ESSOR

European Secure SOftware defined Radio

a4ESSOR SAS

ESSOR Program Update

2011 Wireless Innovation Forum European Conference on Communications Technologies and Software Defined Radio
International Tactical Radio Workshop II
Brussels (Belgium) – 23 June 2011

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Agenda

1. ESSOR Programme strategic aim
2. ESSOR Program stakeholders and relationships
3. ESSOR Contract
4. ESSOR Perspectives on SDR
5. Status of activities
6. a4ESSOR participation in WINNF activities
7. The future
8. Conclusions

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1. ESSOR Programme strategic aim

Strategic aim

The aim of the ESSOR Programme is to provide the basis for development and production of Software Defined Radio (SDR) products in Europe to meet the requirement for fielding such equipment in Europe, within a timeframe that depends on National SDR Programmes.

- Focus on SDR technology
- European initiative to improve know how
- Security considered as a key topic

Expected Main Outcomes

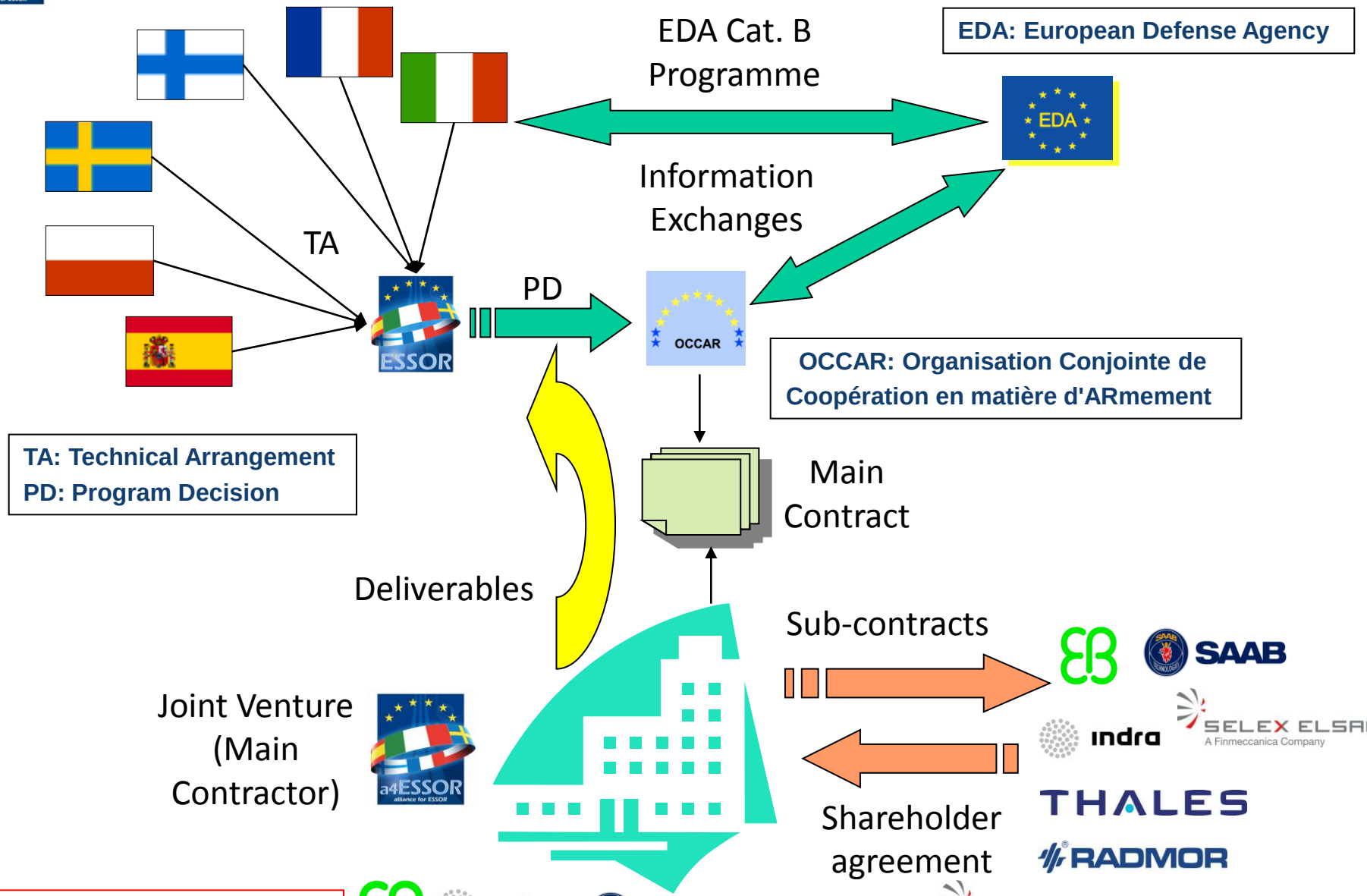
- The ESSOR Programme will provide **a common architecture**, shared by the ESSOR Nations, that defines the framework for the development of radio platform software and associated security elements.

- This architecture is key to **interoperability**, **portability** and will promote the development of SDR equipment in Europe.

- Interoperability and Portability will be tested through the development of a waveform with advanced communication characteristics, the **HDR WF**.

2. ESSOR Program stakeholders and relationships

ESSOR Programme stakeholders – Relationships Scheme



ESSOR Nations expectations

- To improve interoperability between EU Members States, the USA and NATO, and public safety/homeland security communication systems by the means of:
  - Deployment of SDR concepts, architecture and technologies
  - Deployment of common Information Security Architecture
  - Definition and validation of new coalition waveforms (WF) to be used in future Network Enabling Capability (NEC) operations
- To master SDR architectures and technologies in Europe in order to:
  - Facilitate WF (Waveform) portability between different SDR products
  - Facilitate the future development of new generations of SDR products
  - Maintain a competitive offer in Europe
- To leverage on current National/Multinational investments and optimise future European developments in these domains.

3. ESSOR contract

Contract overview (1/2)

- The contract has national radio Platforms (PTF) as the basis for the application of the ESSOR Architecture onto which the HDR Base WF will be ported.
- The outcome will be 6 national target HDR WF developed from a common HDR Base WF running on 6 different national radio PTF with a common ESSOR architecture.
- The radios will be interoperable when using the HDR WF.

Contract overview (2/2)

- Elaboration and validation of a joint secure architecture for SDR, based on the SCA:
  - Referential system & secure architecture shared at European level.
- Elaboration and validation of a coalition secure networking waveform:
  - First multinational HDR waveform designed for secure interoperability in terrestrial operations.
- Option for specification of certification tools.

ESSOR Program Products and roadmap

2010

ESSOR Architecture definition

High Fidelity Simulations

HDR WF Specification

2010

WF Specification Elaboration

Design Methodology

2011

HDR Base WF

Base WF Development

ESSOR ARCHITECTURE (APIs & OPERATING ENVIRONMENT)

Native Test Environment

ESSOR AL(*) ... ESSOR AL(*) ... ESSOR AL(*)

Base WF Porting

6 NC different SDR Platforms updated to ESSOR Architecture

2012

HDR Target WF

HDR Target WF

HDR Target WF

2011

ESSOR AL(*) ... ESSOR AL(*) ... ESSOR AL(*)

HDRWF ported on 6 NC SDR Platforms updated to ESSOR Architecture

2013

Multinational Validation

(*) AL: Abstraction Layer and APIs

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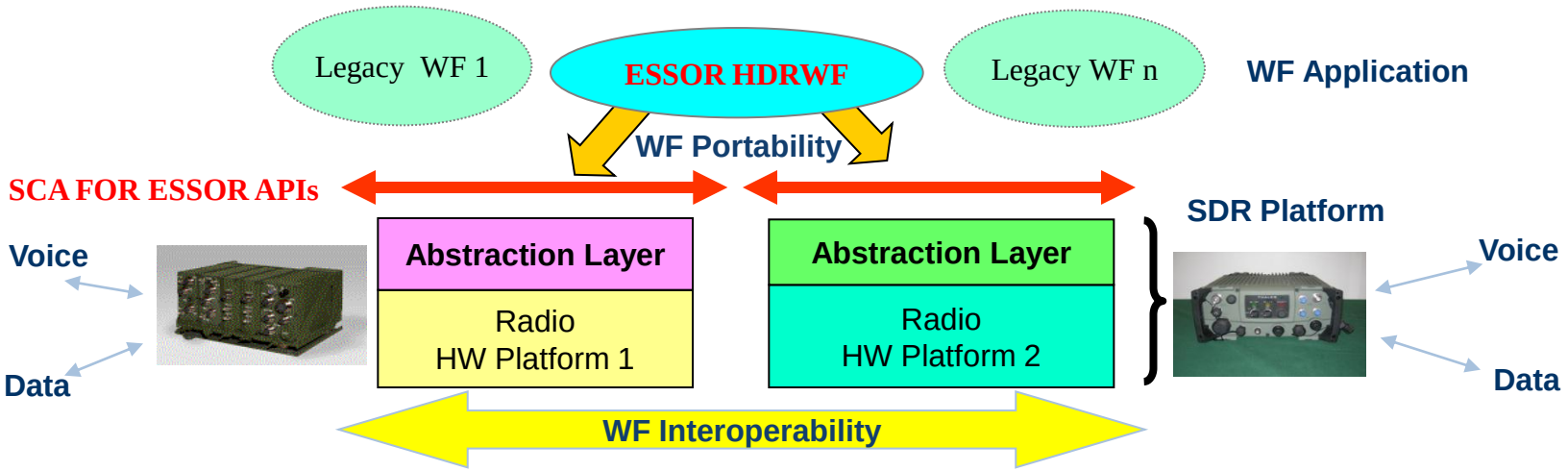
4. ESSOR Perspectives on SDR

ESSOR Perspectives on SDR

- ESSOR Program addresses the following topics
  - Definition and development of a new High Data Rate WF (HDRWF) for Ad-Hoc mobile network for Land Applications in order to achieve Interoperability between the coalition forces.
  - Definition of an SDR Architecture in order to facilitate WF Portability amongst the six different National SDR Platforms.



Goals on SDR Architecture

- ESSOR Nations and Industries have recognized since a long time the outstanding benefit of the US Joint Tactical Radio System (JTRS) Software Communications Architecture (SCA) as a de facto Procurement Specification / Standard for SDR in Military Business.

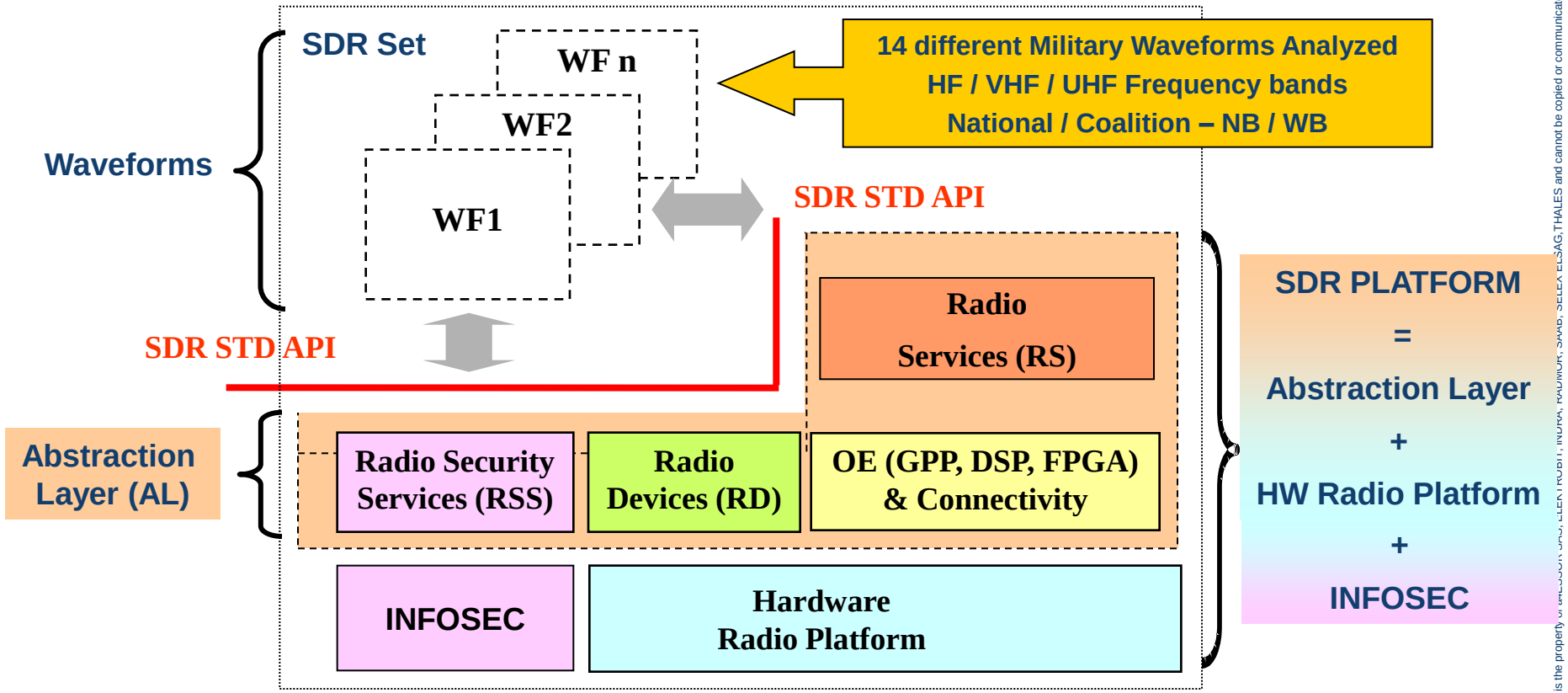
- The goal of the ESSOR Program is to extend the public part of the SCA in order to achieve WF Portability amongst the ESSOR Nations, maximising the compatibility with the open parts of the SCA.

- Under ESSOR Nations control, the goal of the ESSOR Program is also to make public these SCA extensions in order to achieve further SDR Standardisation.

SDR Architecture – Main Parts

In order to achieve WF Portability, SDR Architecture shall address Std APIs definition between WFs and SDR Platform (composed of HW Radio Platform + INFOSEC + Abstraction Layer)

- Extending OE, RD, RS APIs and defining RSS APIs are the main ESSOR Program efforts



ESSOR Architecture Extensions

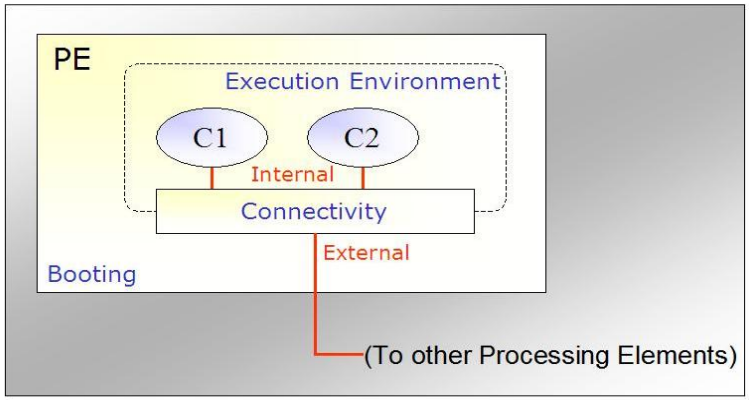
- ESSOR Architecture extends the following specifications
  - JTRS SCA 2.2.2 and API Release 1.0.3
  - WINNF Transceiver APIs

ESSOR Architecture Functional Elements	Existing Published Specifications Referenced	ESSOR Architecture Efforts
Execution Environment	SCA 2.2.2 GPP (CF, OS)	***Extensions for DSP & FPGA OE***
Connectivity	SCA 2.2.2 CORBA on GPP JTRS MHAL on DSP / FPGA	***Extensions for: CORBA on DSP/FPGA MHAL DSP /FPGA***
Radio Devices (RD)	Published JTRS RD APIs	***RD Extensions***
	WINNF Transceiver APIs	***Transceiver Extensions***
Radio Services (RS)	Published JTRS RS APIs	***RS Extensions***
Radio Security Services (RSS)	SCA Security Supplement **for Information Only (*)**	***Defining High Level ESSOR Security Architecture and RSS API***

(*) SCA Security Supplement not more supported by SCA 2.2.2 release

OE for DSP & FPGA

- ESSOR Architecture defines system components related to Operating Environments (OE) for different types of processing units, typically used for data signal processing (DSP, FPGA), and provides a specification for such environments, taking into account currently available technologies.
- Operating Environments are namely composed of:
  - Execution Environment:
    - Deployment of Waveform Components on Processing Elements (PE)
    - AEP (Application Environment Profile) for DSP
  - Connectivity:
    - Logical Interconnection of deployed components, wherever located (for mutual interaction purposes)
    - Access to RD / RS by co-located WF components



OE for DSP & FPGA

- ESSOR Architecture considers two approaches for Connectivity on DSP and FPGA: CORBA and MHAL
  - Both are issued from SCA achievements
  - The choice of Connectivity is a SDR Platform provider decision
- Specific profiles are being defined for usage of CORBA in DSP and FPGA environments
- The JTRS MHAL specification is being extended to support additional capabilities (OS tasks synchronization, etc…)
- ESSOR Architecture identifies relationships between DSP, FPGA OEs and GPP OE

ESSOR Architecture is scalable, fitting with different classes of processing and connectivity environments

ESSOR Radio Devices API

ESSOR RD API (*)	Reference JTRS API	Considered SDRF API
Audio	AudioPortDevice API VocoderService API	
Discrete	-	
Serial	SerialPortDevice API	
Ethernet	EthernetDevice API	
GNSS	GpsDevice API	
Transceiver	MHAL RF Chain Coordinator API Extension to MHAL API	SDRF Transceiver Facility Spec (including SDR Forum inputs)
Power amplifier		

(*) Elaborating ESSOR RD API takes into account also ESSOR Industries & ESSOR PS Background Information

For RD APIs, ESSOR mainly extends JTRS and SDRF (WINNF) RD APIs

ESSOR Radio Service API

ESSOR RS API (*)	Reference JTRS API	Considered SDRF API
Configuration	-	-
SNMP	-	-
Fault Management	-	-
HMI Service	-	-
Retransmission	-	-
IP Routing	-	-
Vocoder Service	JTRS VocoderService API	-
Time Management	JTRS TimingService API	-

(*) Elaborating ESSOR RS API takes into account also ESSOR Industries & ESSOR PS Background Information

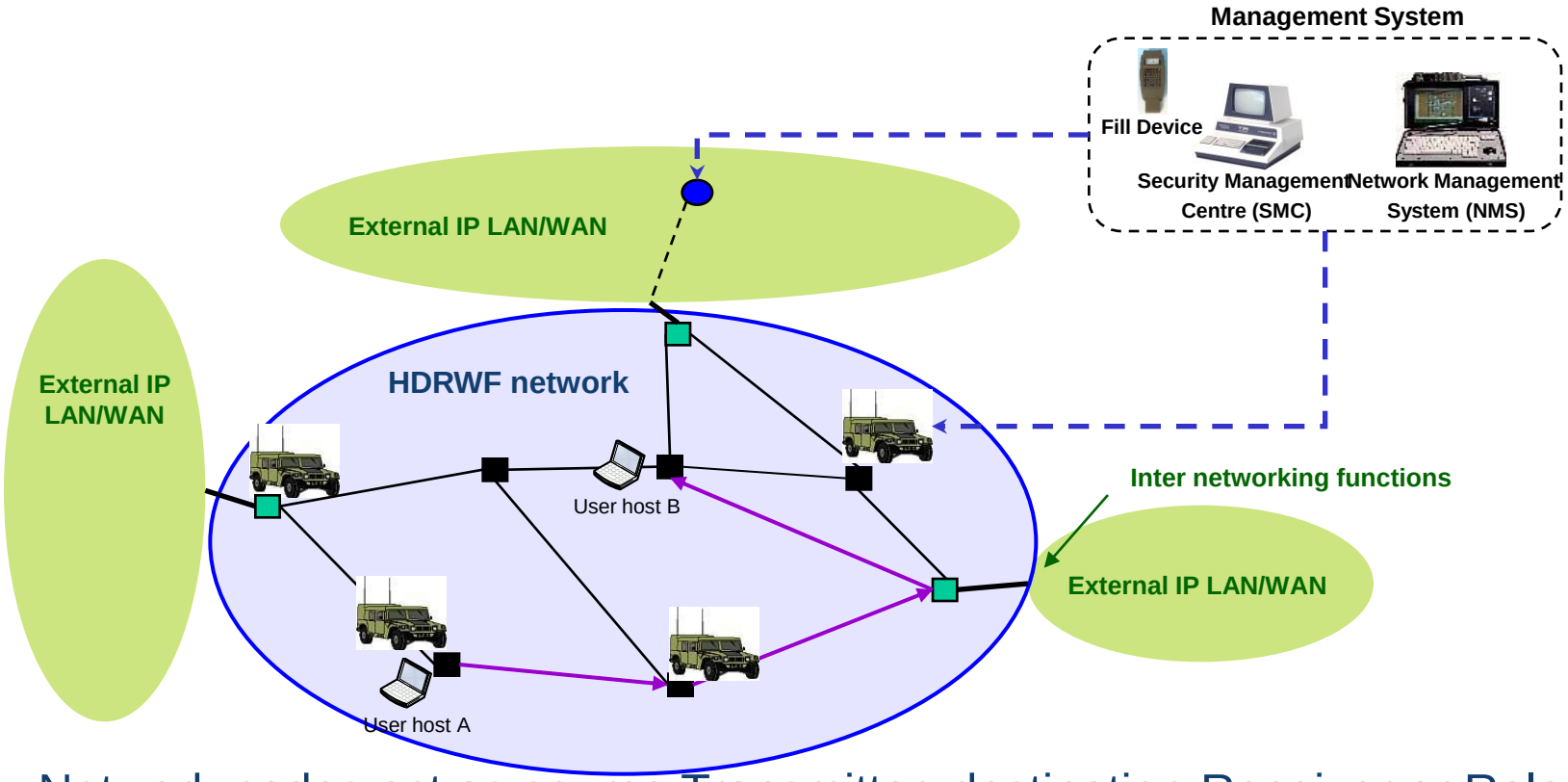
For RS APIs, ESSOR mainly uses as foundations the ESSOR Industries & PS Background Information

ESSOR HDR WF Key Features

- High Data Rate: ~1 Mbps, ~ 512 kbps, ~ 256 kbps
- UHF: 225-400 MHz, ~1,25 MHz bandwidth, Frequency-Hopping
- Mobile: up to 200 nodes
- Ad-Hoc: Mobility management of the nodes and communication on the move
- Synchronization: With or Without GNSS
- Radio Silence Capable
- Secure: COMSEC / NETSEC / TRANSEC capabilities
- Compatible with standard IP applications: QoS driven approach – Unicast / Optimized Multicast / Broadcast traffic
- Voice Capable: Voice CNR Push To Talk (PTT) and VoIP
- Local or Remote Management and Supervision functions
- Vehicular deployment with interfaces to Air / Naval: Brigade and Below

HDRWF System Overview

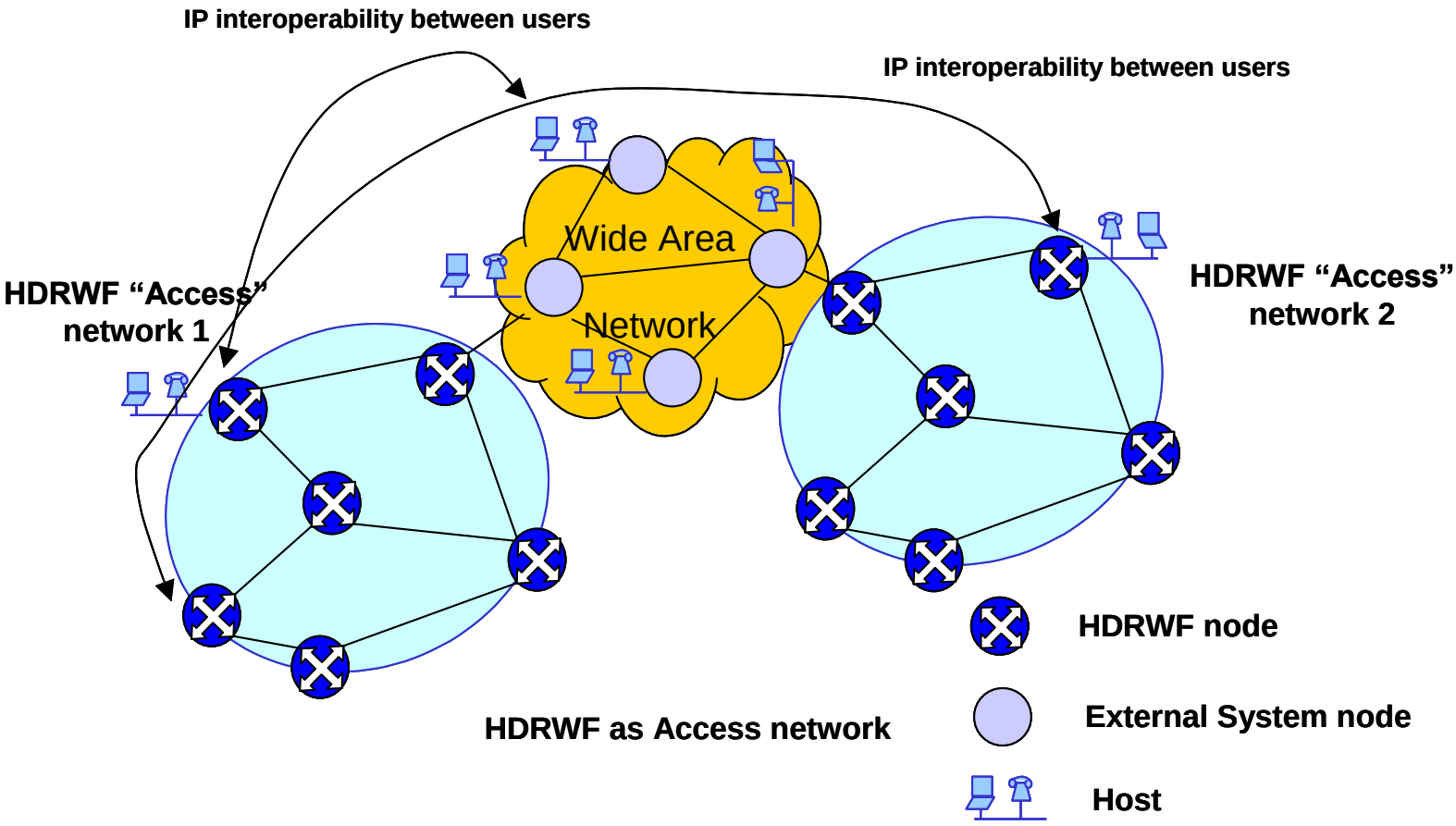
- The HDRWF network is a high data-rate multi-hop mobile ad hoc network, self-organizing and self-healing.



- Network nodes act as source Transmitter, destination Receiver or Relay node.
- Network nodes can be connected to IP external networks through inter-networking functions.

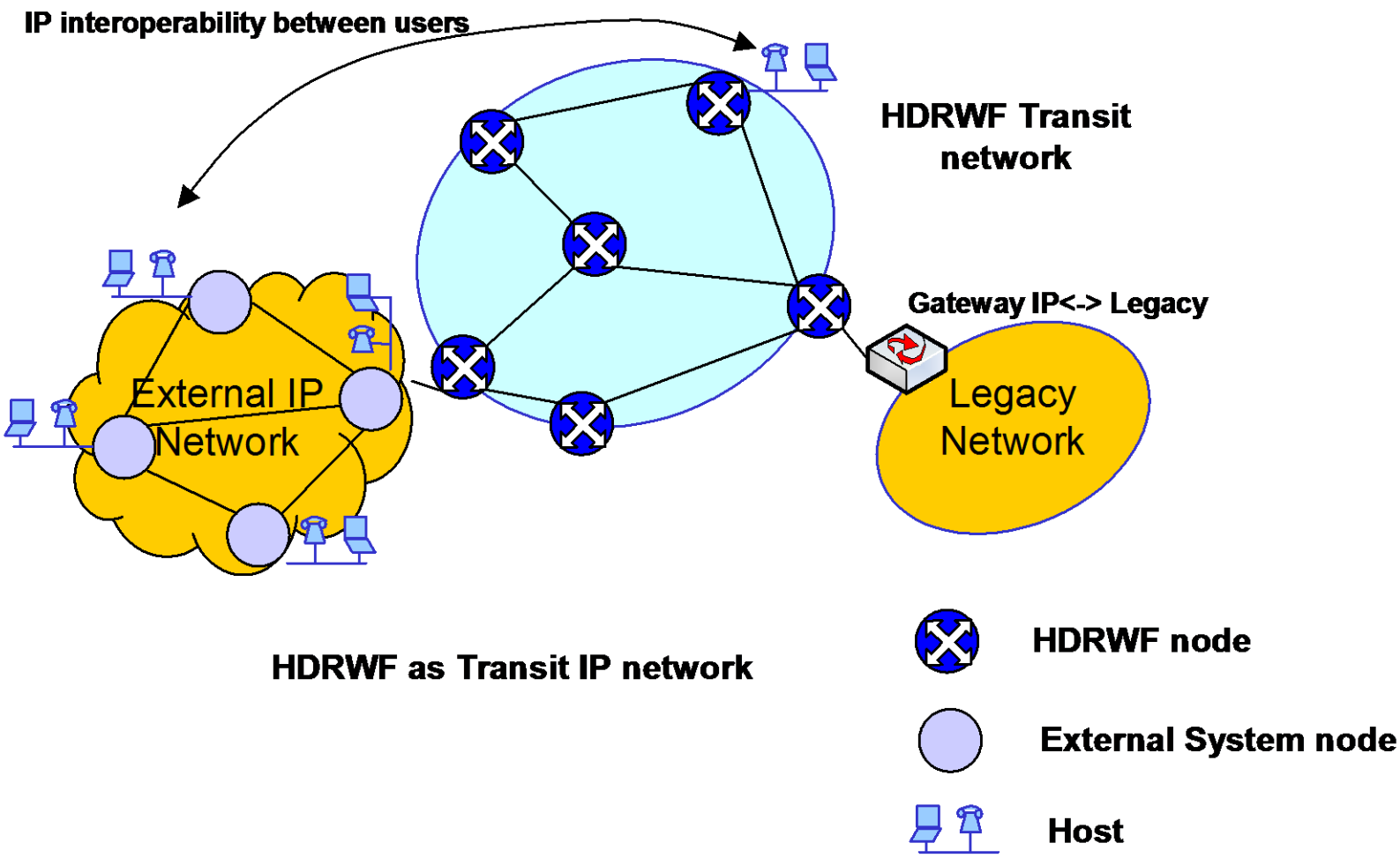
ESSOR HDRWF Use Cases

- ESSOR HDRWF as an Access Network

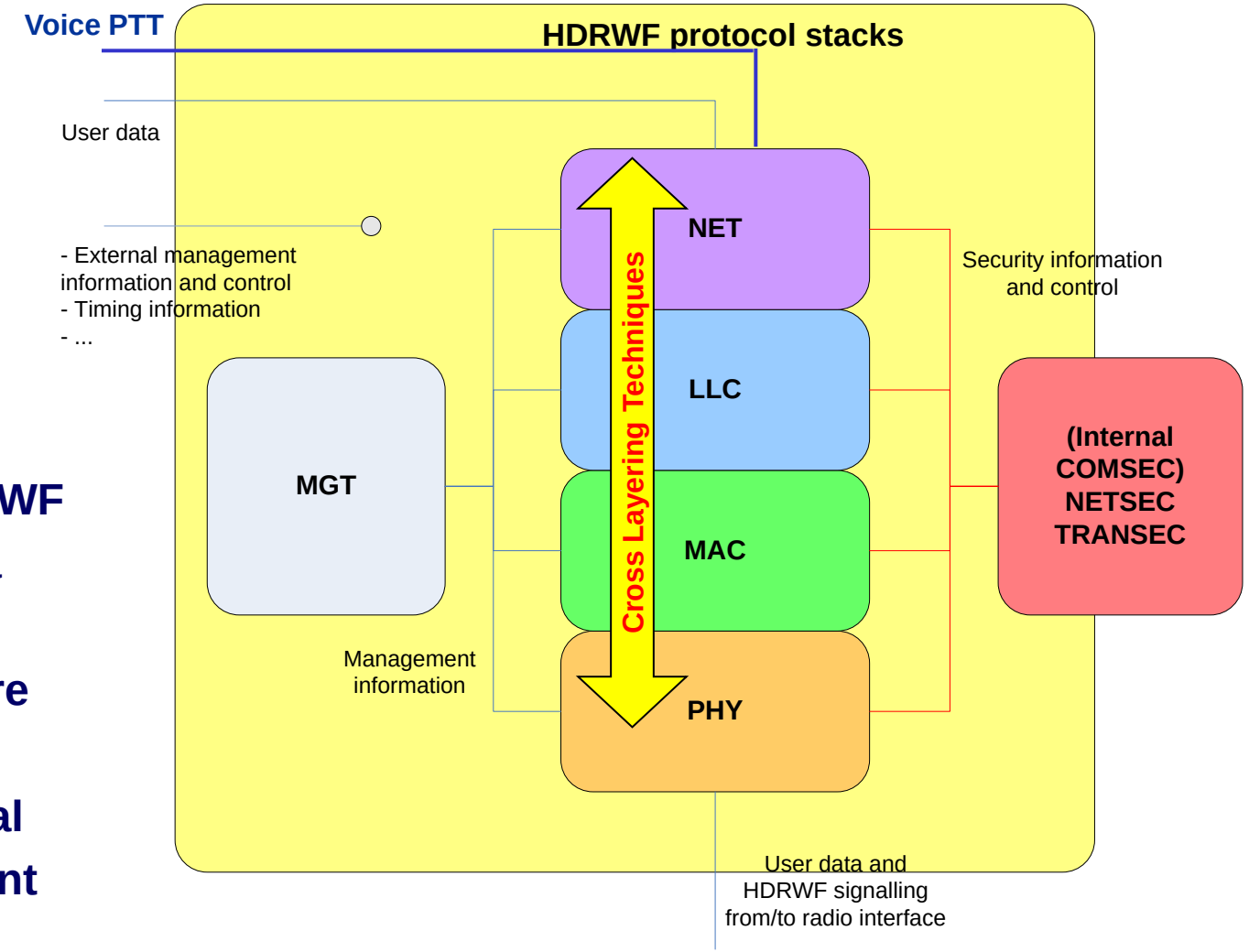


ESSOR HDRWF Use Cases

- ESSOR HDRWF as a Transit Network



ESSOR HDRWF Protocol Stack Logical View



ESSOR HDRWF exhibits a Modular Architecture enabling Incremental Development

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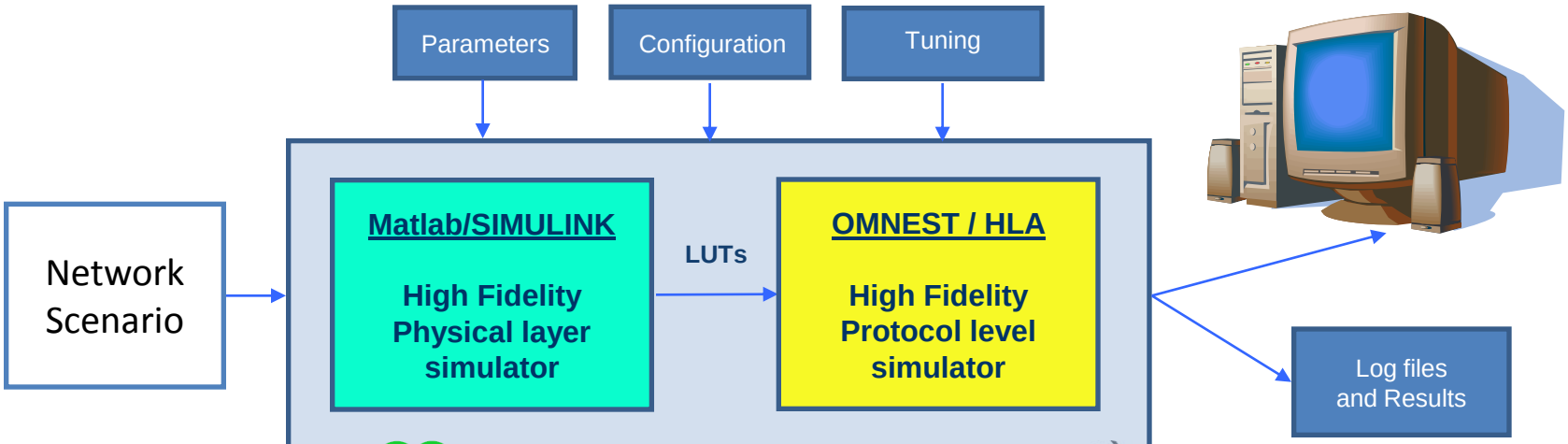
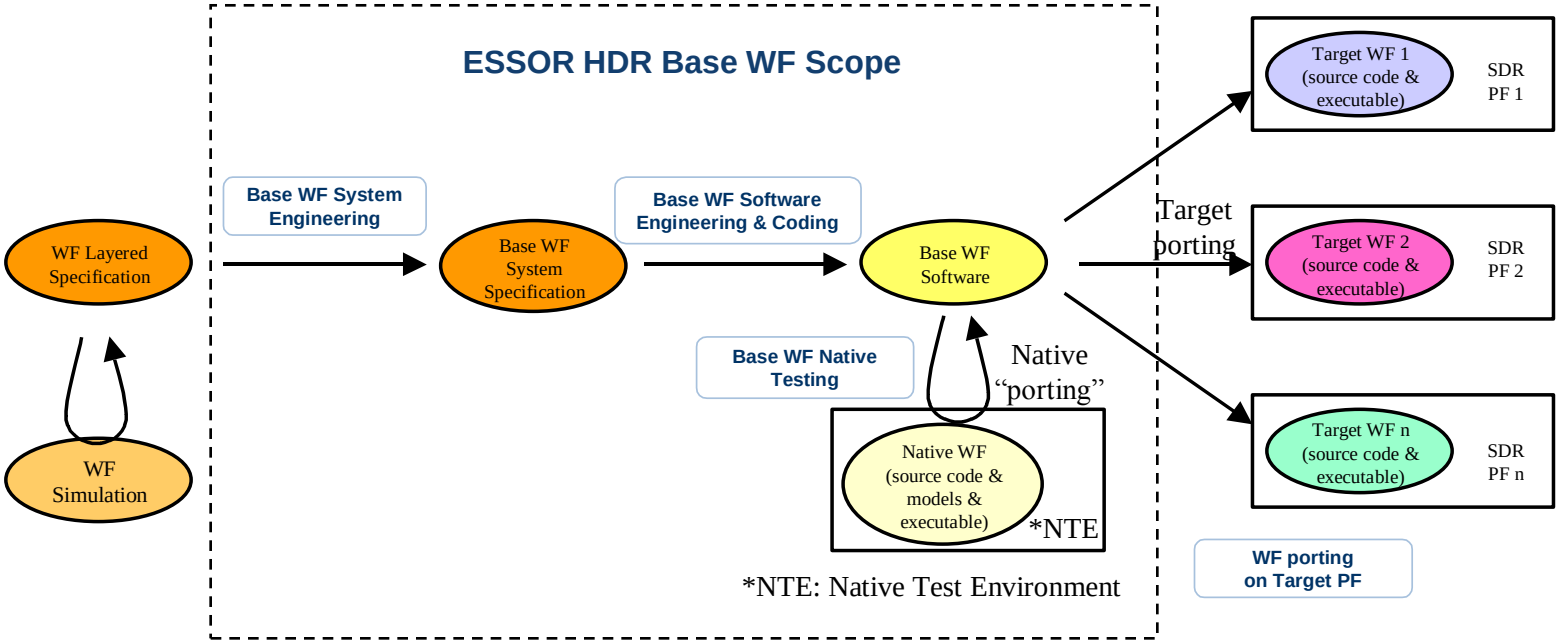
ESSOR HDRWF Hi-Fi Simulations

- The goals of ESSOR HDRWF Hi-Fi Simulations are:
  - To validate the HDRWF specifications
  - To assess Performance in complex scenarios (Fading Channel, Large Number of Nodes, Mobility, …)
  - To provide models for the development of the HDR Base WF
- PHY link layer Simulator is based on Matlab/SIMULINK
- Protocol level Simulator is based on OMNEST
- Both Simulators are running independently from each other
  - Physical simulator results exported via Look Up Tables (LUT)
- Large network scenarios are addressed by a distributed computing based on HLA (High Level Architecture



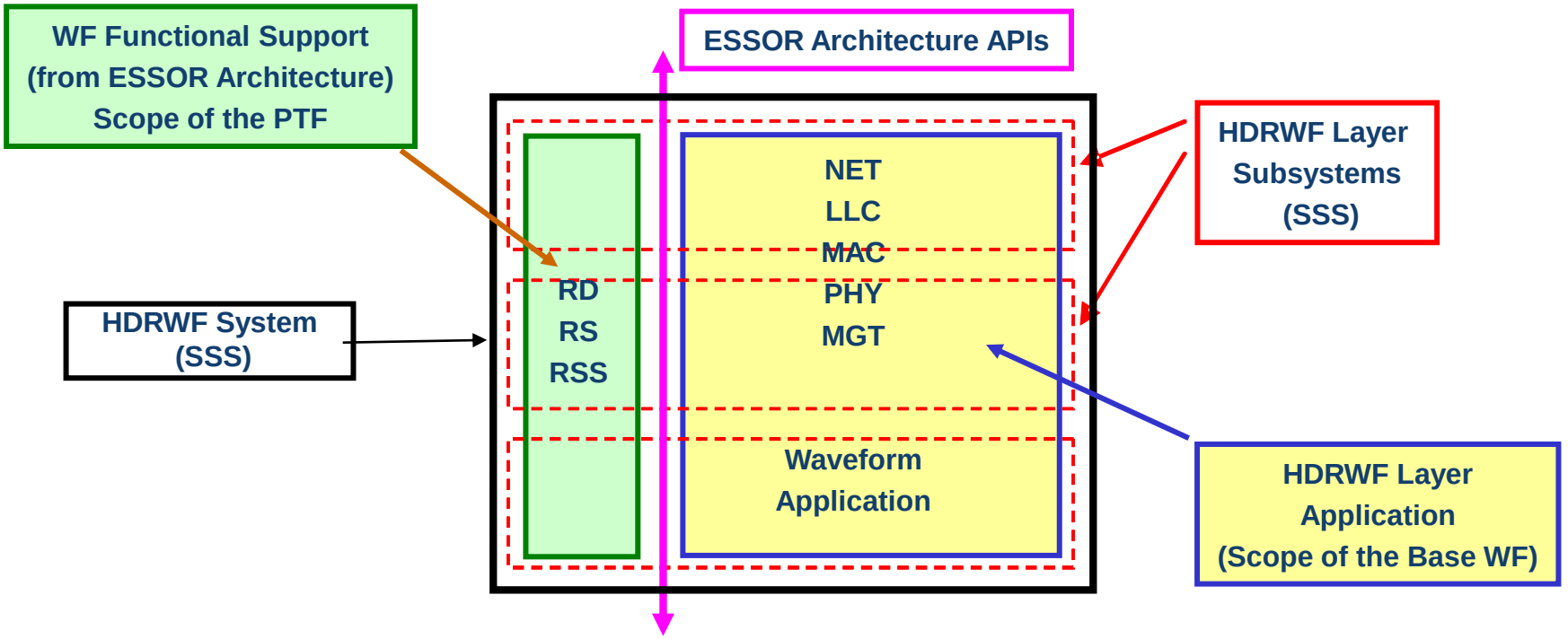
ESSOR HDR Base WF

- ESSOR HDR Base WF main goals
  - Common HDR WF software code amongst the 6 National Champions
  - Initially ported and validated in a common Native Test Environment to de-risk national porting phase
  - Developed using the ESSOR Architecture APIs
  - Supported by ESSOR Base WF Methodology for Portability



ESSOR HDR Base WF / PTF Partitioning

- The HDRWF system functionalities are partitioned between
  - HDRWF Layer Application – Scope of the Base WF
  - The WF Functional Support – Scope of the PTF implementing the selected features of the ESSOR Architecture (with API identification according to RD, RS, RSS)



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ESSOR Base WF Methodology for Portability

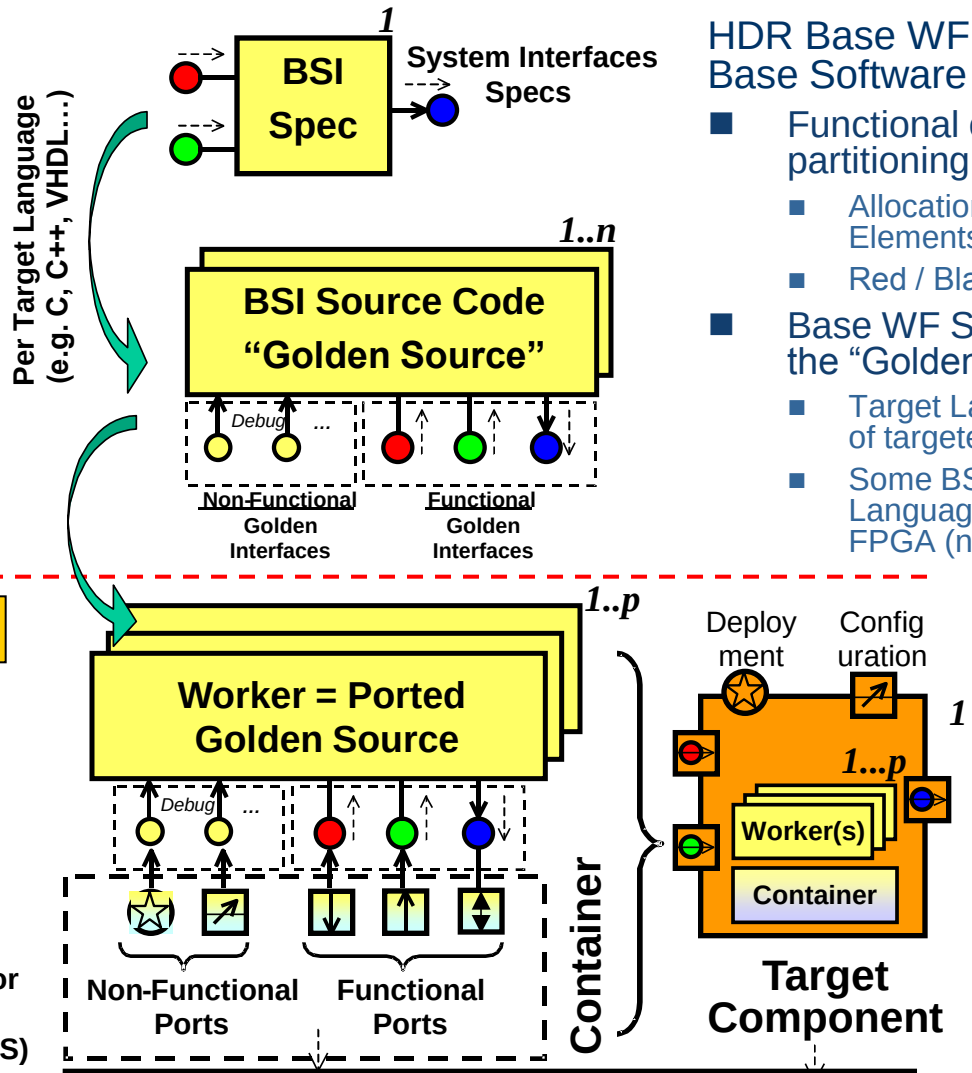
1 - Base WF System Design

2 - Base WF Software Design and Coding

Base WF Domain

Target WF Domain

3 - Base WF Porting on Target Platform



HDR Base WF Application decomposed in Base Software Item (BSI)

- Functional element integrating the partitioning constraints
  - Allocations to dedicated Processors Elements (PE) (GPP, DSP, FPGA)
  - Red / Black separation, …
- Base WF Source Code at BSI level forms the "Golden Source"
  - Target Language (C++, C, VHDL) depends of targeted PE (GPP, DSP, FPGA)
  - Some BSIs can be coded on several Target Languages: e.g. C for DSP and VHDL for FPGA (notion of *dual* BSI for PHY Layer)

Target Component groups Workers and Container

- Worker (Ported Golden Source) can use specific libraries or accelerators
- Container includes the code specific to each Target Platform (OE functionalities: connectivity, RTOS, timers, … RD, RS, RSS)

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ESSOR Base WF Methodology for Portability

- Generic methodology - Portability-focused
  - Goes significantly further than NED* WF Portability Guidelines, while being in line with its principles
  - Separates the stable functional software (the Worker / Golden Source) from platform-dependent software (the Container)
  - Enables WF Portability across different OE choices.
    - One essential asset to preserve Portability when number of possible connectivity increases (e.g. CORBA, MHAL Comm, …)
- Coherent framework integrating key methodological principles
  - System Definition versus Software Definition isolation
  - Separation of Concerns
  - Model Driven Architecture
- Covers the complete Base WF development cycle
  - System Design, Software Design and Coding, Native Verification
  - Includes Coding Rules derived from "*Joint Strike Fighter Air Vehicle C++ Coding Standards*"

(*) - NED: Joint Tactical Radio System Network Enterprise Domain Test & Evaluation Waveform Portability Guidelines, version 1.2.1, 28 December 2009

5. Status of Activities

HDR WF - Progress

- HDR WF System Requirements Review (SRR) held in Jan/Feb 2010.
- HDR WF System Design Review (SDR) held in Nov/Dec 2010.
- HDR WF Preliminary Design Review (PDR) planned during Summer 2011.

ESSOR Architecture - Progress

- **ESSOR Architecture Preliminary Design Review (PDR) held in July/Sept 2010.**

- **Acceptance Review of the draft standard for the ESSOR Architecture held in July/Sept 2010** based on:
  - ESSOR Architecture definition document;
  - Operating Environment description;
  - ESSOR Security Architecture definition document;
  - Radio Devices APIs;
  - Radio Services APIs;
  - Radio Security APIs.

- **Implementation of the ESSOR Architecture on the National Platforms performed in 2011.**

6. a4ESSOR participation in WINNF activities

a4ESSOR Participation in WINNF

- a4ESSOR is member of WINNF since 2010
- a4ESSOR just joined the Steering Group of the Coordination Committe for International SCA Standards
- a4ESSOR is contributing to the SCA Next initiative through ESSOR Industries experts attending the SCA Next Working Group

a4ESSOR contributions to the SCA-Next Initiative

- At the SCA-Next roll out (August 2010) Industries were invited to provide contributions in a number of areas through the WINNF SCA-Next WG for JTRS consideration

- The contributions were to be made via the WINNF “ad hoc” SCA-Next WG, a technical forum intended to channelize to JTRS proposals and optimization of the current draft specification.

- a4ESSOR, duly authorized by ESSOR Nations, released some ESSOR information to the SCA-Next WG in some of the proposed areas, aiming, as much as possible, to align/harmonize the contents of both specifications in specific areas.

- Namely, two contributions have been provided up to now:
  - AEP profile
  - UltraLw corba profile

Both are under SCA-Next Working Group revision/approval before dissemination to JTRS

- The contributions mainly aim to complement the SCA-Next, focusing on very lightweight environments, they are intended to maximize the compatibility of the two specifications.

7. The Future

- **Potential follow on activities:**
  - **SDR Standardization and Certification**
    - a4ESSOR/NC Participation to discussion forums (EDA, WINNF, RTO, IQPC, SMi……)
  - **ESSOR Products technical enhancement**
    - ESSOR Architecture
    - ESSOR HDRWF
  - **Support to Operational Deployment**

"a4ESSOR/NC involvement in the above future activities is under discussion at OCCAR/ESSOR Nations level"

8. Conclusions

Conclusions

- The ESSOR Programme is extending the public SCA specification in order to achieve WF Portability amongst the ESSOR Nations, maximising the compatibility with the SCA.
  - ESSOR Program puts efforts on DSP & FPGA OE (Scalability), RD, RS and Security Architecture (RSS).
- The ESSOR Programme is developing an advanced HDRWF for mobile ad-hoc networking in UHF band
  - ESSOR HDRWF modular Architecture enables Incremental Development
- The ESSOR Programme is a successfully running example of joint development between different Nations and Industries in a high cooperative manner.
- The products are aimed at becoming operational
- Release of any information is under OCCAR-EA / ESSOR Nations control.
- a4ESSOR is proactively preparing for the future, under the guidance of OCCAR/ESSOR Nations

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Questions ?

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