overview

- The **ESSOR Architecture extends** the public part of the **SCA** (2.2.2 and API 1.0.3) and WINNF Transceiver API V1 in order to facilitate WF Portability amongst the ESSOR PS, maximising the **compatibility with the SCA** and focusing on **lightweight DSP & FPGA OE, RD, RS and Security (RSS)**.





ESSOR Architecture Achievements



ESSOR Architecture is implemented on 6 different National Platforms

FIN National PTF
EB FSRN
Tactical Radio prototype
Multi-channel



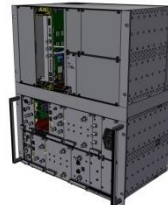
FR National PTF
THALES FlexNet 1
Tactical Radio
Mono-channel



IT National PTF
SELEX Swave VQ1
Tactical Radio
Multi-channel



PL National PTF
RADMOR
Lab Demonstrator
Mono-channel



SP National PTF
INDRA TERSO
Lab Demonstrator
Mono-channel



SE National PTF
Rockwell Collins FlexNet 4
Tactical Radio
Multi-channel



- ESSOR Architecture implementations allow the porting of the ESSOR HDRWF plus additional WFs according to each Nation request.
- Lessons learned from these implementations provide feedback on the ESSOR Architecture definition.



ESSOR SCA 4.x Perspectives



- **ESSOR contributed to SCA 4.0** through WINNF SCA Next WG focusing on very lightweight OE (*AEP profile – WINNF-11-R-0005 / UltraLw IDL profile - WINNF-11-R-0007*).
- Relying on ESSOR Architecture, ESSOR NCs contributed to SCA 4.1 drafting efforts on additional updates to the **Application Environment Profiles (AEPs)** and **Interface Definition Language (IDL) (ultra-)lightweight profiles**.
- The ESSOR Community really appreciated the **joint multinational efforts** performed in the **framework of the WINNF SCA 4.1 WGs** for drafting the SCA 4.1 specifications, **integrating positively significant contributions provided by ESSOR**.
- The ESSOR Community notes favourably that **Backwards Compatibility with SCA 2.2.2** and **Resource Constrained OE** have been at the core of SCA 4.1 efforts, enabling **re-use of past WF developments** (as ESSOR HDRWF and National / NATO WFs) and further **extending applicability** of SCA on **DSPs and FPGAs**.
- As future phase of the ESSOR Programme is being initiated, the ESSOR Community is considering evaluating the impact of **WINNF Specifications** and **coming SCA 4.1** for **future enhancements of the ESSOR Architecture**, with the goal to **maintain the compatibility with the SCA**.



Release of ESSOR Architecture

- The ESSOR PS (Finland, France, Italy, Poland, Spain and Sweden) have announced the availability of a first compilation of information concerning the ESSOR Architecture for third party states.
- The package offered encompasses information about the following items:
 - **ESSOR Architecture definition document.**
 - **Report on the evaluation of the Operating Environment.**
 - **Radio Devices APIs:** AudioPortDevice, SerialPortDevice, EthernetDevice, GNSSDevice, PlatformDiscretesDevice and TransceiverSubsystem.
 - **Radio Services APIs:** ConfigurationService, PlatformControl, FaultManagementService, HMIService, IPService, RetransmissionService, SNMPService, TimingService and VocoderService.
- Every state interested in getting access to the information package needs to be sponsored by one or several ESSOR Participating States.
- The process to follow is described in the OCCAR-EA web site:
<http://www.occar.int/296>



3. ESSOR HDRWF Development and Validation

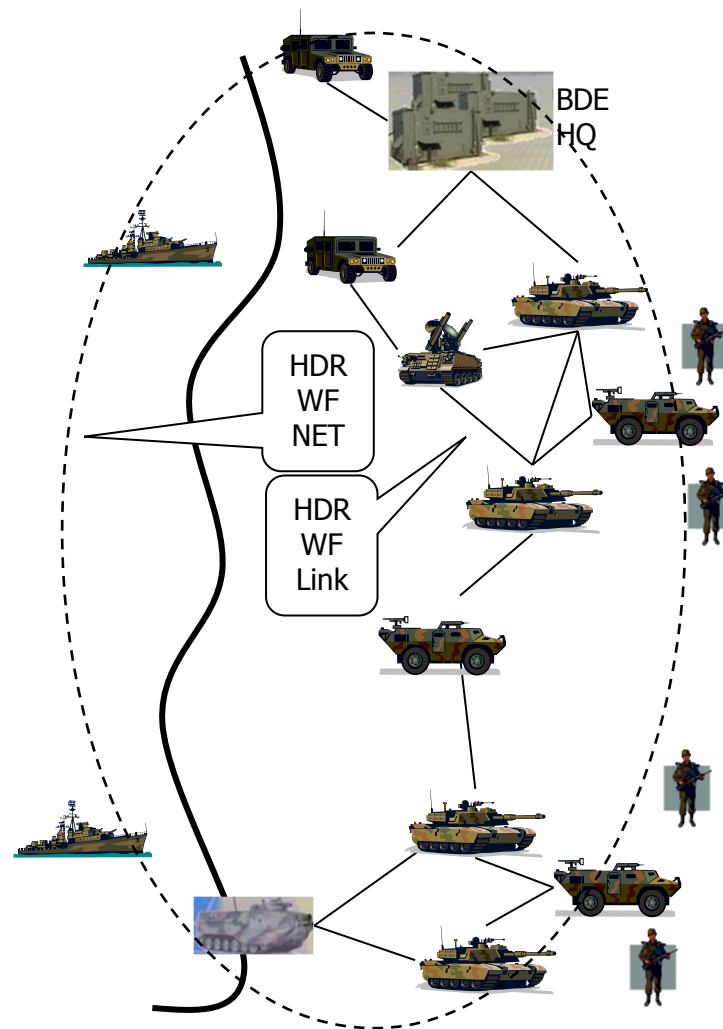


ESSOR HDRWF Main Benefits



ESSOR HDRWF is a **Secure Coalition Network**

- Enhances connectivity on the battlefield by providing a High Data Rate network
- Enables growth capacity of the forces through Ad hoc network, self-organising / self-healing.
- Improves efficiency of the forces on the move:
 - Mobility management for nodes.
 - Communication on the move.
- Enables Network Centric Warfare:
 - Vertical / horizontal communications.
 - Transverse network used to interconnect CNR networks and/or Area Networks.
 - IP Inter-networking between HDRWF network and legacy/future networks with compatible security policy levels through open interfaces.





ESSOR HDR WF Key Features



- High Data Rate: **~1 Mbps, ~ 512 kbps, ~ 256 kbps** at Radio Link
- UHF: 225-400 MHz (extensible), **~1,25 MHz** bandwidth, **Frequency-Hopping**
- Designed to support up to **200 nodes** per Network
- **Ad-Hoc**: Mobility management of the nodes and communication on the move. **Dynamic adaptation to the environment** (Propagation, Node Density, Traffic, Advantaged Nodes, ...)
- **Node mobility**: up to 130 km/h (PHY assessed up to 400 km/h)
- Synchronization: **With / Without GNSS**, taking advantage of the GNSS when available (**Mixed** configuration)
- (O) Radio Silence Capable
- **Secure**: Red / Black – **Embedded** COMSEC / NETSEC / TRANSEC / OTAR/D/Z
- Compatible with standard **IP applications**: QoS driven approach – Unicast / **Optimized Multicast** / Broadcast traffic
- **Voice Capable**: VoIP; (O) Voice CNR Push To Talk (PTT)
- Support **Local or Remote Management and Supervision**

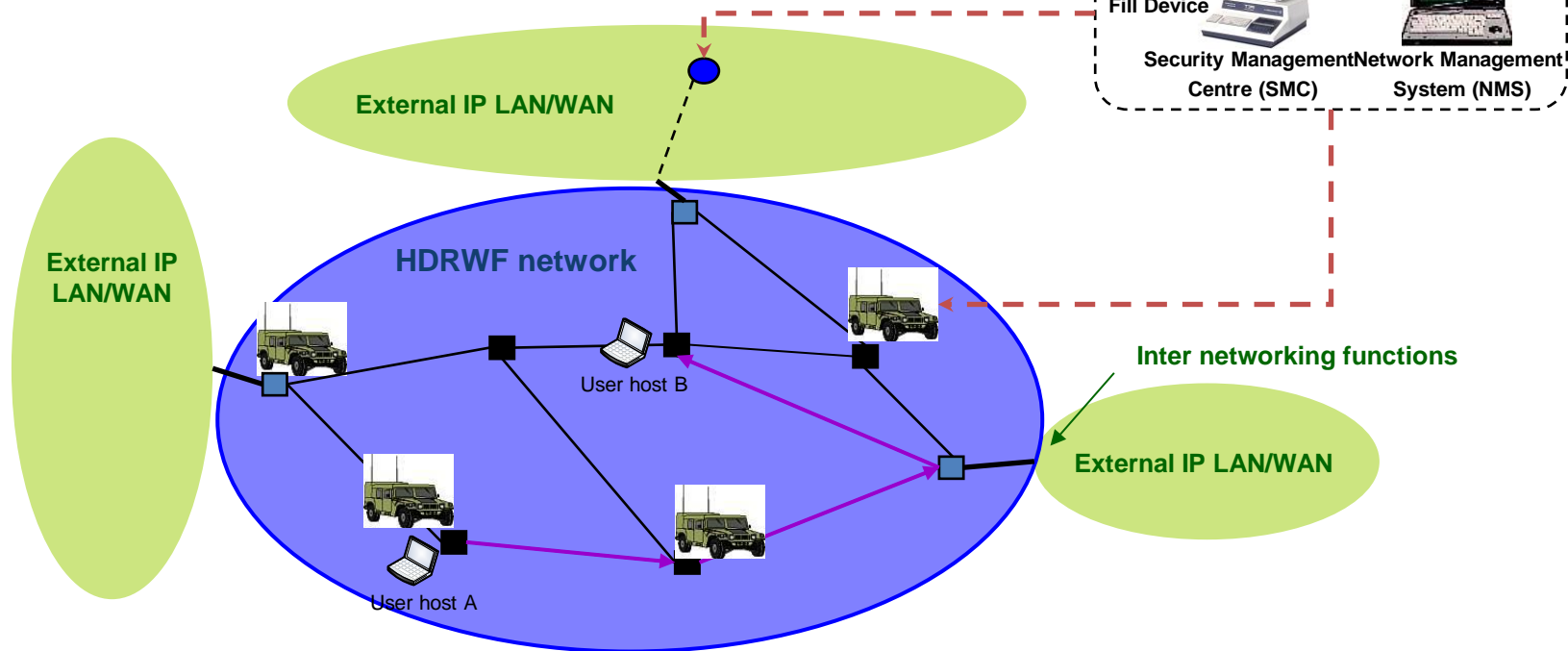
(O) - Objective Requirements refer to features addressed up to the Architectural Definition level (HDRWF SSDD), providing sound foundations for future increments.



ESSOR HDRWF System Overview



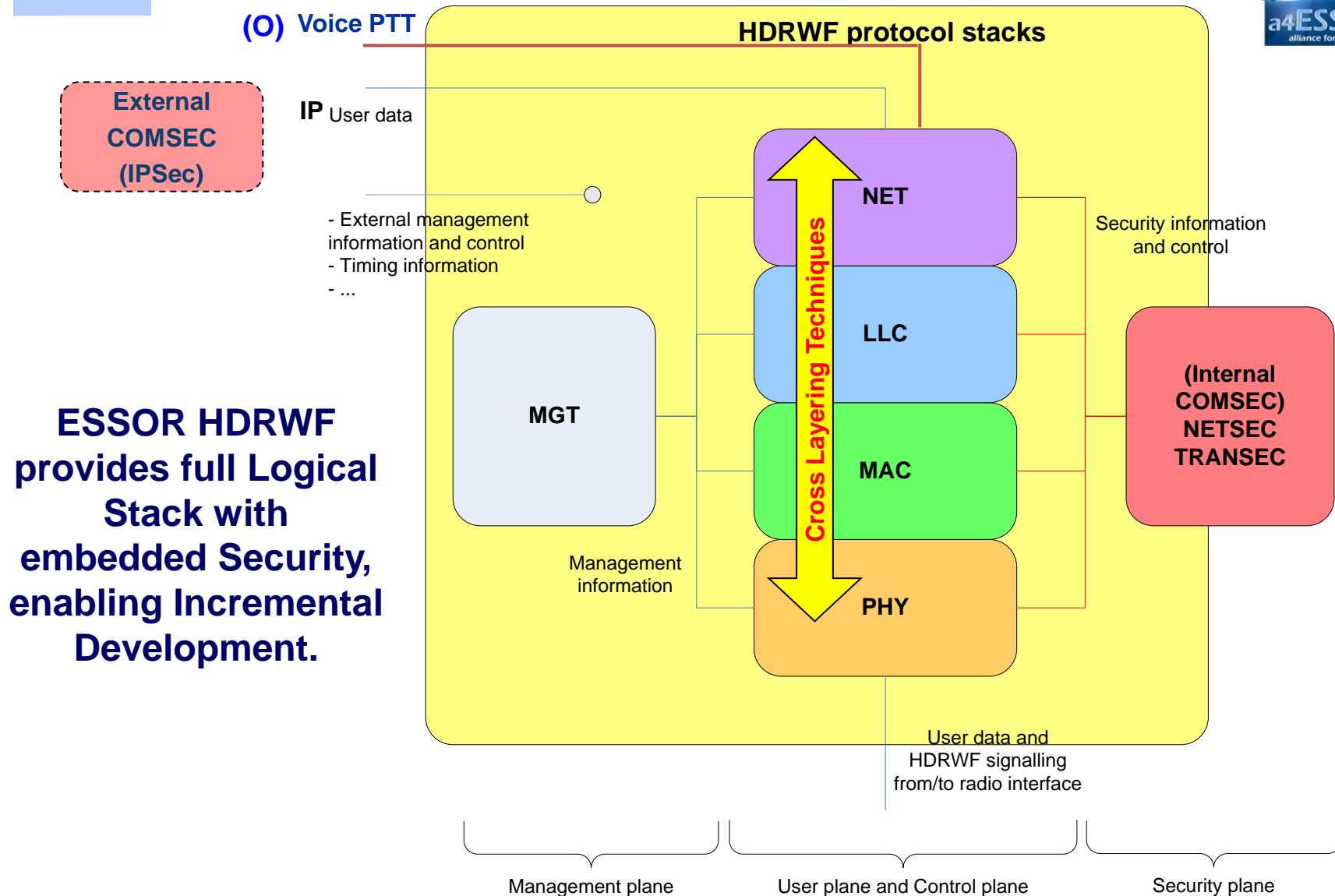
- Multi-hop mobile ad hoc network, self-organizing, self-healing
 - Merging / Splitting (autonomous Network partitions)
 - Node Late Entry



- Nodes are sharing **compatible Mission Parameters** (Keys, Frequencies, @, ...)
- Nodes act as source **Transmitter**, destination **Receiver** or **Relay**
- Connected to IP external networks through **inter-networking functions**
- Over-The-Air (OTA) Network Management performed by **NMS** and **SMC**



ESSOR HDRWF Logical Stack





ESSOR Methodology for WF Portability (Generic Methodology)

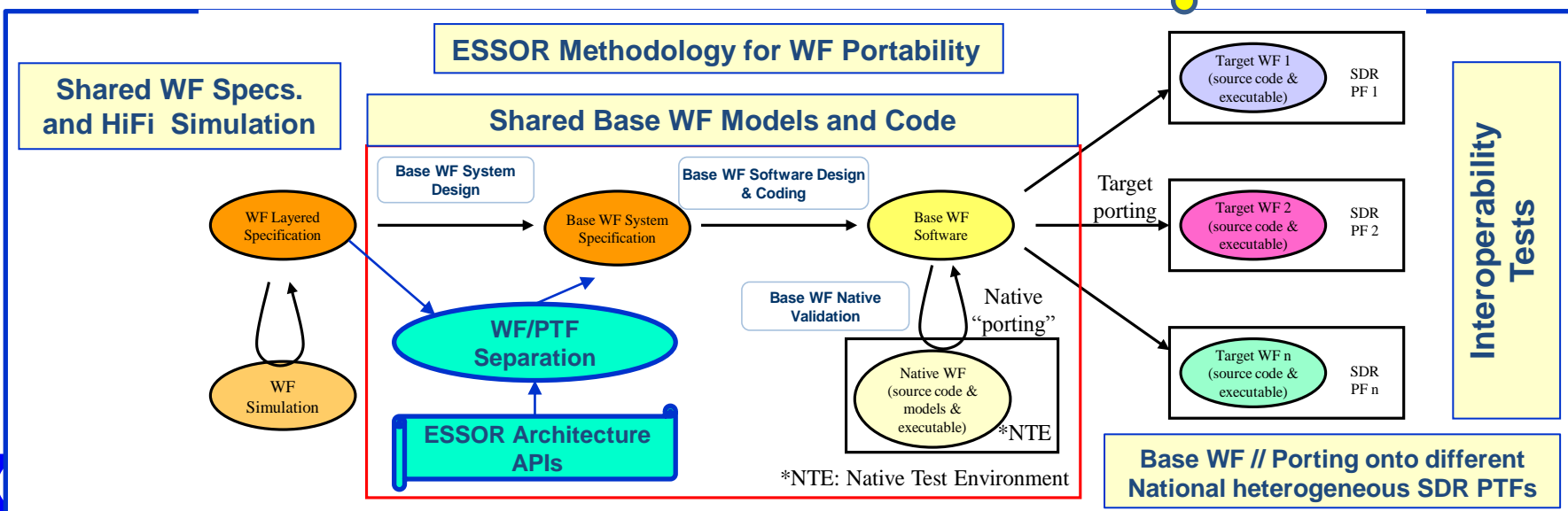


- Shared WF Specifications and High Fidelity (HiFi) Simulation Models
 - HiFi Models provide **Interoperability Assessment References**
- Shared Base WF Models and **Validated "Golden Source Code"**
 - WF / PTF Separation** for defining Base WF "Golden Source" scope
 - Differentiate **Portable Base WF** from **Optimized Ported Target WF**
 - Base WF enables WF Portability across different OE choices**, as possible connectivity choices increases (e.g. CORBA, MHAL, ...)
 - Base WF Modularity** for addressing the **diversity of Target PTF**
- Base WF Porting on different National **heterogeneous** SDR PTF
 - Shared Test Scenarios / Test Vectors / Test Results
- Interoperability validation among different national PTFs

Base WF elaboration: 4 Steps

- Base WF System Design
- Base WF Software Design
- Base WF Software Coding
- Base WF Native Validation

**Validated ESSOR
Methodology for
Portability**





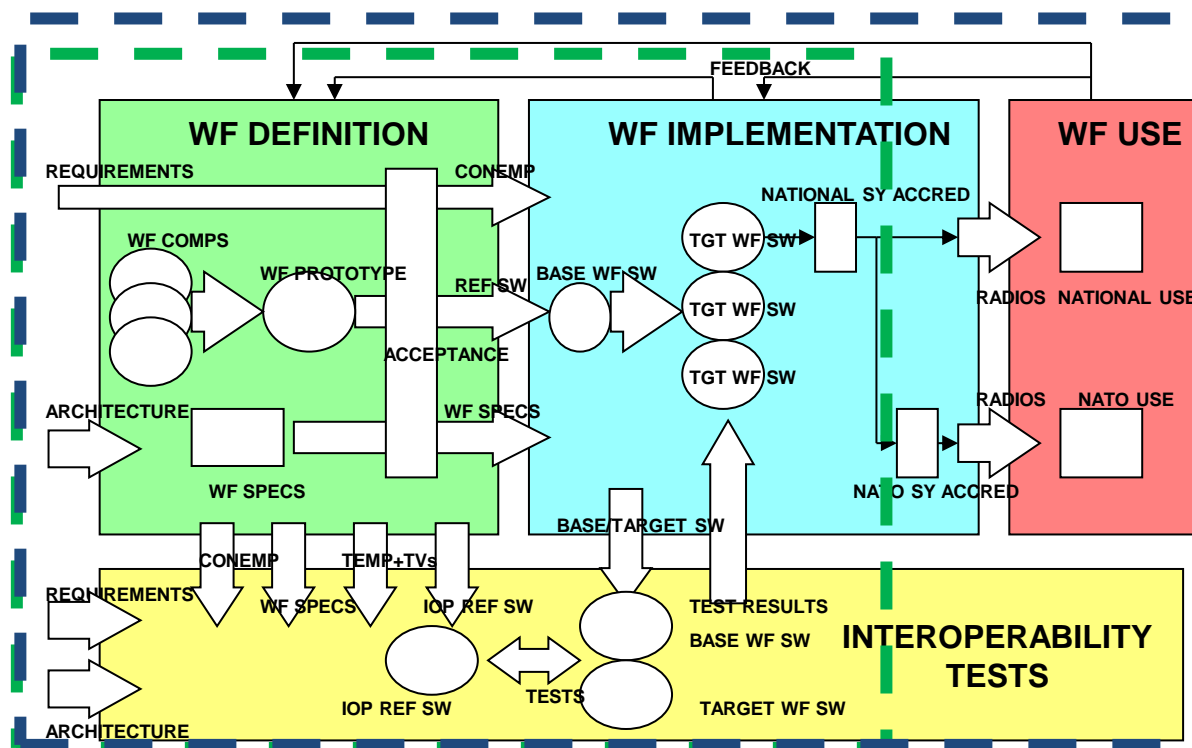
Parallelism between ESSOR and NATO Development Processes



- ESSOR Design & Development process is similar to NATO WF Strategy in term of design & development cycle

Green dashed rectangle = perimeter of the work done in **current phase of ESSOR Programme**

Blue dashed rectangle = extended perimeter of the **future phase of ESSOR Programme**, also **empowering** HDRWF with further technical enhancements.



Ref. ANNEX 1 AC/322-N(2009)108-REV2



ESSOR HDR WF Porting Activities



HDR Base WF is currently Incrementally ported on 5 different National SDR PTFs where ESSOR Architecture has already been implemented



FR National PTF
THALES FlexNet 1
Tactical Radio
Mono-channel



FIN National PTF
EB FSRN
Tactical Radio prototype
Multi-channel



IT National PTF
SELEX Swave VQ1
Tactical Radio
Multi-channel



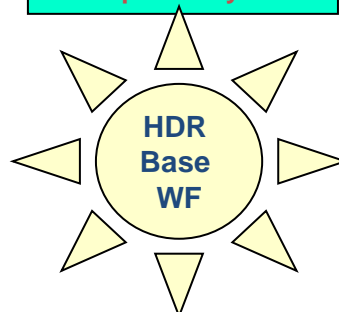
SP National PTF
INDRA TERSO
Lab Demonstrator
Mono-channel



PL National PTF
RADMOR
Lab Demonstrator
Mono-channel



Interoperability Tests



Ported on

*For budget constraints,
Sweden has limited activities
to ESSOR Architecture
Implementation*

Initial Point to Point Interoperability: Early Fall 2013
Initial Demonstration of Full HDRWF ported on NC Platforms: Started Mid 2014



ESSOR HDR WF Incremental Verification

Increment
(DROP)

DROP I MINIMUM Point to Point Communications	DROP II BASIC Networking Capabilities	DROP III ESSENTIAL IP Services	DROP IV COMPLETE HDRWF Functionalities
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Supported
Capabilities

Point to Point communications with simplified data exchanges	Ad-hoc network (synch, build, merge, split, late entry ...)	Ad-hoc network with IP Traffic (Unicast, Multicast, Broadcast) and External IP connectivity	Full Network Flexibility in terms of Topology and Traffic
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Progressive Integration and Verification of HDRWF Functionalities
(at HDR Base WF and HDR Target WF (porting) levels)
Foster proper work alignment amongst NCs

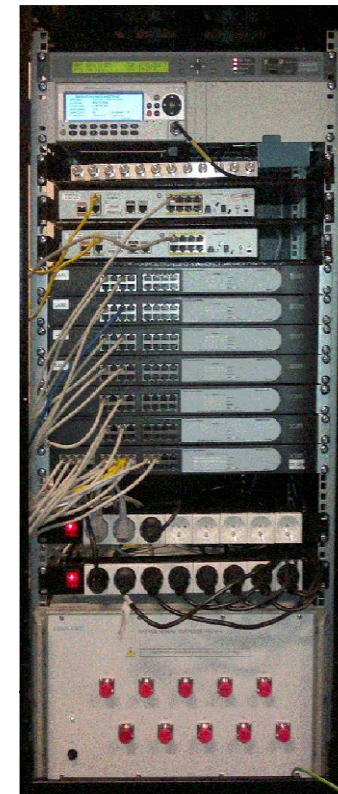


Multinational Test Bed (MTB)



- **MTB is a system test environment used for all system level validation activities of the HDR WF ported on the different National Platforms**
 - **National System Test Beds** performed by the different ESSOR NCs
 - **Interoperability tests** performed between the different ESSOR NCs
- **MTB allows**
 - to interconnect through an **RF Switch Matrix up to 10 Radio Nodes** (loaded with the ported HDR WF), where each of Node is connected to a User LAN, which is transporting the User Traffic.
 - to create, execute and monitor of HDR WF System Test Cases
 - to collect and analyze the results of System Tests of HDR WF
 - to control Test Bed components/tools from remote centralized Test Bed Controller
- **MTB provides the following User Services**

<ul style="list-style-type: none"> ➤ Unicast / Multicast / Broadcast IP Traffic with configured QoS ➤ VoIP calls (P2P and conference) ➤ Video/Images transfer 	<ul style="list-style-type: none"> ➤ FTP ➤ SNMP V3 ➤ HTTP ➤ Emails exchange ➤ Chat ➤ others...
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As a basis MTB uses a common interface for communication between Test Tools used during tests in a way allowing the Test Coordinator to interact with the subject of test – HDR WF Radio Node.



4. Status, Perspectives and Conclusions



ESSOR HDR WF Status

Incremental Development / Validation



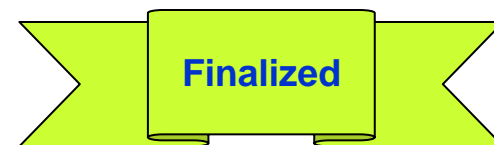
● HDR Waveform Definition:

- Evolutivity / Modularity / Parameterization;
- Elaboration of Draft Standard;
- Supported by High Fidelity Simulations.



● HDR Base WF Development and Validation:

- Common HDR WF software code amongst the 6 National Champions;
- Incremental Validation on NTE for de-risking the porting activity and ensure interoperability;
- Cornerstone for the SDR Business Model.



● HDR Base WF Porting on the National Platforms:

- National Implementation and Validation.
- Incremental Approach



● Multinational Labs Demonstration:

- Supported by Multilateral Test Bed (MTB)
- Incremental Approach





ESSOR HDR WF

Incremental Demonstrations to ESSOR PS



- **Demonstration of HDR Base WF Protocol Layers on Protocol Native Test Environment (PROT NTE)**
- **Demonstration of HDR Base WF Physical Layer on Physical Native Test Environment (PHY NTE)**
- **Demonstration of Initial Point to Point capabilities of HDRWF ported on NCs PTF**
- **Demonstration of Initial Network capabilities of HDRWF ported on NCs PTF**
- **Multinational Labs Demonstration with ESSOR Network capabilities**

June 2013

July 2013

Early Fall
2013

Started
Mid 2014

End 2014



Demonstration of Initial Point to Point Interoperability – Early Fall 2013





Initial Demonstrations of Full HDRWF ported on NC Platforms: Started Mid 2014



Full HDRWF Layers ported on heterogeneous PTF fitted with ESSOR Architecture OE Network Building and Maintenance

User Services Scenarios: IP Traffic, Video Streaming, FTP, VoIP, Web browsing, ...



Perspectives for the Future

- Potential follow on activities
 - **Considerations for Standardization of ESSOR Products**
 - **ESSOR Products technical enhancement:**
 - ❖ ESSOR Architecture;
 - ❖ ESSOR HDRWF.
 - **Support to Operational Deployment, including Field Tests**



Conclusions (1/2)

- The ESSOR Programme is **extending the public SCA specification in order to achieve WF Portability** amongst the ESSOR Participating States, maximizing the compatibility with the SCA.
 - ESSOR focus on DSP & FPGA OE (Scalability), RD, RS and Security Architecture (RSS);
 - ESSOR Architecture is implemented on National Platforms;
 - Contributions to elaboration of SCA 4.0 and SCA 4.1.
- The ESSOR Programme is developing the **advanced Secure Coalition ESSOR HDRWF for mobile ad-hoc networking in UHF band**:
 - Provides Secure Data IP and Voice transmission capabilities;
 - HDRWF modular Architecture enables Incremental Development;
 - HDRWF System is characterized in front of High Fidelity Simulations;
- The ESSOR Programme has validated a **Comprehensive Methodology** for achieving **WF Portability** and **Interoperability** on which ESSOR Stakeholders are capitalizing a significant experience.
 - Common Portable HDR Base WF Software (Golden Source / Container / NTE);
 - Golden Source is *"Configuration, Deployment and Connectivity-agnostic"* (Container);
 - HDR Base WF is ported on different and heterogeneous National Platforms;
 - System level verifications and Interoperability tests (usage of MTB).



Conclusions (2/2)



- ESSOR Programme was launched by 6 Participating States in December 2008 and **demonstrations of the achievements are already done**, including early interoperability tests.
- The ESSOR Programme is a **successfully running example of joint development between different Nations and Industries** in a high cooperative manner for Coalition purposes.
- **The products are aimed at becoming operational.**
- **Future phase** of the ESSOR Programme is being initiated.
- ESSOR Participating States intend to have the HDR WF adopted in the **Coalition Wideband Networking Waveform (COALWNW)** program and as a **standard for the European Community and NATO.**
- **Release of any information** is under OCCAR-EA / ESSOR Participating States control.

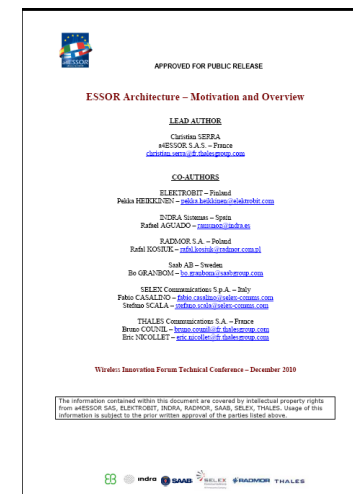


More Information



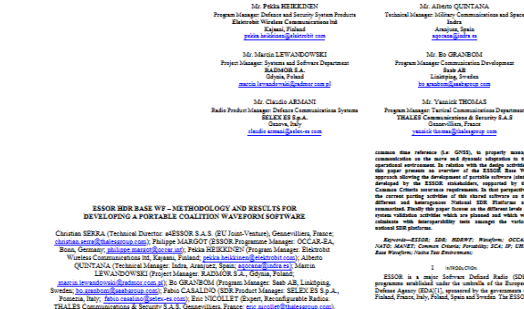
ESSOR Architecture

- **“ESSOR Architecture – Motivation and Overview”** - WINNF Technical Conference – Dec. 2010
 - ❖ <http://groups.winnforum.org/d/do/3824>
- **Contributions to SCA 4.0** through WINNF SCA Next WG focusing on very lightweight OE
 - ❖ AEP profile – WINNF-11-R-0005
 - ❖ UltraLw corba profile - WINNF-11-R-0006
 - ❖ www.wirelessinnovation.org



ESSOR HDRWF Stack and HiFi Simulations

- **“ESSOR HDRWF – Capabilities and Perspectives of an Innovative Coalition Waveform”** - MILCOM'13 – Nov. 2013
 - ❖ http://www.occar.int/media/raw/1569736547_ESSOR_Paper_for_MILCOM_2013.pdf



ESSOR HDR Base WF

- **“ESSOR HDR BASE WF – METHODOLOGY AND RESULTS FOR DEVELOPING A PORTABLE COALITION WAVEFORM SOFTWARE”** - WINNF Technical Conference – March 2014
 - ❖ http://www.occar.int/media/raw/1569827333_ESSOR_HDR_Base_WF_WlinnComm2014.pdf



OCCAR-EA ESSOR PD

Godesberger Allee 140
D-53175 Bonn - Germany

Philippe Margot

ESSOR Programme Manager
Tel.: +49 (0)228 5502 122
Mob: +49 (0)160 5876 520
philippe.margot@occar.int

Jorge Jarauta

ESSOR Technical Specialist
Tel.: +49 (0)228 5502 107
Mob: +49 (0)174 3128 945
alfonso.aiello@occar.int

Leon Hernandez

ESSOR Technical Specialist
Tel.: +49 (0)228 5502 128
Mob: +49 (0)160 5876 350
leon.hernandez@occar.int

a4ESSOR S.A.S.

4, Avenue Des Louvresses
92 230 Gennevilliers Cedex - France

Lino Laganà

a4ESSOR SAS - President
Tel.: +33 (0)1 46 13 27 30
+39 06 91 85 25 00
lino.lagana@selex-es.com

Raúl Dopico López

a4ESSOR SAS - Program Director
Tel: +33 (0)1 46 13 21 97
Mob: +34 608 702 748
rdopico@indra.es

Christian Serra

a4ESSOR SAS - Technical Director
Tel: +33 (0)1 46 13 23 55
Mob: + 33 (0)6 75 65 76 60
christian.serra@thalesgroup.com

