Leonardo's SWIM status of play

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18/05/2016

LEONARDO
SECURITY & INFORMATION SYSTEMS

Focus on Aerospace, Defence and Security

Leonardo is Italy's main industrial Group, leader in the high technology sector, and ranks among the main Aerospace, Defence and Security groups worldwide. We operate in the following business areas:

| HELICOPTERS	SPACE	AERONAUTICS	ELECTRONICS, DEFENCE & SECURITY SYSTEMS
DIVISIONS	**COMPANIES**	**DIVISIONS**	**DIVISIONS**
▪ **Helicopters**	▪ **Telespazio** ▪ **Thales Alenia Space**	▪ **Aircraft** ▪ **Aerostructures**	▪ **Airborne & Space Systems** ▪ **Security & Information Systems** ▪ **Defence Systems** ▪ **Land & Naval Defence Electronics**

Group Financial Results* Full Year 2015

REVENUES 2015
€bln. 13.3

- **40%** DEFENCE AND SECURITY ELECTRONICS
- **34%** HELICOPTERS
- **23%** AERONAUTICS
- **3%** DEFENCE SYSTEMS

ORDER BACKLOG
€bln. 29.4

- **40%** HELICOPTERS
- **35%** DEFENCE AND SECURITY ELECTRONICS
- **21%** AERONAUTICS
- **4%** DEFENCE SYSTEMS

NEW ORDERS
€bln. 13.0

- **52%** DEFENCE AND SECURITY ELECTRONICS
- **30%** HELICOPTERS
- **13%** AERONAUTICS
- **5%** DEFENCE SYSTEMS
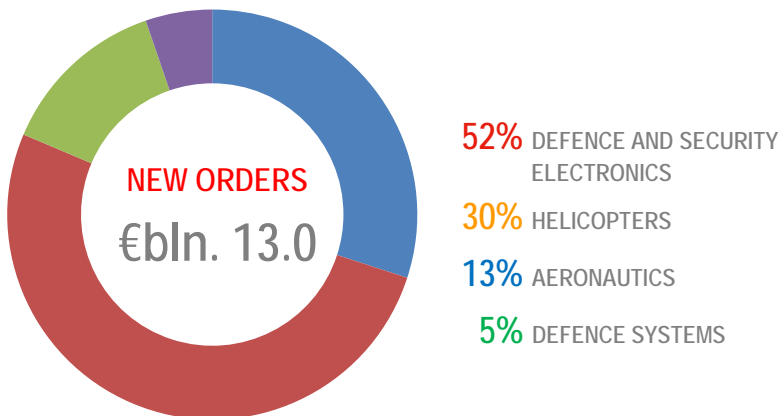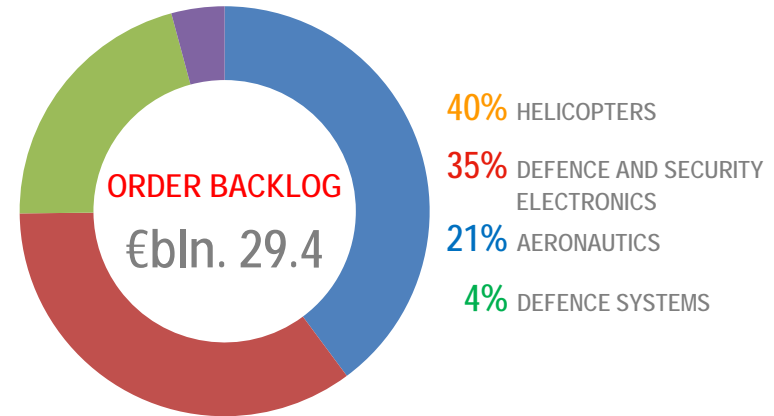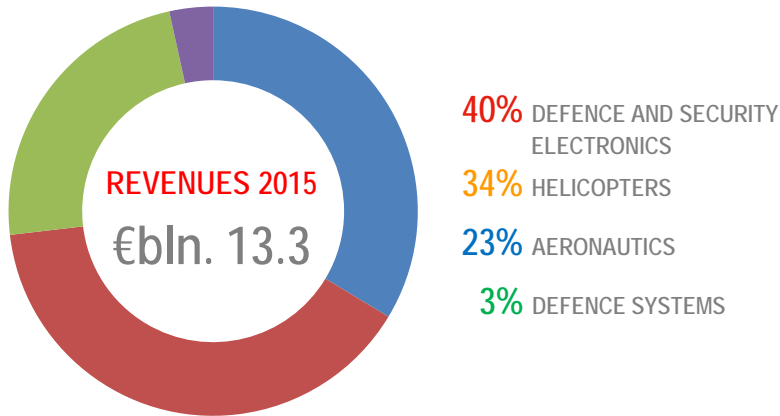
RESULTS 2015 in €mln.	GROUP TOTAL
Revenues	**13,322**
New Orders	**13,037**
Order Backlog	**29,413**

* Figures restated as a result of the adoption of the new IFRS 11, which led to the deconsolidation of the Group's joint ventures.

As of 31 December 2015

Worldwide Operations

We operate in more than 20 countries and employ 47,331 people.
Our product and systems are operative in nearly 150 nations.

NORTH AMERICA **21%**

EUROPE **57%**

ASIA **11%**

AFRICA **2%**

SOUTH AMERICA **7%**

OCEANIA **2%**

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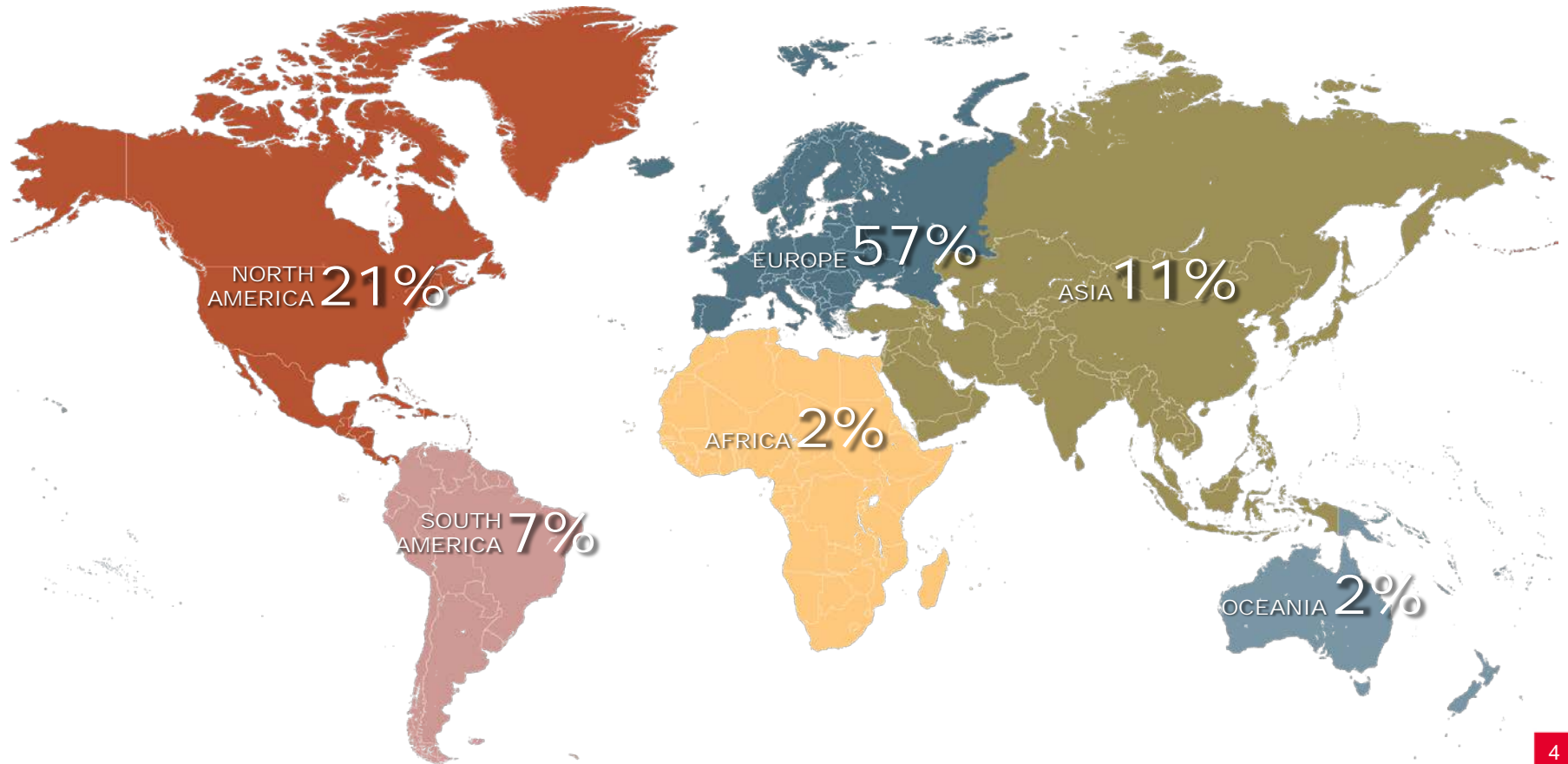
Security & Information Systems Division - Markets

GOVERNMENT & DEFENCE

- Public Sector
- Defence
- NATO & EU

INDUSTRIAL SECTOR & CNI

- Oil & gas
- Energy
- Airports&Ports
- Bank
- Industrial enterprises

TRAFFIC CONTROL SYSTEMS

- ATM
- Coastal and land border security
- Port Security
- VTMS

SAFETY & SECURITY AGENCIES

POSTAL & COURIER OPERATORS

RAILWAYS, MASS TRANSIT, ROADS

Outline

- Leonardo in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Leonardo's experience on SWIM
- Leonardo SWIM Node Implementation
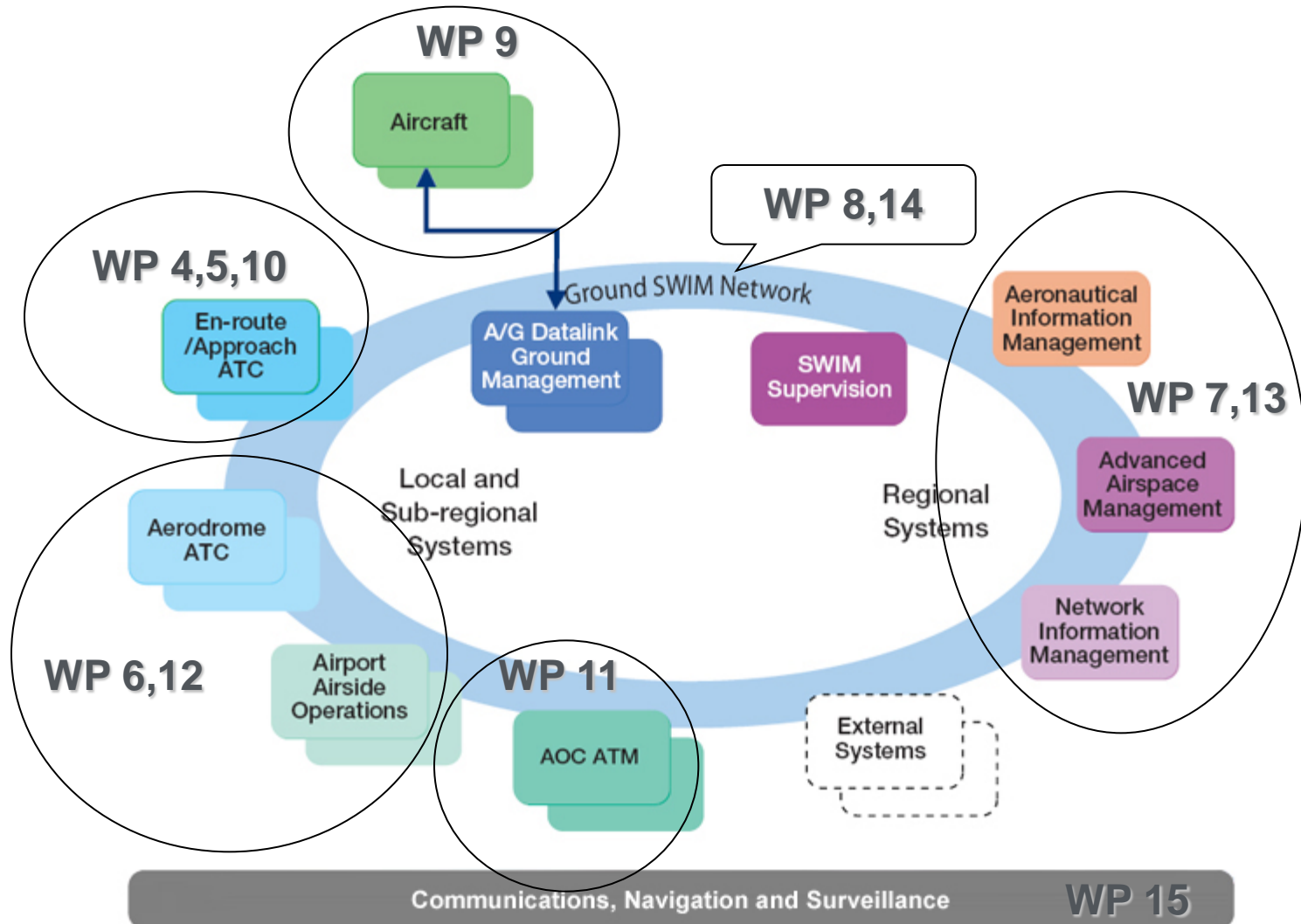   - High level architecture

Leonardo in SESAR1

What is SESAR?

- Single European Sky ATM Research
- It is a large European ATM R&D Programme
- 2.1 Billion Euros as budget over 2009-2016 timeframe
- Public-Private Partnership
- 18 Work Packages
- Almost 300 projects

Leonardo is one of the key members of the SESAR Development Phase

High Level SESAR Target System Architecture

Outline

Leonardo in SESAR

SWIM Concept

SESAR SWIM Definition

SESAR SWIM Technical Infrastructure

Leonardo's experience on SWIM

Leonardo SWIM Node Implementation

     –   High level architecture

SWIM Concept in short

SWIM is all about information exchange and interoperability among heterogeneous stakeholders/systems

In order to achieve this you need to tackle (at least) two aspects:

– Agreement (standardization) on which are the information that need to be exchanged, how they are represented and what they really mean

This then results in the definition of exchange models and definition of services to exchange such information

– In order to actually exchange information among systems specific technologies to convey such info/services must be agreed and used (here so called SWIM-Technical Infrastructure comes into play)

In SESAR different technologies for different information exchanges have been agreed.

SWIM Concept in short

A picture is better than hundreds of words
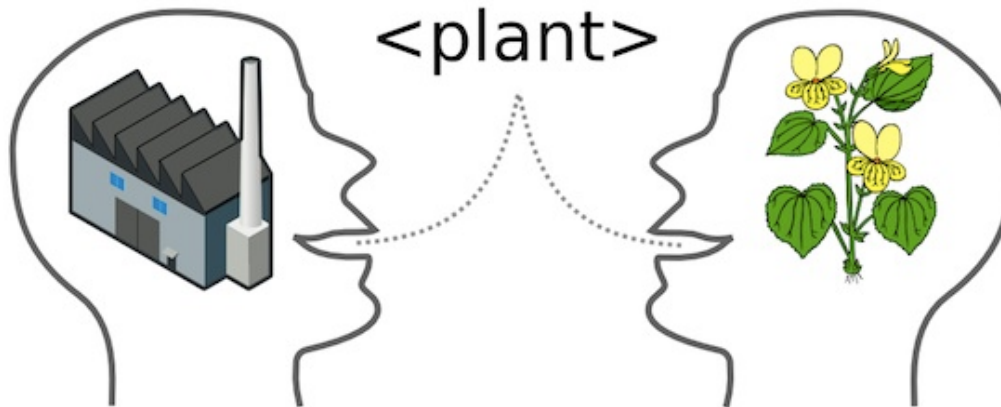
Semantic interoperability: the meaning of information specified in a way understood by all parties (e.g. definitions, relations and structure of terms used to describe data).

The above problem is taken care in SESAR by WP8

- – Definition of ATM Concepts, definitions, dictionary, data structures and relationships, services to exchange information…

SWIM Concept in short

But even if you agree on a common concept and a data representation, you still need to make computer systems interact each other. Multiple technologies, standards, implementations exist…

Technical interoperability: issues involved in linking computer systems and services together (e.g. transport and serialization of data).

The above problem is taken care in SESAR by WP14

– Design of SWIM Technical Architecture, requirement and interface specifications, selection of standards and technologies etc..

Outline

Leonardo in SESAR

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– High level architecture
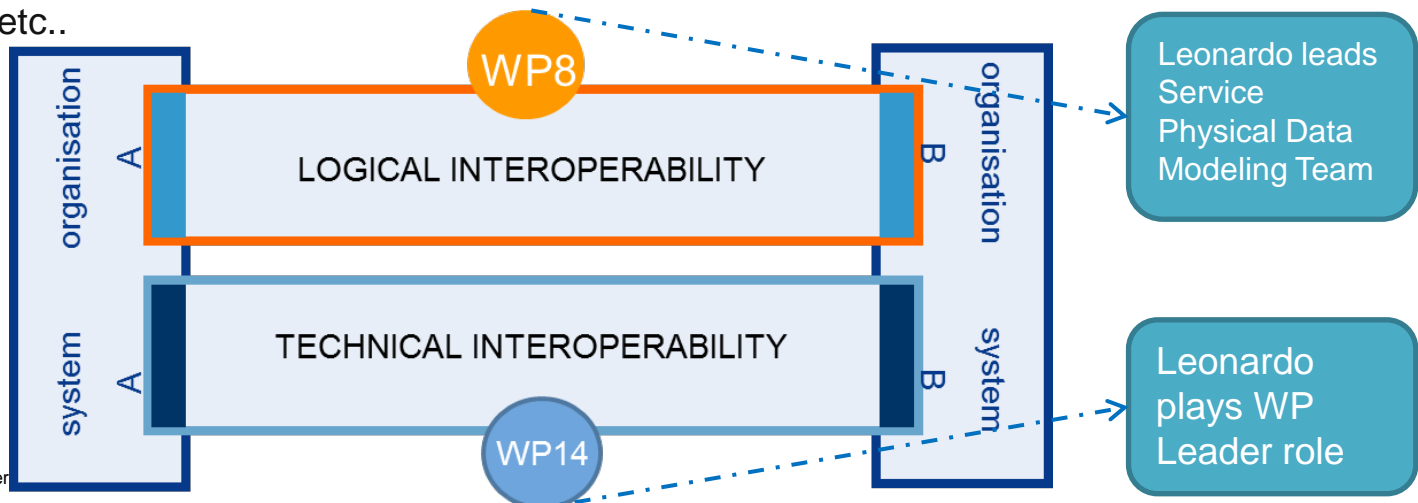
SWIM SESAR Definition

SWIM consists of **standards**, **infrastructure** and **governance**
enabling the management of **ATM information** and its exchange
between **qualified parties** via **interoperable services**

The definition above synthetize (and extends) previous points and (notably) include also "governance" aspects which basically addresses yet another "problem".

Organizational interoperability: coordination of processes in the context where data is used/transformed. (e.g. shared definitions of the roles, responsibilities and interactions of/between participants).

In SESAR, this is also taken care by WP8

– Definition of service lifecycle, stakeholder and service qualification, service and models evolution etc..

organisation A — **WP8** — LOGICAL INTEROPERABILITY — organisation B

Leonardo leads Service Physical Data Modeling Team

system A — TECHNICAL INTEROPERABILITY — system B — **WP14**

Leonardo plays WP Leader role

Outline

Leonardo in SESAR

SWIM Concept

SESAR SWIM Definition

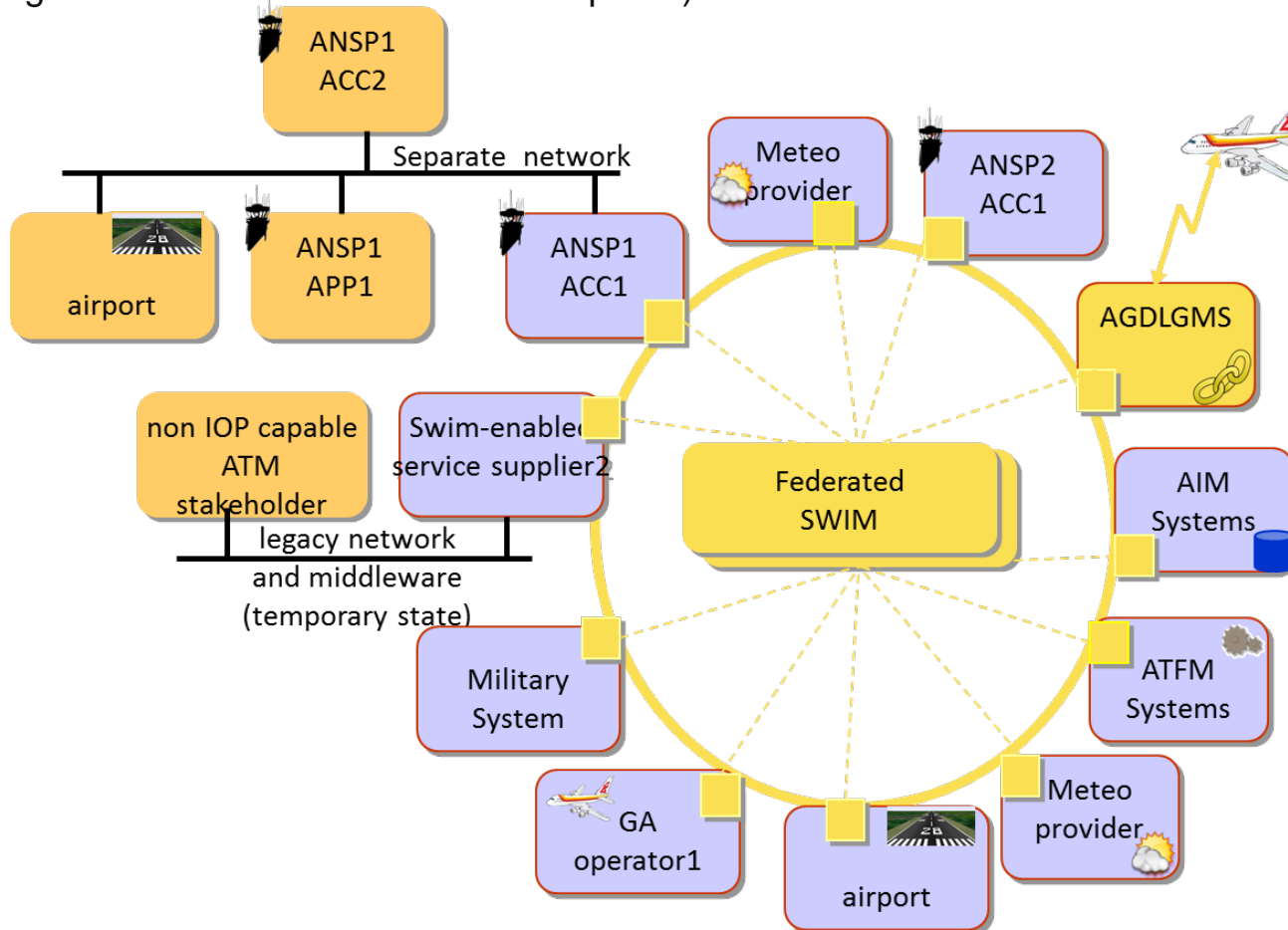SESAR SWIM Technical Infrastructure

Leonardo's experience on SWIM

Leonardo SWIM Node Implementation

–   High level architecture

SWIM Technical Infrastructure in short

Often SWIM-TI is graphically represented like this (a number of stakeholder\systems connected together thanks to a kind of "access point")
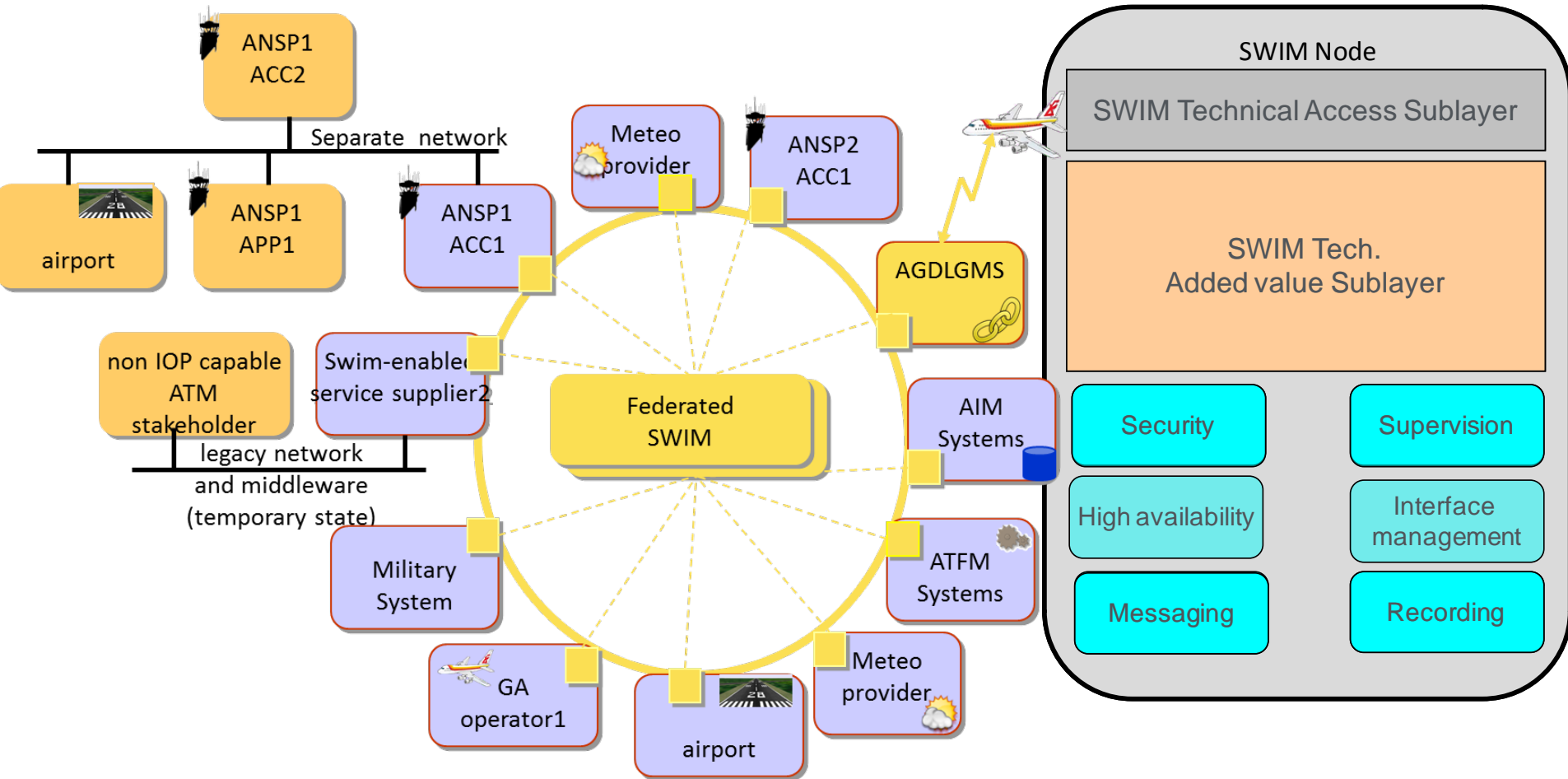
SWIM Technical Infrastructure in short

This «kind of» access point is what is called a «SWIM Node»

- – Still a logical entity which holds a number of functionalities (mainly Messaging, recording, data validation etc..)
- – The set of «SWIM Nodes» realize the ring in the picture (i.e. so called SWIM Network – Network not in the sense of physical IP net)
- – Many possible implementations of SWIM Node are possible. The «constraint» is that they need to be interoperable (i.e. expose agreed/standard interfaces/technologies)

Swim Node role in SESAR

Outline

Leonardo in SESAR

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Leonardo's experience on SWIM

Leonardo SWIM Node Implementation

- – High level architecture

Leonardo: SWIMing in our history

- SWIM-SUIT FP6 Project - 2006-2009 – 12M€ EC funded project, 17 Partners
  - Leonardo (former Selex ES) leading the consortium
  - Swim-Box (pre-SESAR) as main concrete project outcome
  - Project recognized as main baseline for SESAR SWIM

- SESAR WP14 (SWIM Technical Infrastructure) - 2009 up to now
  - Overall WP Technical Leadership
  - Technical Leadership on Specification (and Design) – SWIM Profiles Technical Specifications

- SESAR SWIM Demonstrations - 2011 up to now
  - Major contribution to ALL SESAR SWIM Demonstrations
  - Major contributor to World ATM Congress 2013 SESAR SWIM Demo

Awards (on SWIM)

- SWIM Master Class 2013
  - 3rd Prize Winner on Best ATM Service category
  - 3rd Prize Winner on Best SWIM Enabled Application category
- SWIM Master Class 2014
  - 1st prize Winner on Best SWIM Technical Infrastructure category
- SESAR Projects Awards 2016
  - Project 14.01.04 (led by Leonardo): SESAR Best In Class Award

Third prize for **Applications** category

Third prize for **Services** category

SWIM Master Class Ceremony

SESAR Projects Awards Ceremony

First prize for **SWIM Technical Infrastructure** category

Strong commitment for making SWIM a reality

- SESAR SWIM Enabled Validations - 2014 – 2016
  - EXE-06.03.01-VP-709 (TWR/A-CDM integration via SWIM)
  - EXE-06.05.05-VP-668 (Sharing of Weather Information via SWIM)
  - EXE-06.03.01-VP-669 (Airport Operations Plan and AOP-NOP Seamless Integration)
    - **Highest level of SWIM Compliance achieved** on ALL criteria (Information, Service and Technical Infrastructure Compliance)

- EU/US SWIM Interoperability
  - Multiple International Interoperability Demonstrations
  - Leadership (EU side) of SESAR/FAA Coordination Plan 2.2 (SWIM Standards)
  - (EU side) Technical Coordination of SESAR contribution to Mini Global II demonstration and SWIM Global Demonstration

- SESAR 2020
  - Solution leadership for *SWIM-TI Purple Profile for Air/Ground Advisory Information Sharing*

Ready to support our clients on deployment…

- EU I/R 716/2014 (also known as PCP - Pilot Common Projects) targets SWIM on ATM Functionality (AF) 5
  - European Union is asking for initial SWIM Deployment

- Leonardo is ready to support deployment of AF5 family with its Swim-Box Platform and a range of ATM solutions targeting
  - SWIM Blue and Yellow Profiles [AF5.2.2]
  - Aeronautical Information Exchange (AIXM5.1) [AF5.3.1]
  - Meteorological Information Exchange (iWXXM) [AF5.4.1]
  - Flight Information Exchange (ED133, FIXM) [AF5.6.1]

- Leonardo developed a number of "Adapters" to ease transition from "legacy" to SWIM Enabled applications

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…Both in EU and everywhere else

- Leonardo has been pioneering SWIM with SWIM-SUIT project from early 2007

- We extended the scope with a strong commitment in SESAR
  - SWIM Technical Infrastructure Technical Leadership

- Still looking globally thanks to our cooperation with FAA and Boeing
  - With multiple interoperability demonstrations during the years

- We will support our customers in Europe but we are also ready to support SWIM Deployment globally

Outline
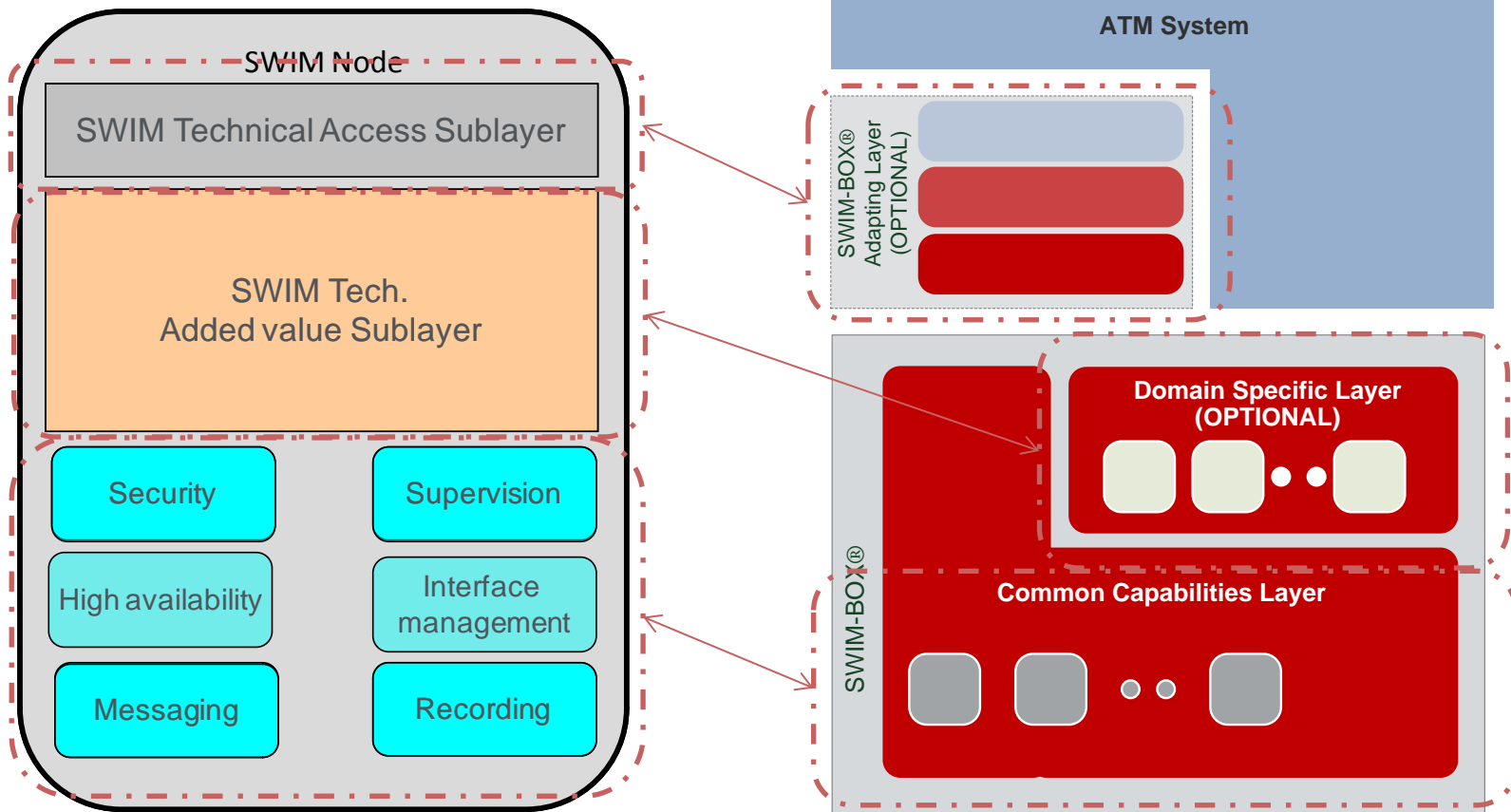
Leonardo in SESAR

SWIM Concept

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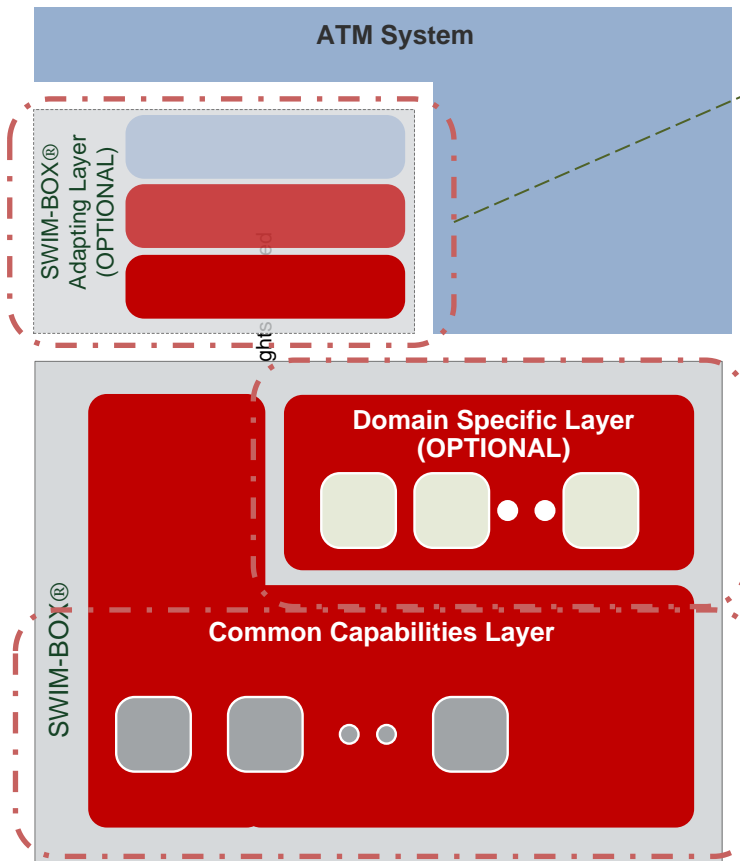
Leonardo's experience on SWIM

Leonardo SWIM Node Implementation

    –   High level architecture

Leonardo SWIM-Node Implementation: Swim-Box Platform

Leonardo's Architectural Choices

ATM System

SWIM-BOX® Adapting Layer (OPTIONAL)

Domain Specific Layer (OPTIONAL)

SWIM-BOX®

Common Capabilities Layer

Application Level
Role of (optional) Adapter is to take care of transformation to/from applications to SWIM exchange formats (decoupling the applications from exchange format variations)

SWIM Level (Optional)
Role of Modules in Domain Layer is to perform "simple" tasks, specific for a given information kind (e.g. flight, weather etc..), providing domain specific interface hiding generic messaging interface at lower levels.

SWIM Level
Generic (i.e. as much as possible not bound to specific data) capabilities for messaging, data validation, registry... Here actual technology used for data exchange is chosen.

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Leonardo SWIM-TI Implementation Overview
Swim-Box® Architecture & Features

Examples of Domain modules

Aeronautical Data Retrieving, Distribution, Validation and Transformation (AIXM)

Weather Data Distribution, Validation and Transformation (IWXXM)

SWIM Enabled System

SWIM-BOX® Adapting Layer (OPTIONAL)

SWIM Enabled System

SWIM-BOX® Adapting Layer (OPTIONAL)

Domain Specific Layer / Added-Value Capabilities (OPTIONAL)

| Flight Data Domain (ED-133/FIXM) | Surveillance Data Domain (CAT62) | Alarm Data Domain (CAP) | Geospatial Data Domain (KML) | Sensor Data Domain (SensorML) |

Common Capabilities Layer

Messaging | Registry | Data Validation And Transformation | Shared Data Store

Security Management

Supervision

SWIM-BOX® Platform

Network Layer (LAN, WAN)

One Swim-Box can serve one or more Adapters/Applications. Depending on deployment, there can be multiple instance configured with different domain modules.
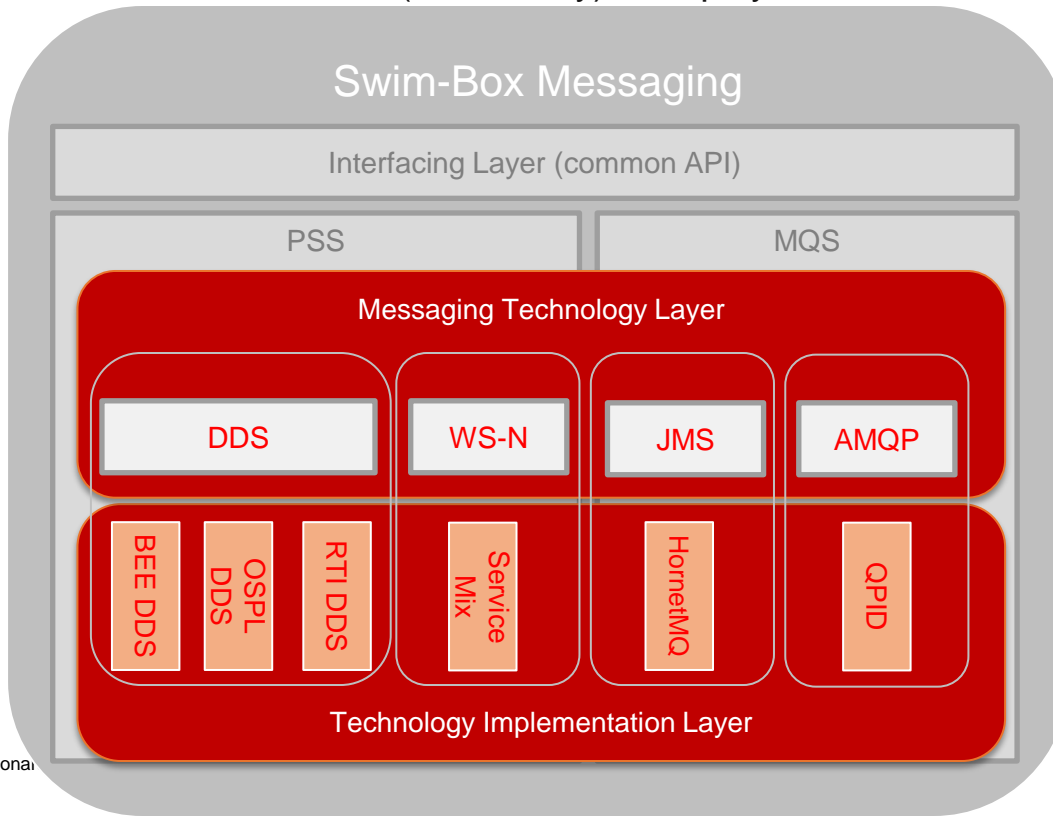
Some highlights:
Swim-Box Messaging

Provides an Abstraction layer hiding the underlying (C)OTS therefore decoupling «users» from Technology/Middleware

Supports Publish/Subscribe and Message Queue patterns

(May) Decouple(s) from data representation on the wire

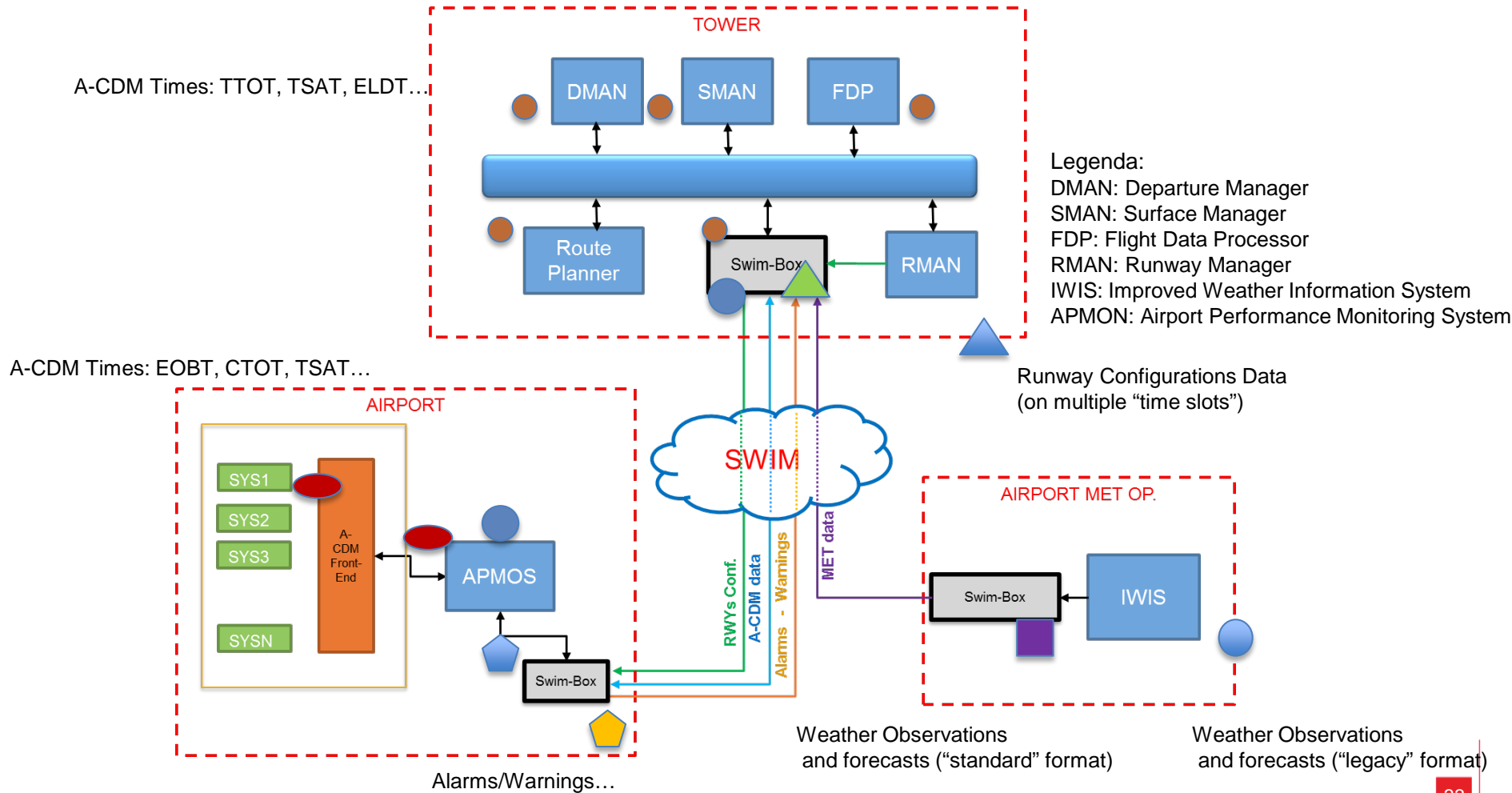Packaging is flexible (Technologies/(C)OTS can be present or not on a need basis)

Can be used stand-alone (as a library) or deployed in J2EE container

Swim-Box Messaging

Interfacing Layer (common API)

| PSS | MQS |

Messaging Technology Layer

| DDS | WS-N | JMS | AMQP |

| BEE DDS | OSPL DDS | RTI DDS | Service Mix | HornetMQ | QPID |

Technology Implementation Layer

- Utilized several times both in stand-alone configuration and deployed in J2EE
- Can be considered as an autonomous "component" (i.e. disconnected from Swim-Box EAR)
- Under a same interface, supports multiple implementations relying on different standards. For each standard, multiple products (C)OTS are supported.

© Leona

Yeah... But what can I do with all that strange stuff?!? An example:

A-CDM Times: TTOT, TSAT, ELDT…

A-CDM Times: EOBT, CTOT, TSAT…

Legenda:
DMAN: Departure Manager
SMAN: Surface Manager
FDP: Flight Data Processor
RMAN: Runway Manager
IWIS: Improved Weather Information System
APMON: Airport Performance Monitoring System

Runway Configurations Data
(on multiple "time slots")

Weather Observations
and forecasts ("standard" format)

Weather Observations
and forecasts ("legacy" format)

Alarms/Warnings…

THANK **YOU** FOR YOUR ATTENTION

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SECURITY & INFORMATION SYSTEMS