



# Selex ES

A Finmeccanica Company

---

**Selex ES SWIM Enabling Solutions**

---

*Dario Di Crescenzo*

---





## Outline

- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

# FINMECCANICA TODAY

© Copyright Selex ES S.p.A. 2013. All rights reserved

## HELICOPTERS

AgustaWestland  
AgustaWestland Tilt-Rotor  
Company  
NHIndustries

Revenues  
EUR 4,243 mil.      Workforce  
13,050



## DEFENCE AND SECURITY ELECTRONICS

DRS Technologies  
Selex ES

Revenues  
EUR 5,754 mil.      Workforce  
25,183



## AERONAUTICS

Alenia Aermacchi  
SuperJet International  
ATR  
Eurofighter GmbH

Revenues  
EUR 2,974 mil.      Workforce  
11,708



## SPACE

Telespazio  
Thales Alenia Space

Revenues  
EUR 1,053 mil.      Workforce  
4,131



## DEFENCE SYSTEMS

Oto Melara  
WASS  
MBDA

Revenues  
EUR 1,256 mil.      Workforce  
3,963



## ENERGY

Ansaldo Energia\*

Revenues  
EUR 715 mil.      Workforce  
1,830



## TRANSPORTATION

AnsaldoBreda  
Ansaldo STS  
BredaMenarinibus

Revenues  
EUR 1,719 mil.      Workforce  
6,568



Revenues and Workforce for business sector  
at 31 March 2012

(\* In 2011 Finmeccanica sold 45% of the share capital of the Ansaldo Energia. As a result of this sale, Ansaldo Energia Holding and its subsidiaries have been consolidated on a proportional basis as of the transaction date.

Owned company      Joint venture

3

## Selex ES Key facts

- 17,700 people
- Revenues in excess of 3.5 billion Euros
- More than 17% of investment in R&D
- 70% engineers and personnel with technical qualifications
- Worldwide industrial footprint



## An international leader

- Industrial and commercial footprint in the US, Germany, Turkey, Romania, Brazil and Saudi Arabia
- Fully owned subsidiaries across the globe



# Selex ES Divisions



## Airborne and Space Systems

- Radar and Advanced Targeting
- Air Systems, Unmanned Systems and Simulators
- Electronic Warfare
- Avionics
- Space Systems
- Support and Service Solutions



## Land and Naval Systems

- Naval & Air Defence Systems
- Land & Battlefield Systems
- Optronics Systems
- Defence Communications Systems
- Support & Service Solutions



## Security and Smart Systems

- Homeland Security & Critical Infrastructures
- Cyber Security & Information Assurance
- Air & Vessel Traffic Management Systems
- Automation Systems
- ICT & Networking
- Smart Solutions



**We promote technology and application convergence by providing solutions across IT, communications, automation, physical and cyber security to create a smart and sustainable environment for a collaborative and prosperous life**

## Key Capabilities

### Homeland security and CNI protection

Solutions for intelligence, territory control, emergency management, turn key solutions for CNI protection, physical and cyber security.

### Networked professional communications

Communications solutions integrating TETRA, DMR, GSM-R, WiFi, WiMAX and LTE, GSM-R.

### Information & Communication technology

Outsourcing & Cloud services, business industry solutions, networking, operation support systems and Enterprise Information Systems.

### Air and vessel traffic management

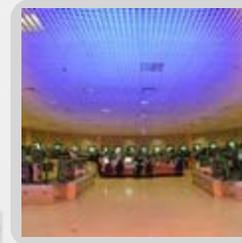
Air Traffic Control, surveillance and weather radars, avionic communications, VTMS and coastal surveillance.

### Automation systems

Solutions for postal, logistic operators, express couriers, airports baggage handling systems, Industrial Automation & Control.

### Innovative sustainable smart solutions

Integrated solutions for airports, major events, smart and safe cities: Intelligent transportation and inter-modal logistic systems, smart grids, smart buildings, digital identity.



Air Traffic Control



ICT



CNI Protection



Logistics



Cyber Security



Baggage Handling System



Law Enforcement support systems



VTMS



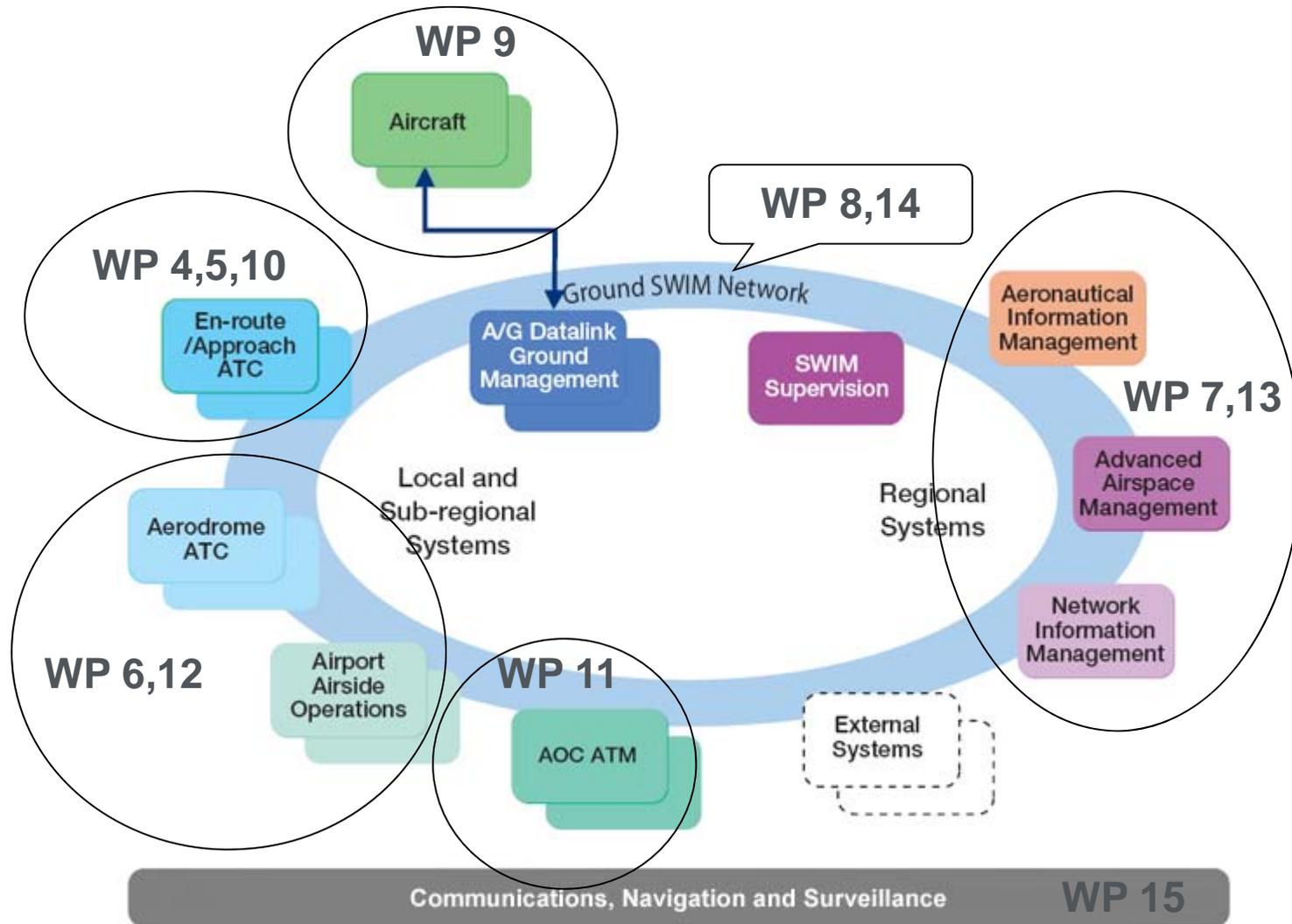
Smart Mobility

- More than 150 countries rely on our systems for safe and efficient Air Traffic Management operations
- Our baggage handling systems helped one of our customers reduce its mishandling of baggages by 40%
- We are the Safe City and Main Operation Centre Official Global Partner for the Milan EXPO 2015
- Our solutions monitor 7,500km of coastline in Italy, 24 hours a day, as well as coastlines across China, Russian Federation, Poland, Yemen and Turkey
- More than 50 countries rely on our integrated mobile communications for enhanced operations of their security, police and emergency forces
- Alongside Northrop Grumman we have been awarded the NCIRC Full Operating Capability-FOC to supply a turnkey cyber security capability to NATO, the largest cyber security programme outside the US
- We are the main provider to the Russian Federation for their postal logistics hub
- We have developed the largest southern Europe logistics courier hub for DHL (more than 700m sorters and 2km conveyours).

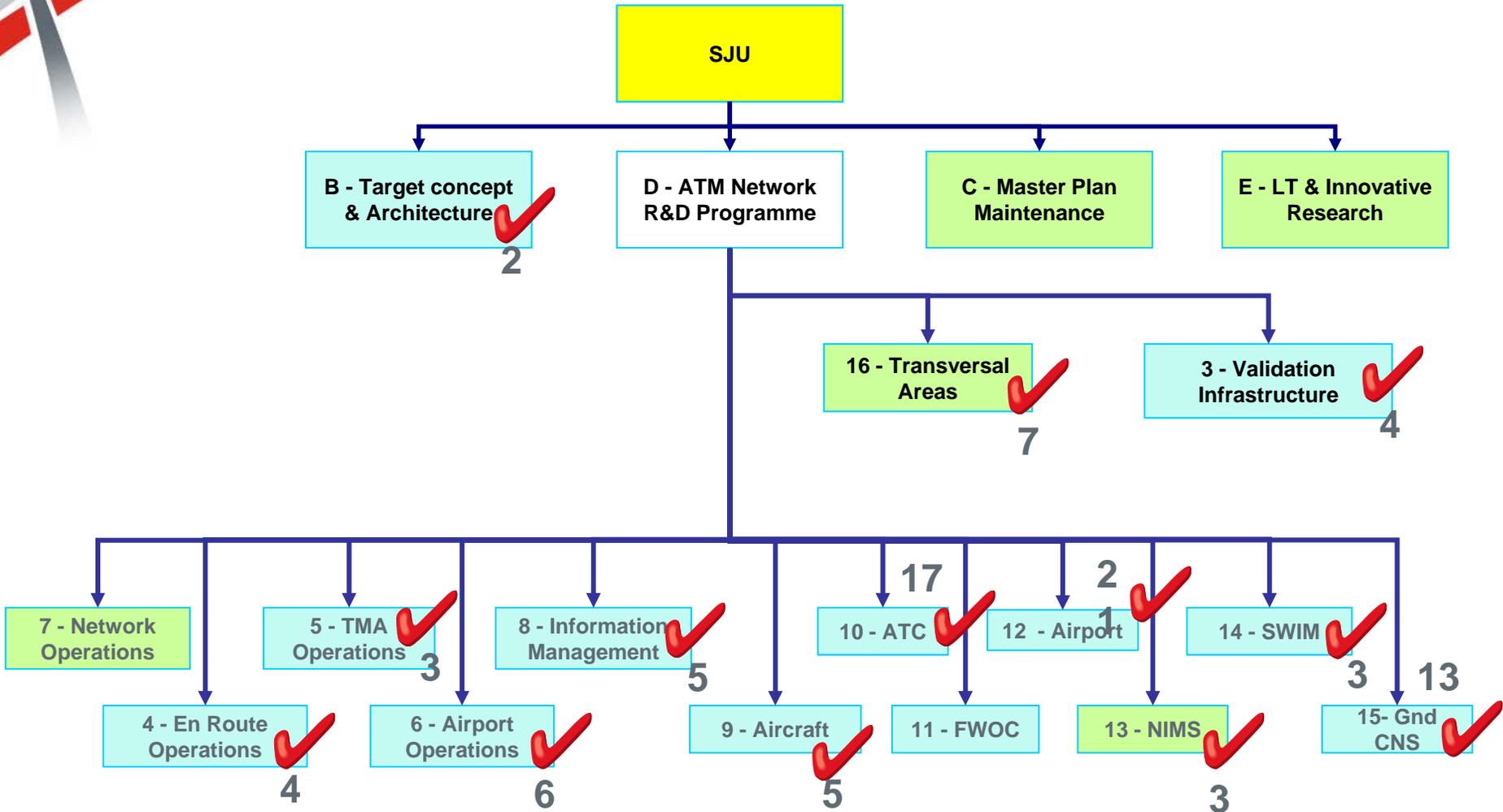
- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

- 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
- Selex ES is one of the key members of the SESAR Development Phase

# High Level SESAR Target System Architecture



© Copyright Selex ES S.p.A. 2013. All rights reserved



© Copyright Selex ES S.p.A 2013. All rights reserved

93 PROJECTS



## Outline

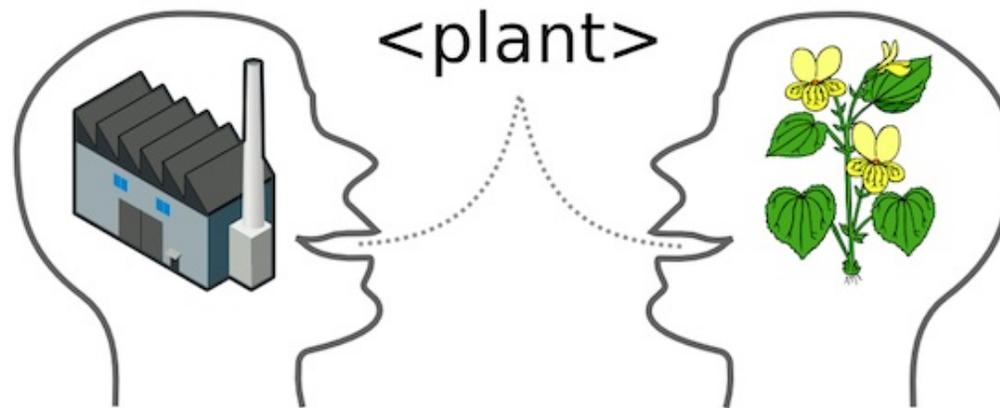
- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## 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



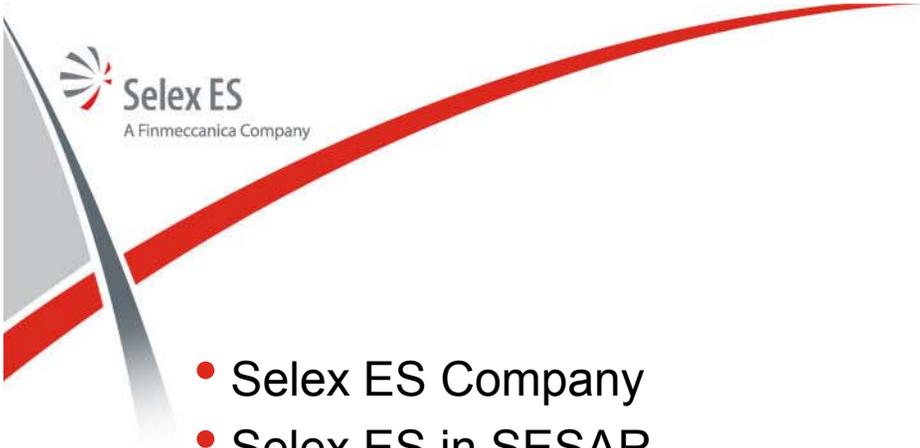
- *Semantic interoperability*: the meaning of information specified in a way understood by all parties (e.g. definitions, relations and structure of terms used to describe data).
- The above problem is taken care in SESAR by WP8
  - Definition of ATM Concepts, definitions, dictionary, data structures 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..



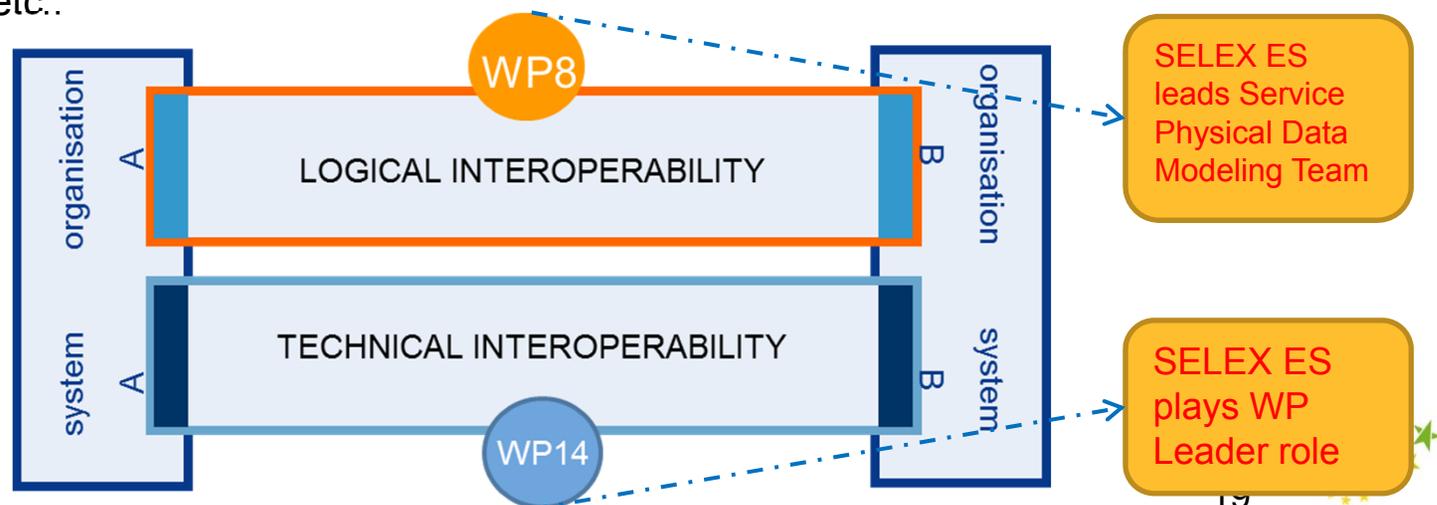
## Outline

- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## 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..



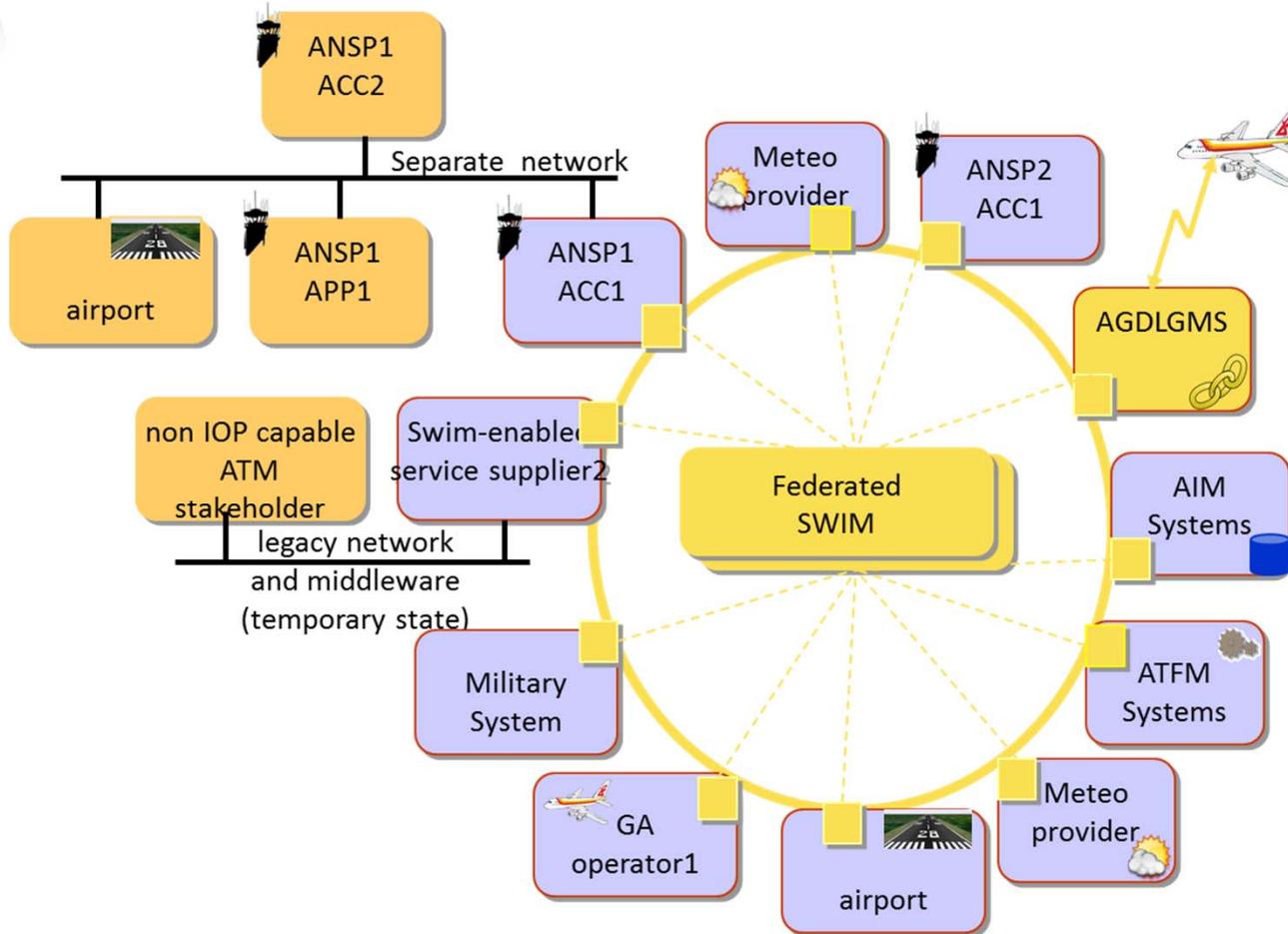


## Outline

- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## SWIM Technical Infrastructure in short

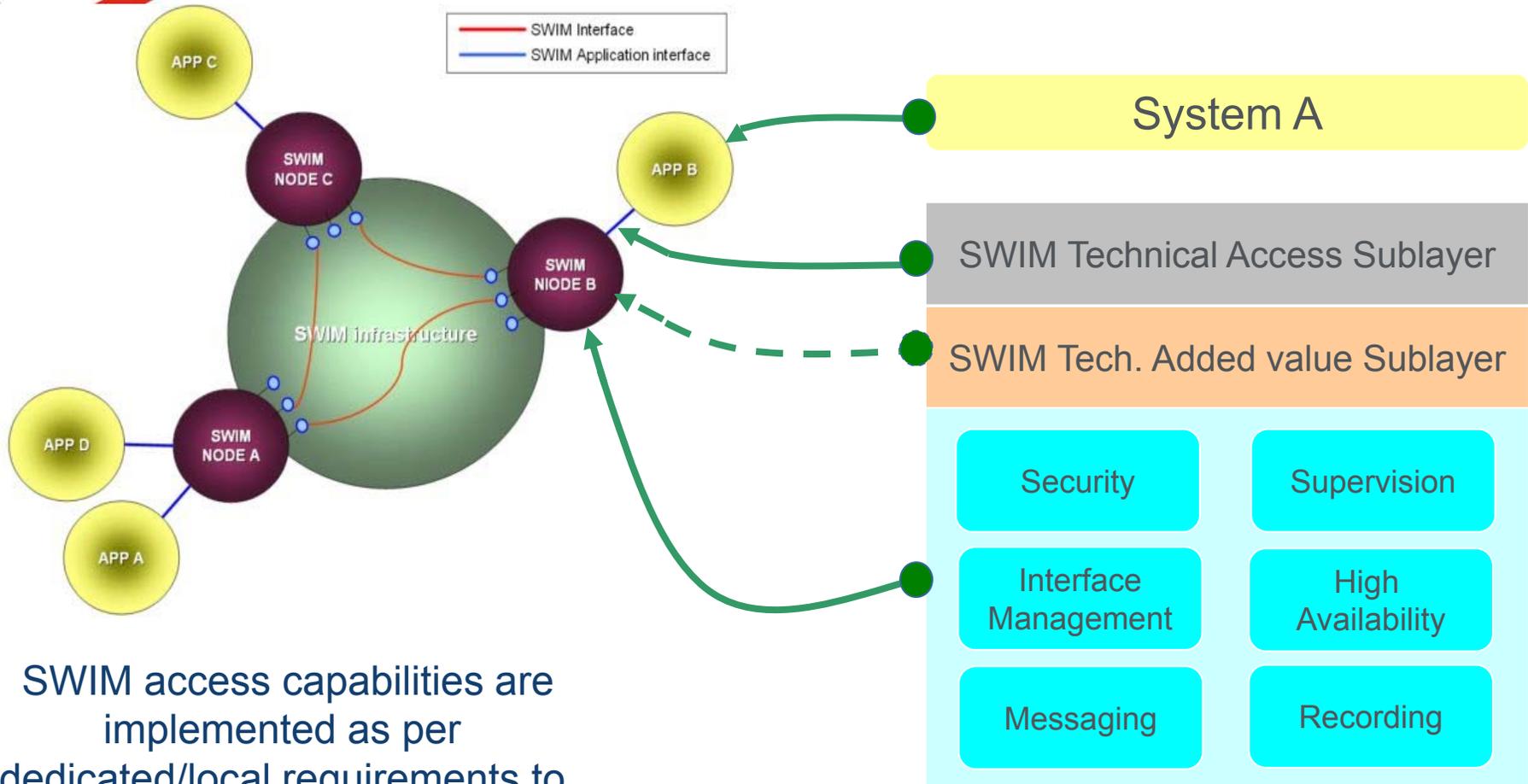
- Often SWIM-TI is graphically represented like this (a number of stakeholder\systems connected together thanks to a kind of “access point”)



## SWIM Technical Infrastructure in short

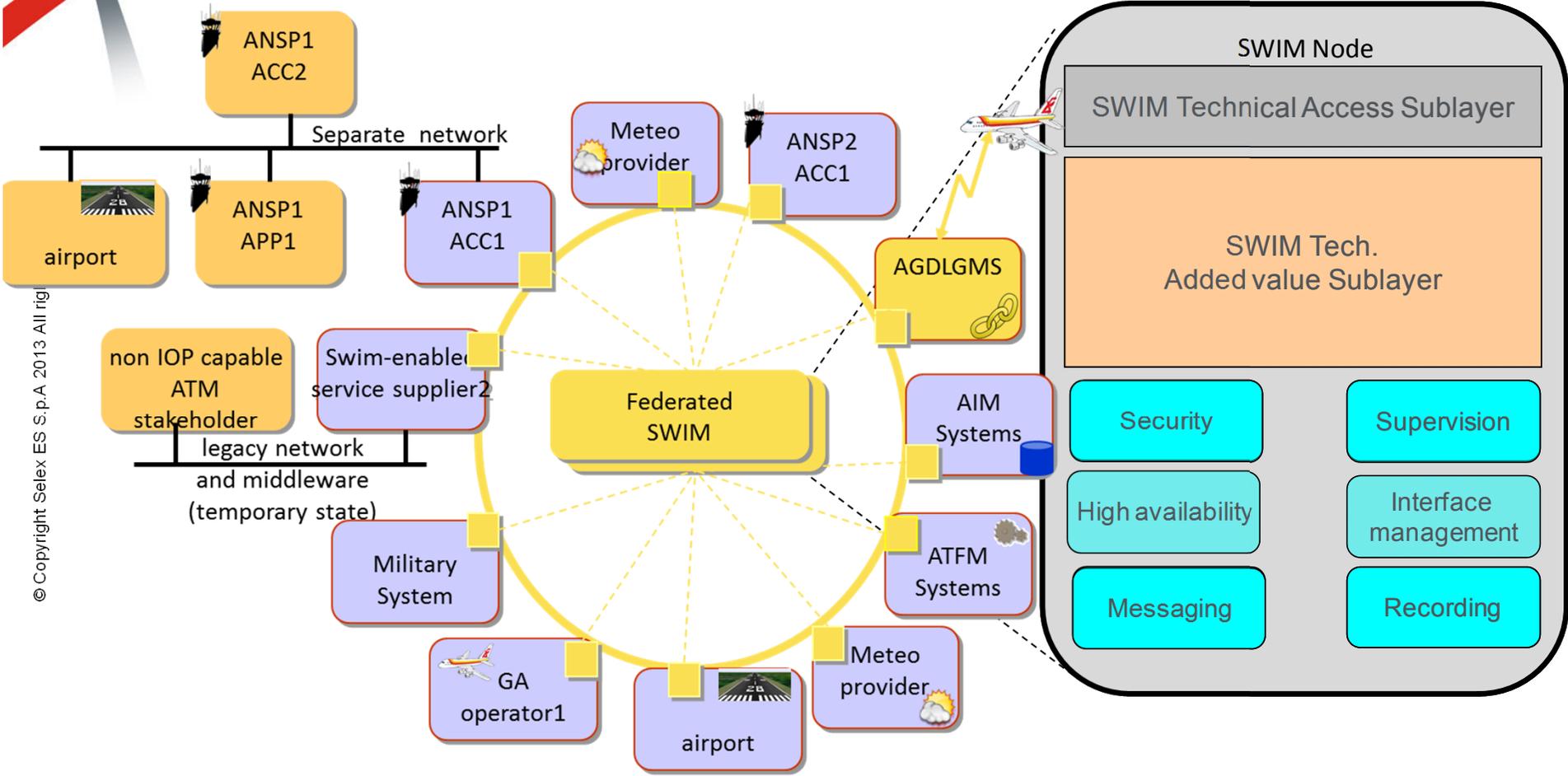
- This «kind of» access point is what is called a «SWIM Node»
  - Still a logical entity which holds a number of functionalities (mainly Messaging, recording, data validation etc..)
  - The set of «SWIM Nodes» realize the ring in the picture (i.e. so called SWIM Network – Network not in the sense of 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 High Level functionalities



SWIM access capabilities are implemented as per dedicated/local requirements to access SWIM for certain actors (allow different transition paths for different systems)

# Swim Node role in SESAR

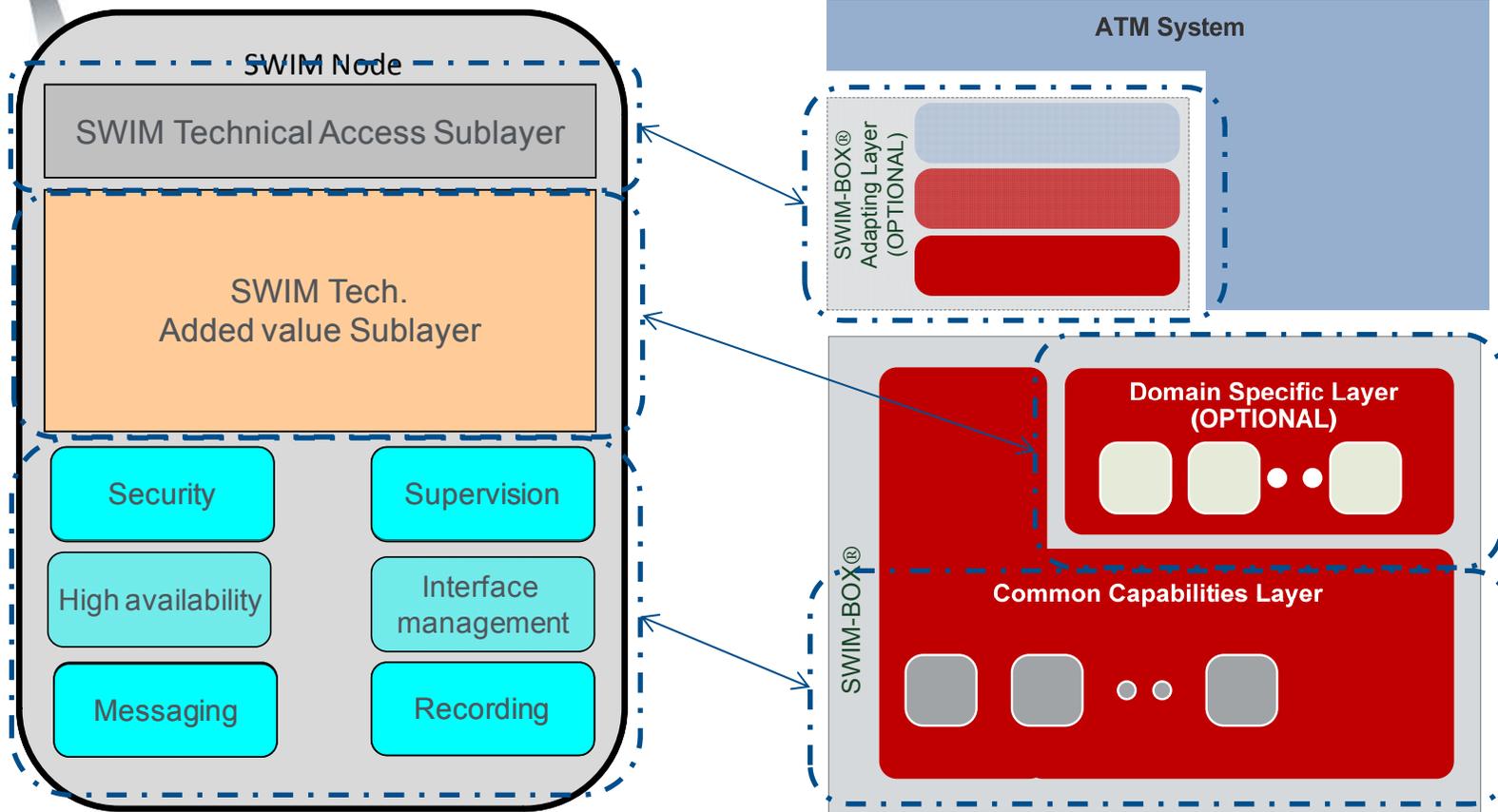


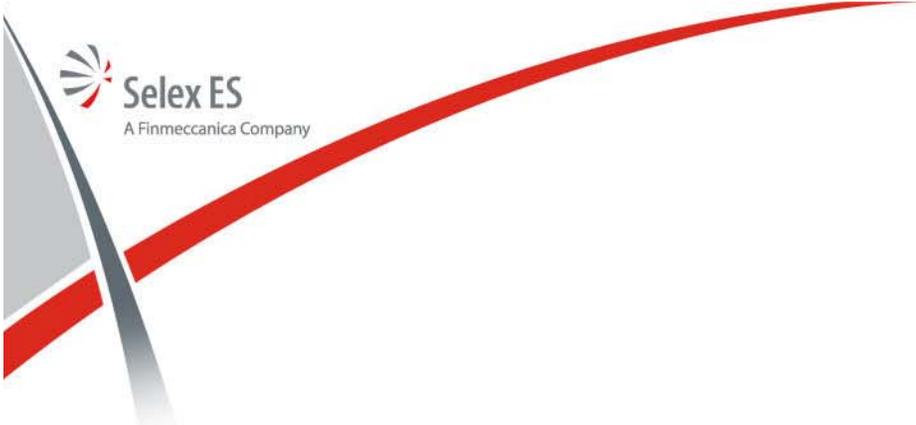
© Copyright Selex ES S.p.A. 2013. All rights reserved.

- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

# SELEX SWIM-Node Implementation: Swim-Box

© Copyright Selex ES S.p.A. 2013. All rights reserved



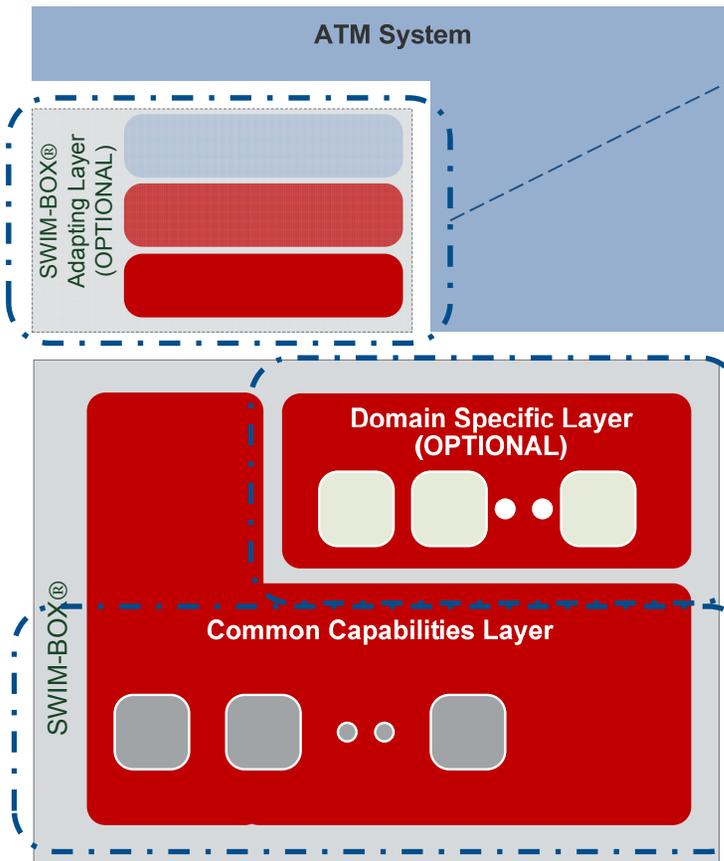


## SELEX's Architectural Choices

**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.



© Copyright Selex ES S.p.A 2013. All rights reserved

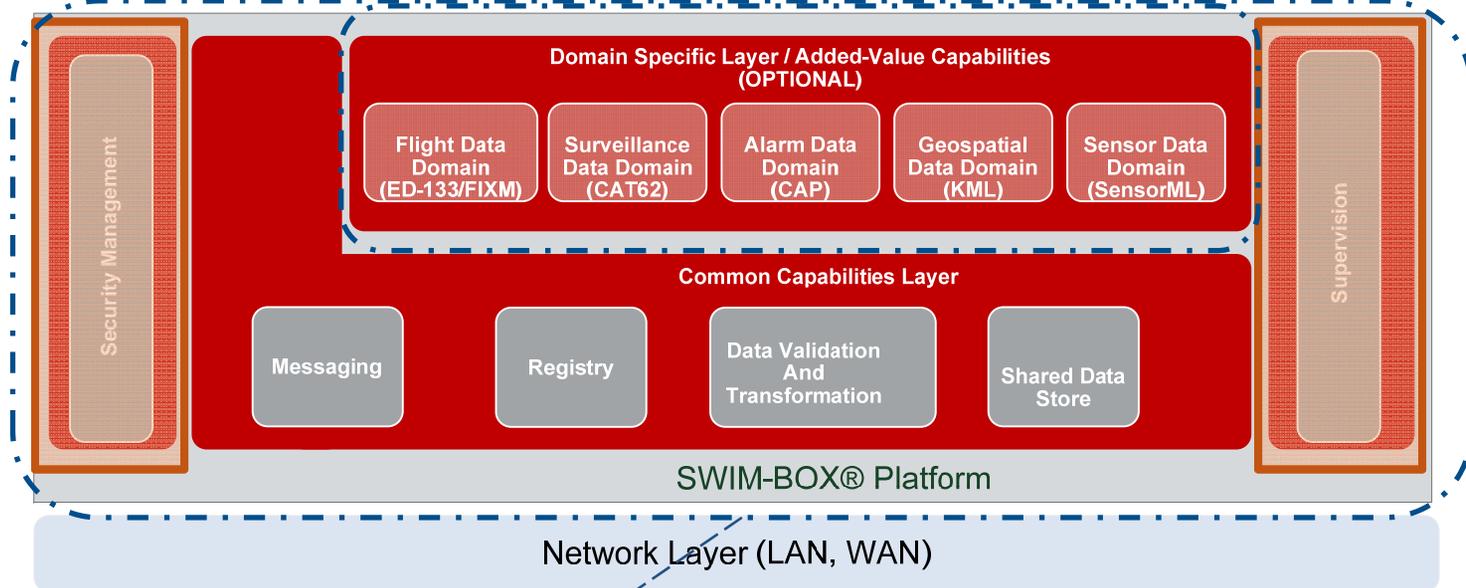
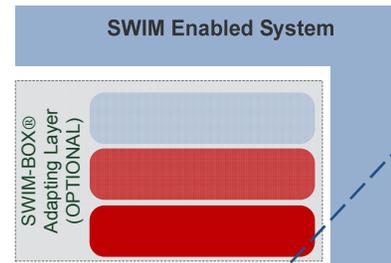
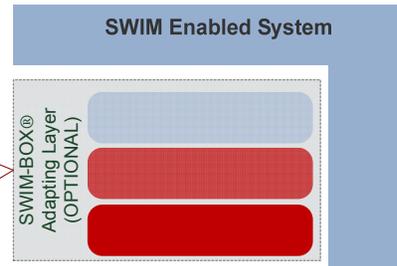
# SELEX SWIM-TI Implementation Overview

## Swim-Box® Architecture & Features

Examples of Domain modules

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

Weather Data Distribution, Validation and Transformation (WXXM)



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

## (Optional) Domain Layer role

- Advantages

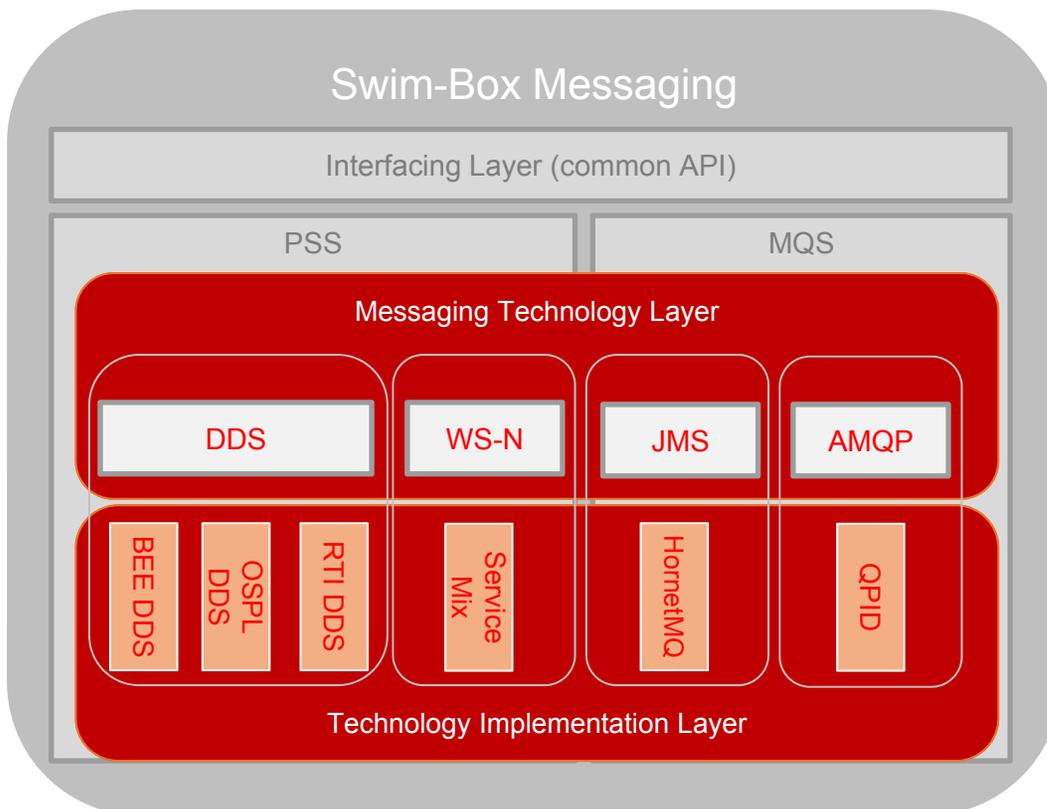
- (Typically) Exposes simple CRUD operations on a given subject (i.e. domain specific information)
- May reduce integration «costs» by providing a fixed «integration point» on a given subject.
- Abstract application from underlying communication (both in terms of technology/middleware used and data representation over the wire)
- Decouple Application Provider from Application Consumers (i.e. clients)
- May help application to concentrate on business level tasks by taking responsibility of lower level «technical» tasks (e.g. data exchange, end-point discovery, QoS enforcement...)

- Disadvantages

- By hiding multiple layer it may introduce delays not acceptable in every contexts
- If CRUD is not enough, It may require customization if application uses service virtualization pattern.
- Implementation is Java Based. Integration with non-java applications is possible via CORBA/RMI/WS interfaces.

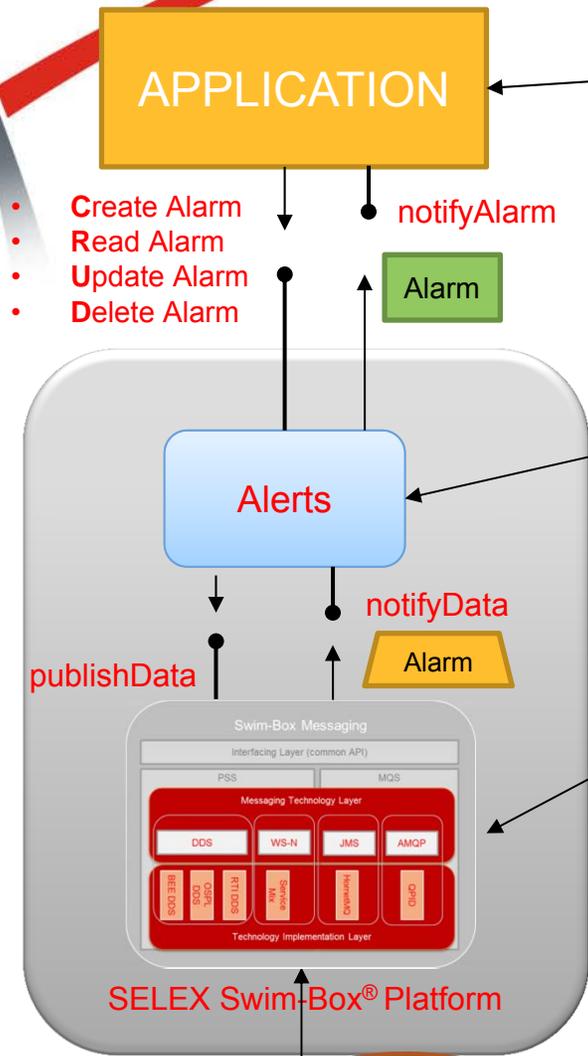
## Some highlights: Swim-Box Messaging

- 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



- 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.

## A (simplified) graphical example

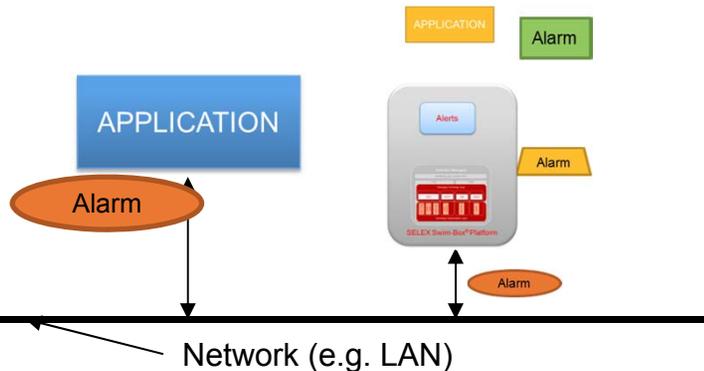


Only knows about «Alarms»  
Does not know (directly) about Alarm consumers and/or other Alarm providers  
Does not know about Alarm representation on the wire  
Does not know about technology/middleware for Alarm exchange

- Create Alarm
- Read Alarm
- Update Alarm
- Delete Alarm

Exposes CRUD Alarm interface and knows about Application “notify” interface (needed to forward “alarms”)  
May know about Alarm consumers and/or other Alarm providers  
May know about Alarm representation on the wire  
(Currently) Does not know about technology/middleware for Alarm exchange

Exposes interface for “data” exchange  
(May) know about data consumers and/or other data providers  
Knows about Alarm representation on the wire  
Knows about technology/middleware for Alarm exchange



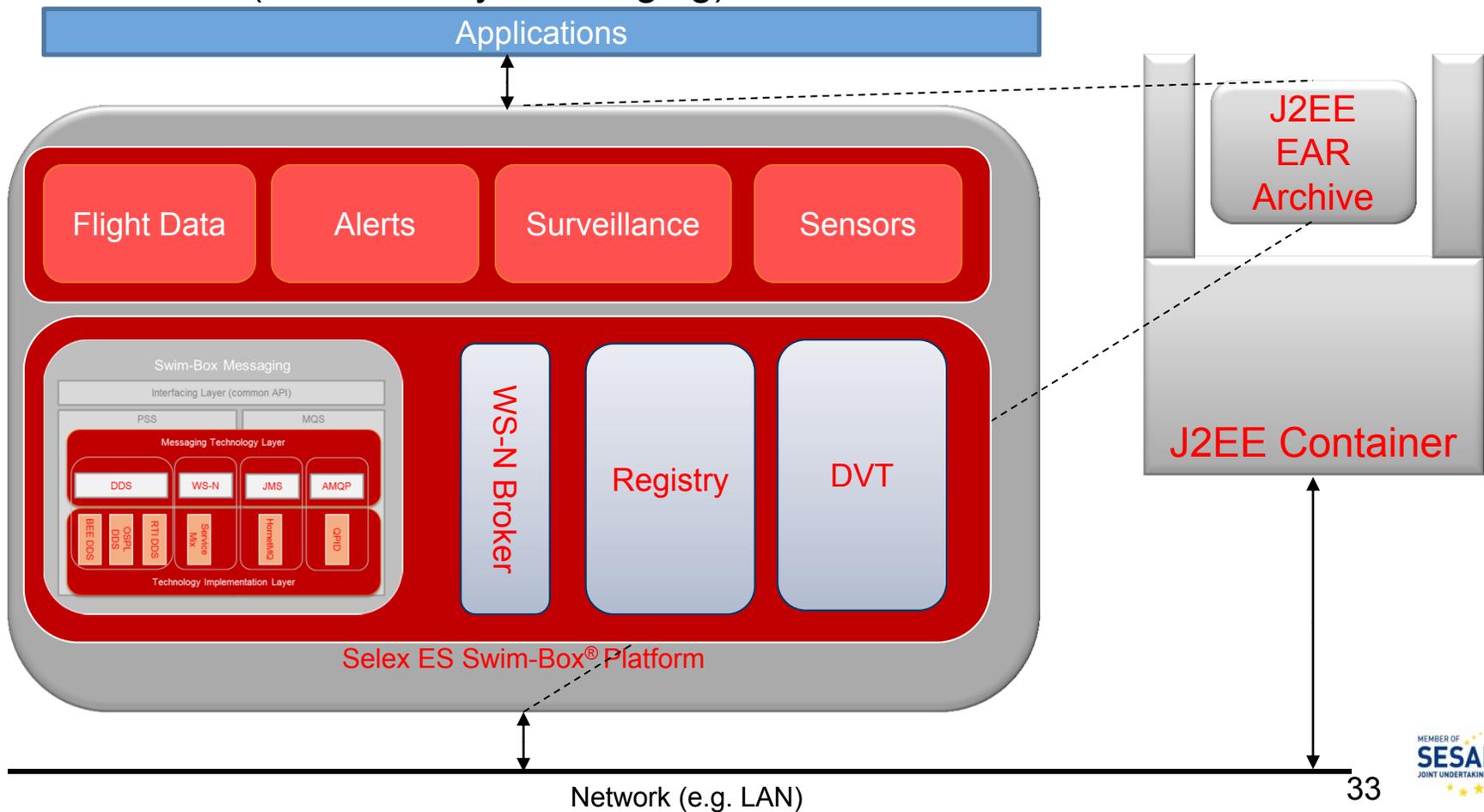


## Outline

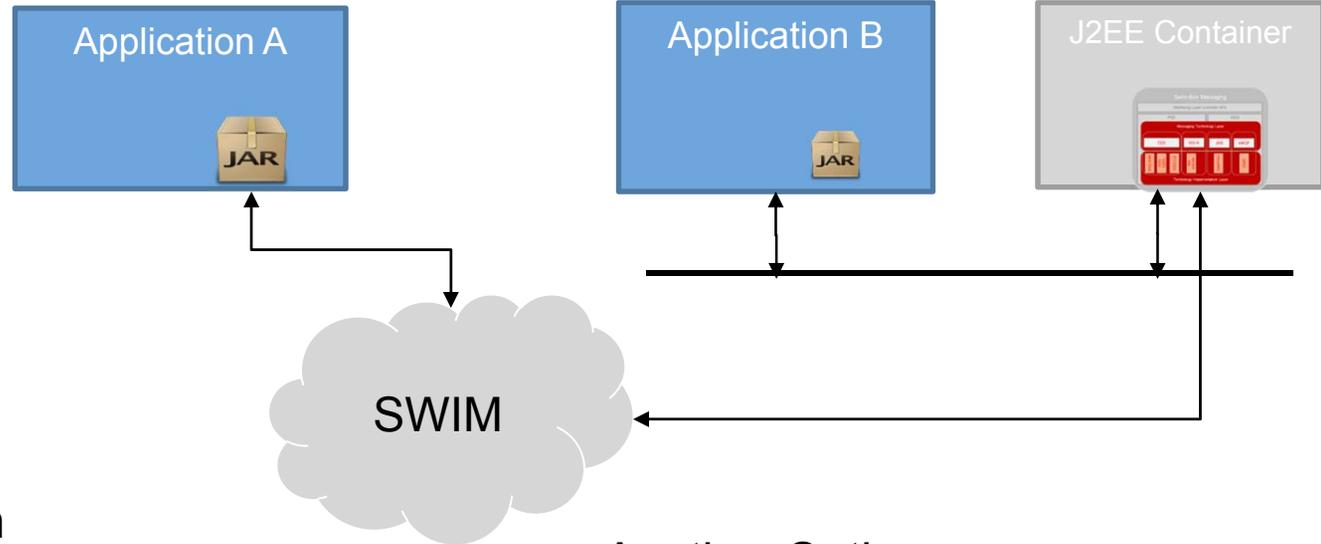
- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- **Selex ES SWIM Node Implementation**
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## Deployment details

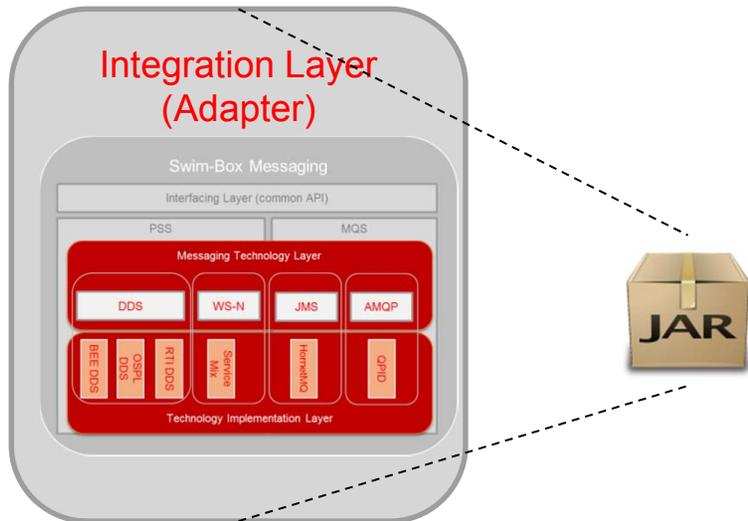
- It can be packaged in an EAR Archive and deployed in a J2EE Application Server
- Basic components can be also built as libraries and executed stand-alone (most notably, Messaging)



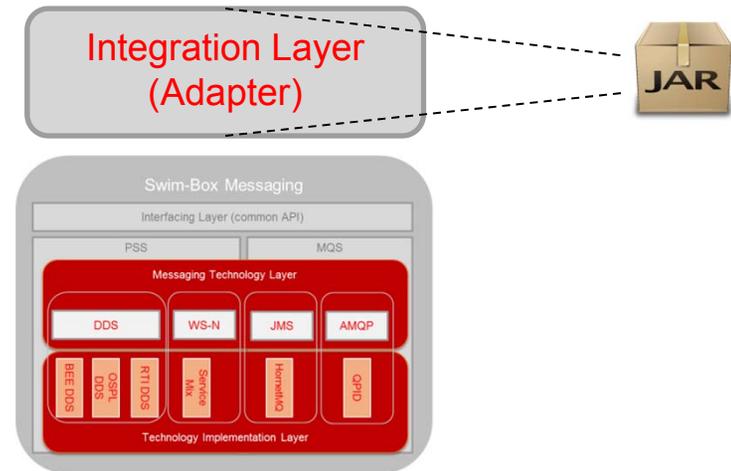
## Some examples



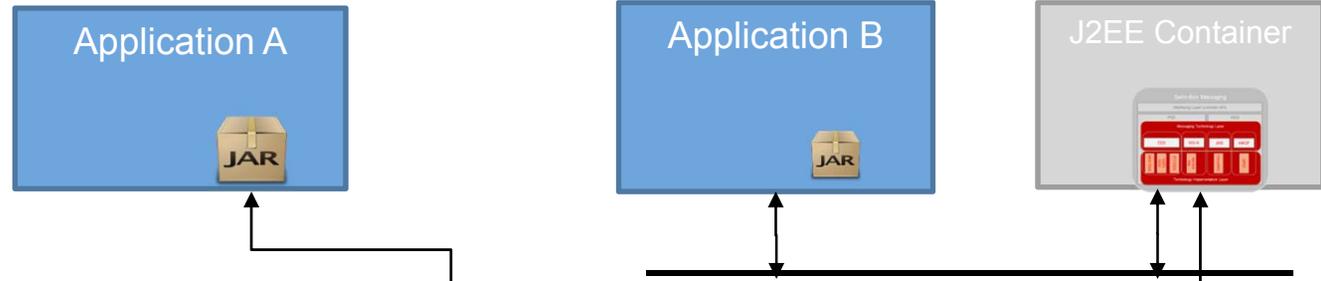
### An Option



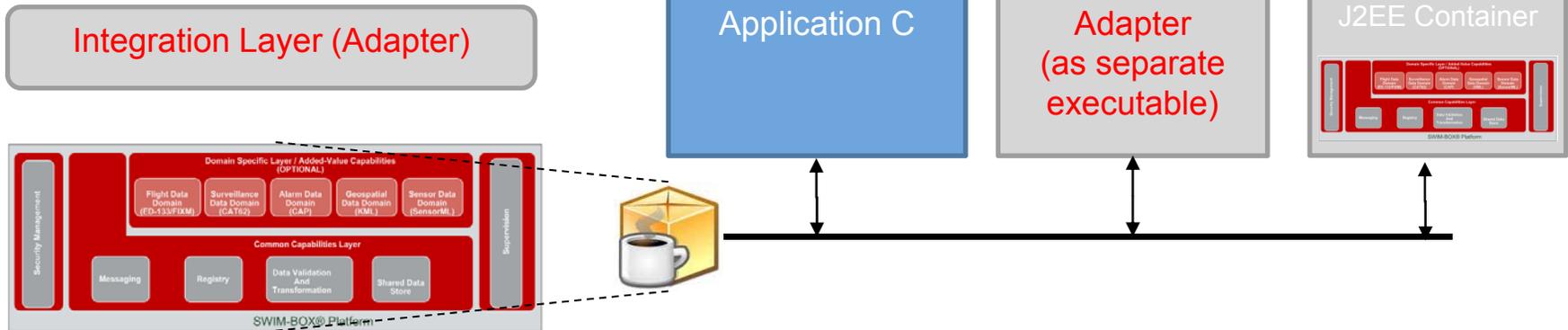
### Another Option



## Some examples



## Yet Another Option



- They are of course dependent from the «legacy» application that they are «bridging» over SWIM but normally a kind of common skeleton can be used.
- Selex ES already developed different Adapters for various «integrations»
  - In some cases under the form of «libraries» (when the application to «SWIM Enable» can be modified)
  - In the form of a stand-alone application (when the application to «SWIM Enable» cannot be modified or to minimize impact on it)
  - Example are for Flight Data exchange (ED-133, FIXM v2.0, Weather data (IWXXM), METAR, D-SNOWTAM (according to ECTL event specification based on AIXM5.1)
  - A number of libraries are available to manage SESAR agreed exchange formats (ED-133, FIXM, AIXM, IWXXM ...)

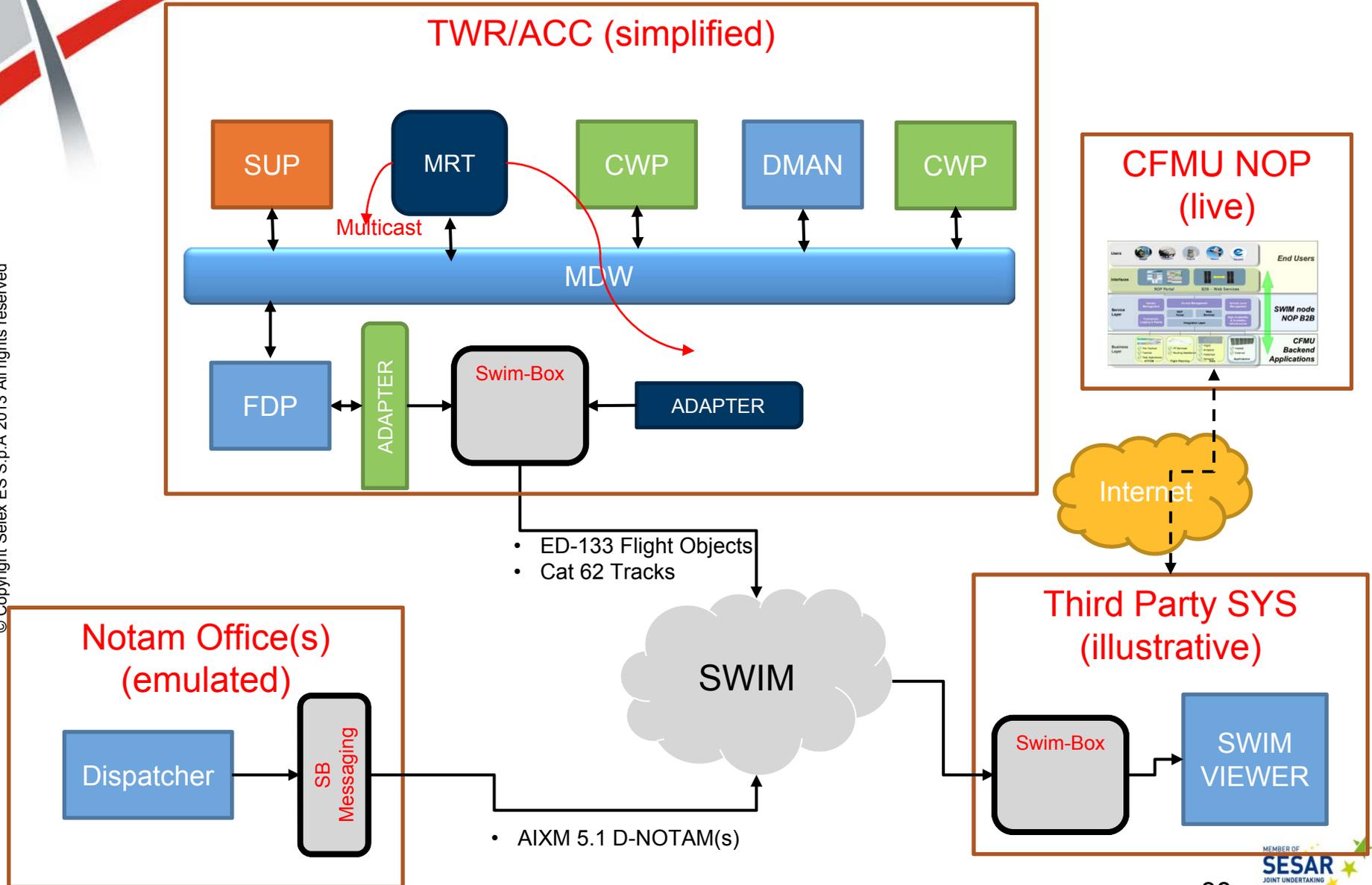


## Outline

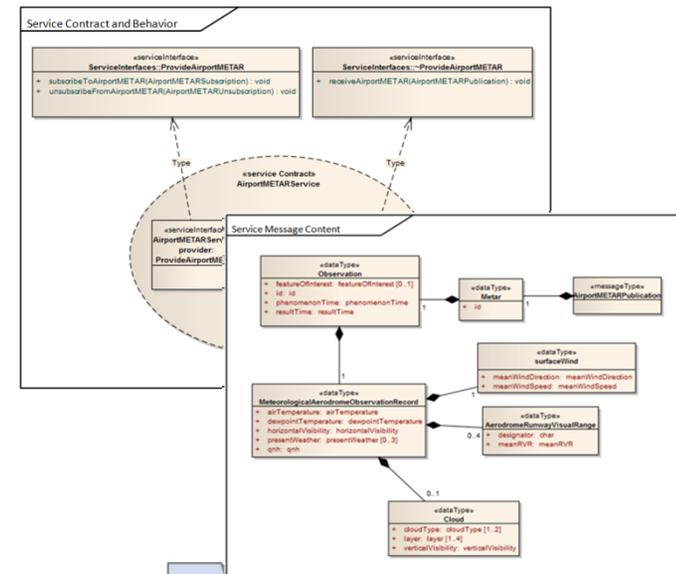
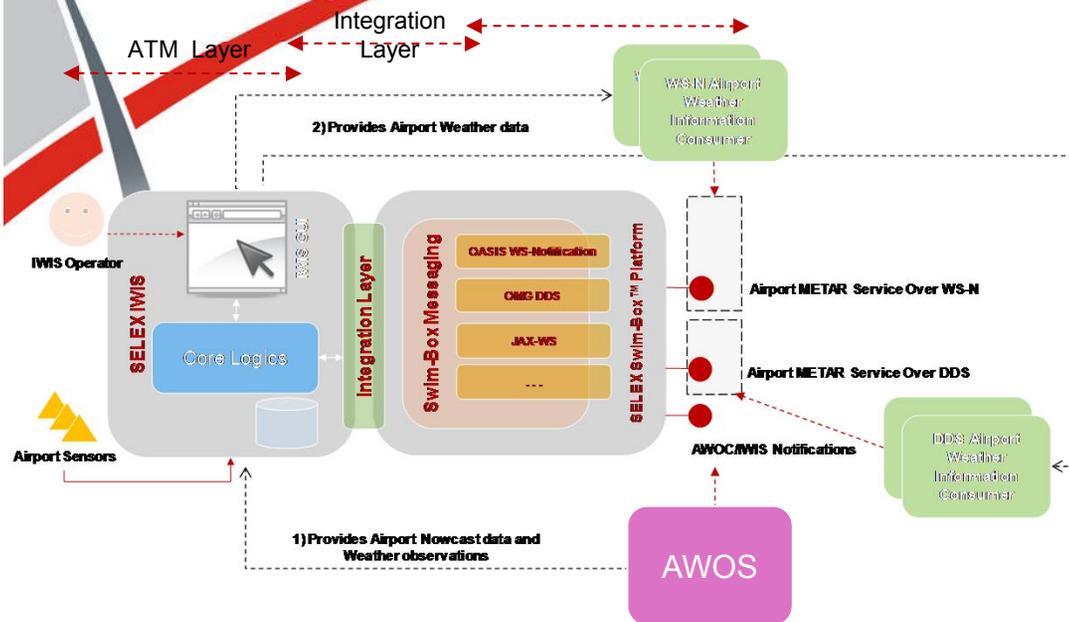
- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## An example of Integration scenario

© Copyright Selex ES S.p.A 2013. All rights reserved



# IWIS (Improved Weather Information System) prototype



- Layered Architecture (decoupling, extensibility, flexibility, etc.)
- Physical Service Data Models based on ICAO iWXXM
  - iWXXM XSDs
  - IDL (based on XSD2IDL transformation)
- Provisioning architecture
  - Multiple standard technologies are supported
    - OASIS WS-BrokeredNotification
    - OMG Data Distribution Service (DDS)
- Provision of Integration Layer (libraries) for production of:
  - Observations and Forecasts (18 sets of MET measurements)
  - ICAO Annex 4 Bulletins (METAR, TAF, SIGMET)
  - Digital SNOWTAM

IDL

Service Contract

**WSDL**

**XSD**

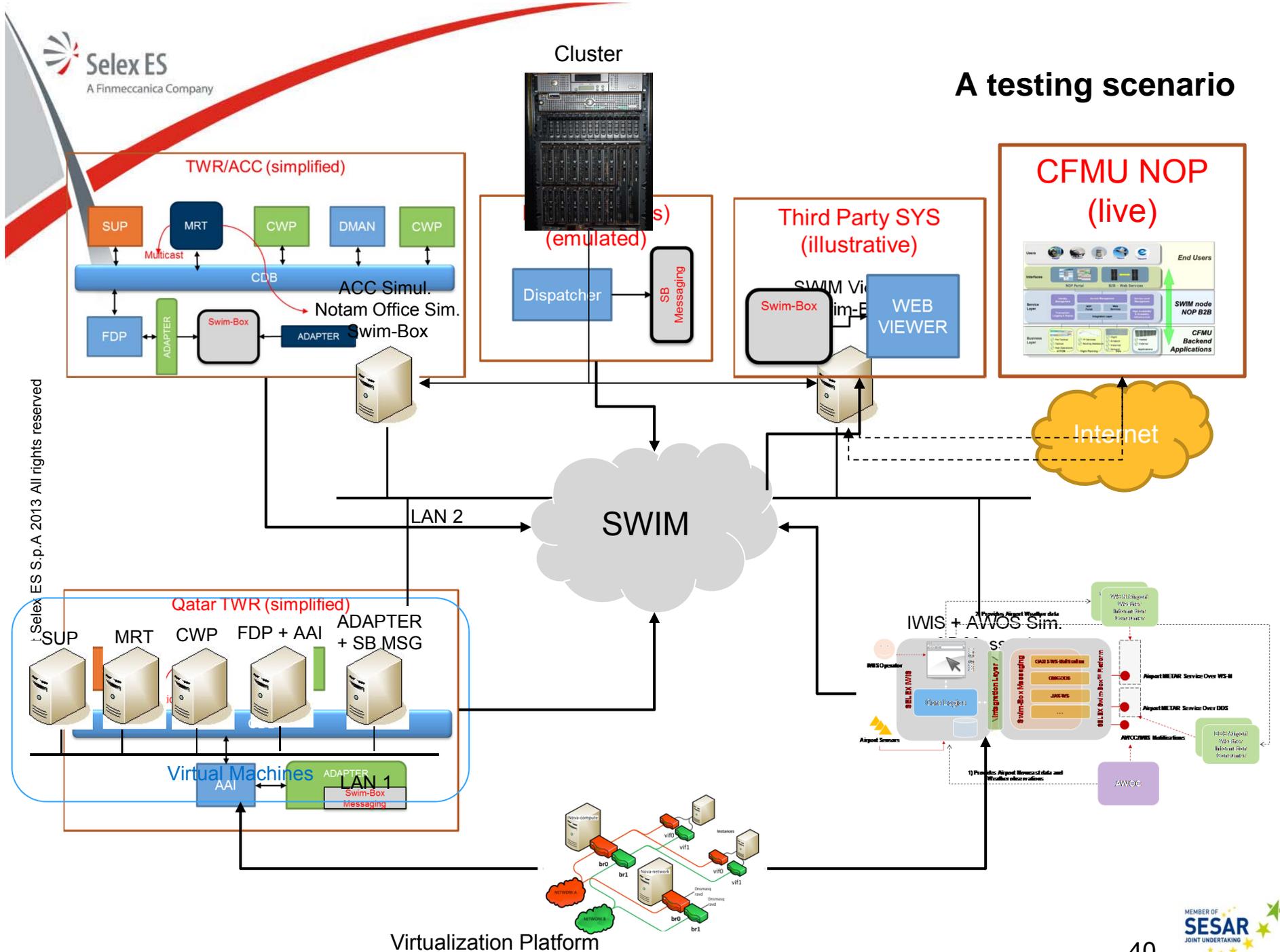
**OASIS**

- Weather data over OASIS WS-BrokeredNotification
- Standard WSDLs and XSDs
- XSDs for the weather data distributed by IWIS
- Topic names for each weather data
- IWIS playing the role of Notification Producer
- Airport Weather consumers playing the role of Notification Consumer

**OMG**

- Weather data over OMG DDS
- Standard OMG DDS
- IDL for the weather data distributed by IWIS
- Topic names for each weather data
- DDS QoS
- IWIS playing the role of Data Writer
- Airport Weather consumers playing the role of Data Reader

# A testing scenario

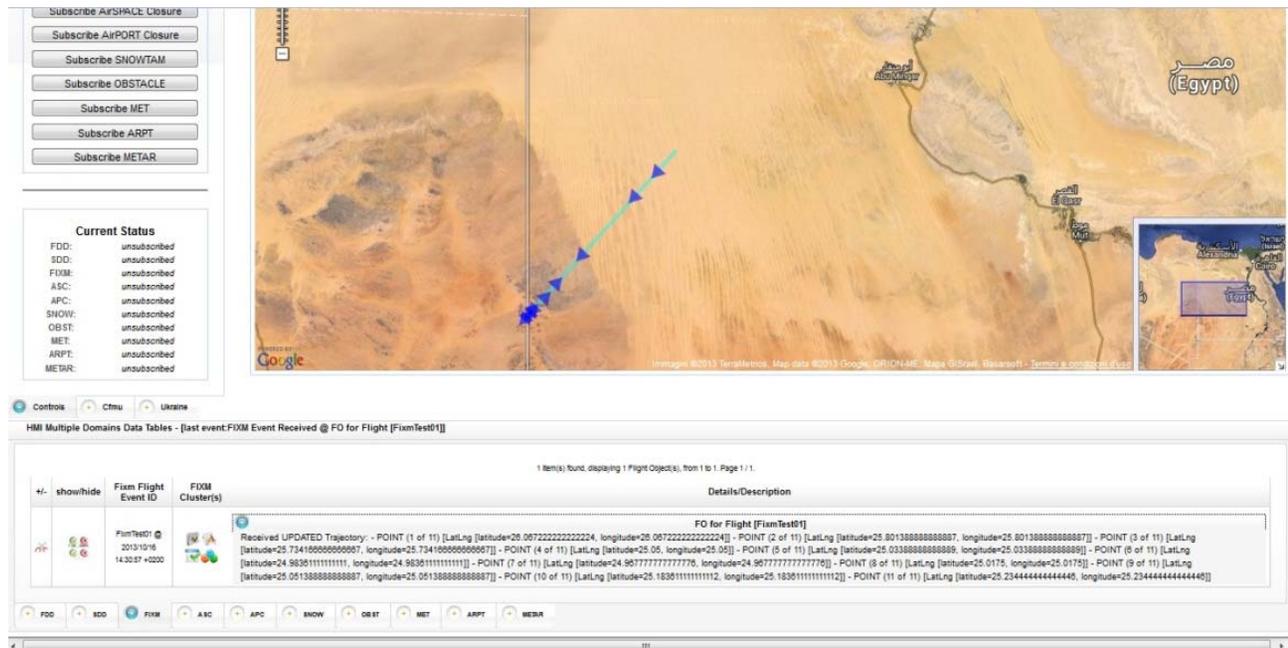


© Selex ES S.p.A. 2013. All rights reserved

- Selex ES Company
- Selex ES in SESAR
- SWIM Concept
- SESAR SWIM Definition
- SESAR SWIM Technical Infrastructure
- Selex ES SWIM Node Implementation
  - High level architecture
  - Flexible deployment
- Examples of utilization
- SWIM-Viewer: An example of what you can achieve

## A demonstrator of the possibilities: SWIM-Viewer

- **FIXM 2.0 Flight Objects** The Flight Information Exchange Model (FIXM) is a data interchange format for sharing information about flights among ICAO regions at global level (Extra European Flights) throughout their lifecycle.
  - The Selex ES SWIM-Viewer consumes FIXM data received through the Airport Flight Object distribution service.



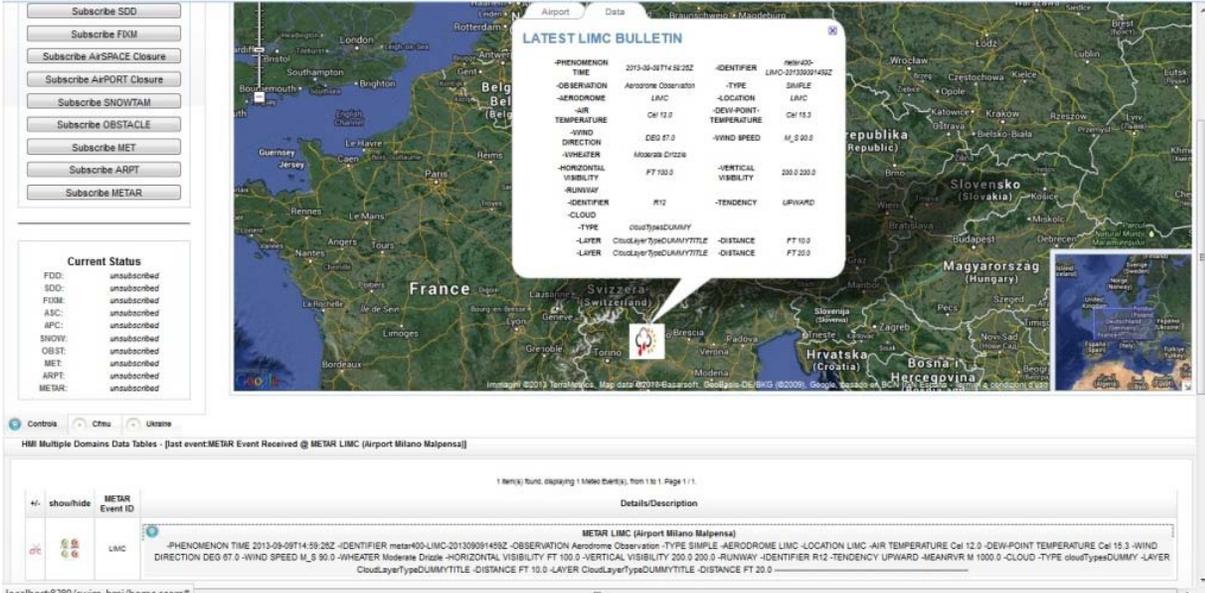
The screenshot displays the SWIM-Viewer interface. On the left, there are subscription buttons for various data types: AIRSPACE Closure, AIRPORT Closure, SNOWTAM, OBSTACLE, MET, ARPT, and METAR. Below these is a 'Current Status' section with a list of data types and their subscription status (all are 'unsubscribed'). The main area is a map of Egypt showing a flight trajectory with blue and green arrows. An inset map shows the location within the Middle East. Below the map is a table with the following data:

showhide	Fixm Flight Event ID	FIXM Cluster(s)	Details/Description
	FixmTest01 2013/10/16 14:30:07 +0200		<p>Received UPDATED Trajectory: - POINT (1 of 11) [Lat.Lng [latitude=25.08722222222224, longitude=25.08722222222224]] - POINT (2 of 11) [Lat.Lng [latitude=25.80138888888889, longitude=25.80138888888889]] - POINT (3 of 11) [Lat.Lng [latitude=25.73410888888889, longitude=25.73410888888889]] - POINT (4 of 11) [Lat.Lng [latitude=25.05, longitude=25.05]] - POINT (5 of 11) [Lat.Lng [latitude=25.03388888888889, longitude=25.03388888888889]] - POINT (6 of 11) [Lat.Lng [latitude=24.98301111111111, longitude=24.98301111111111]] - POINT (7 of 11) [Lat.Lng [latitude=24.96777777777778, longitude=24.96777777777778]] - POINT (8 of 11) [Lat.Lng [latitude=25.0175, longitude=25.0175]] - POINT (9 of 11) [Lat.Lng [latitude=25.05138888888889, longitude=25.05138888888889]] - POINT (10 of 11) [Lat.Lng [latitude=25.18301111111112, longitude=25.18301111111112]] - POINT (11 of 11) [Lat.Lng [latitude=25.23444444444444, longitude=25.23444444444444]]</p>

## ■ Airport METAR service (consumer)

- The Airport METAR service which provides a Meteorological report including weather conditions concerning a given airport. Its design is based on ICAO IWXXM encoding of the ICAO Annex 3 reports (METAR, SPECI, TAF, SIGMET).
- The Selex ES SWIM-Viewer consumes METAR data received through the *Airport METAR Distribution Service*.

© Copyright Selex ES S.p.A 2013. All rights reserved



The screenshot displays the SWIM-Viewer interface. On the left, there is a sidebar with subscription buttons for various services: SDD, FDM, AirSPACE Closure, SNOWTAM, OBSTACLE, MET, ARPT, and METAR. Below these is a 'Current Status' section listing various services as 'unsubscribed'. The main area features a map of Europe with a callout window titled 'LATEST LMC BULLETIN' for airport LMC. The callout contains the following data:

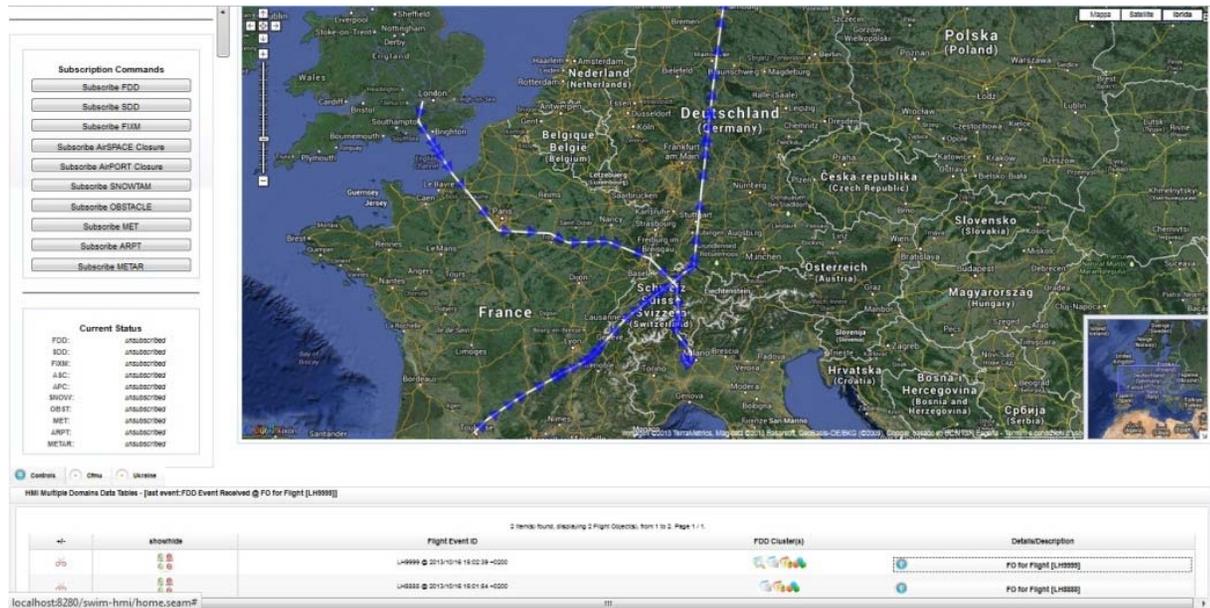
PHENOMENON	TIME	IDENTIFIER	PHENOMENON	TIME	IDENTIFIER
OBSERVATION	2013-09-09T14:59:20Z	LMC-201309091459Z	TYPE	2013-09-09T14:59:20Z	LMC-201309091459Z
AERODROME	LMC	LMC	LOCATION	LMC	LMC
TEMPERATURE	Cel 12.0	DEW-POINT	TEMPERATURE	Cel 15.3	DEW-POINT
DIRECTION	DEG 07.0	WIND SPEED	M 5.00.0		
WHEATER	Moderate Drizzle				
HORIZONTAL VISIBILITY	FT 100.0	VERTICAL VISIBILITY	200.0 200.0		
IDENTIFIER	R12	TENDENCY	UPWARD		
CLOUD					
LAYER	CloudLayerTypeDUMMYTITLE	DISTANCE	FT 10.0		
LAYER	CloudLayerTypeDUMMYTITLE	DISTANCE	FT 20.0		

Below the map, there is a table with columns for 'METAR Event ID' and 'Details/Description'. The table contains one entry for the LMC event.

## ■ ED-133 Flight Objects (consumer)

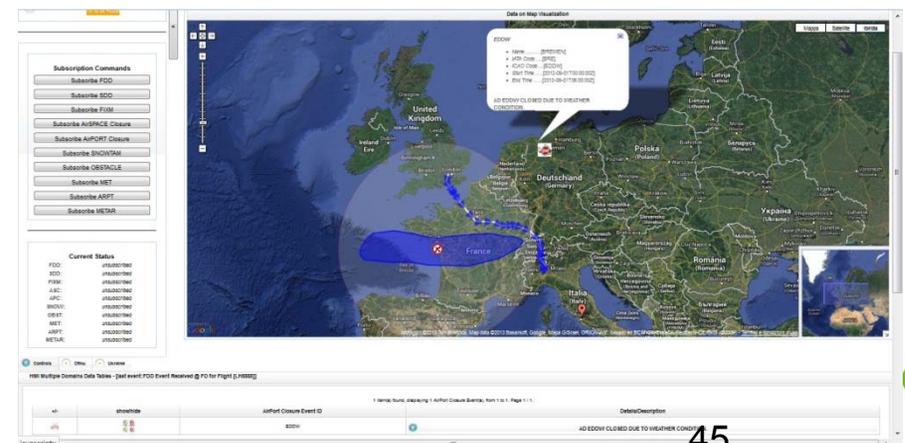
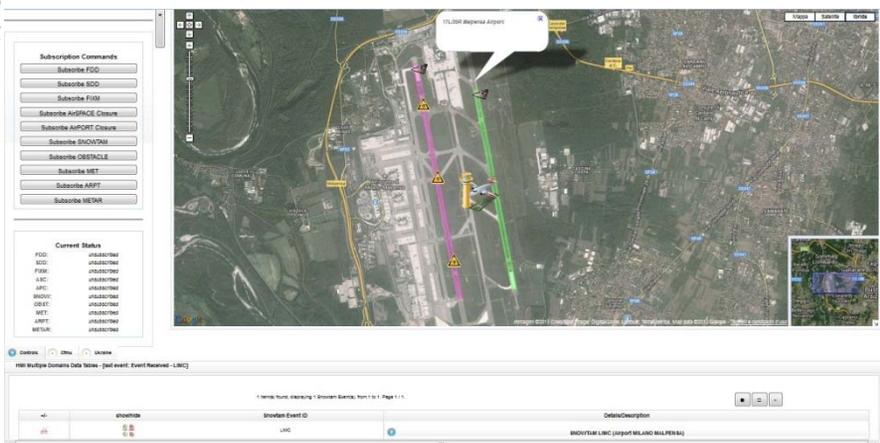
- The ED-133 (ED-133 Flight Object Interoperability Specification) is a data interchange format for sharing information about flights in support of En-route and Terminal ATC Operations. It explicitly covers the exchange of real time Flight Information and Aeronautical information
- The Selex ES SWIM-Viewer is able to consume all of the ED-133 service instances developed by any organization and distributed via DDS distribution technology (as mandated by SESAR specifications)

© Copyright Selex ES S.p.A 2013. All rights reserved



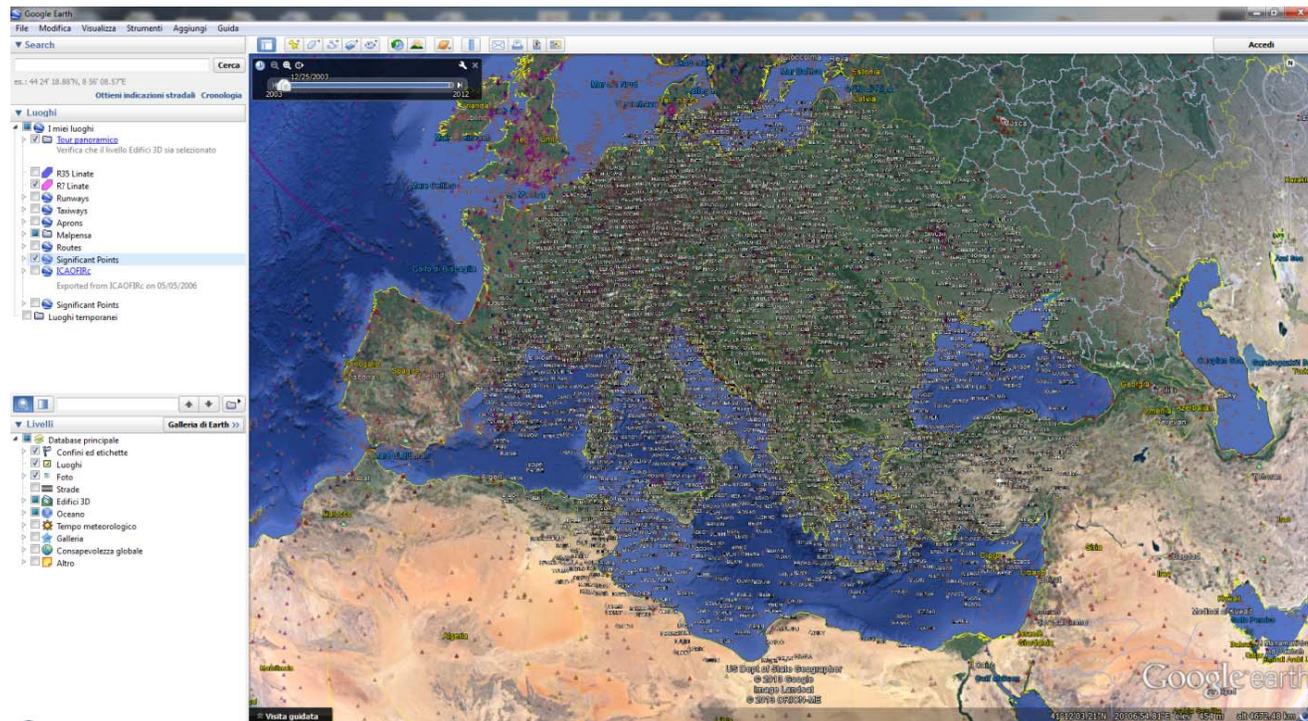
## ■ D-NOTAM (consumer)

- The D-NOTAM (Digital NOTAM) is a way of sharing Information about Obstacles, Airspace Closure, Snowtam, Airport Closure, using the Aeronautical Information Exchange Model (AIXM 5.1 specification).
- The Selex ES SWIM-Viewer is able to consume D-NOTAMs provided by any organization and distributed via WS-N distribution technology (as mandated by SESAR specifications).



## ■ ADR Data (consumer)

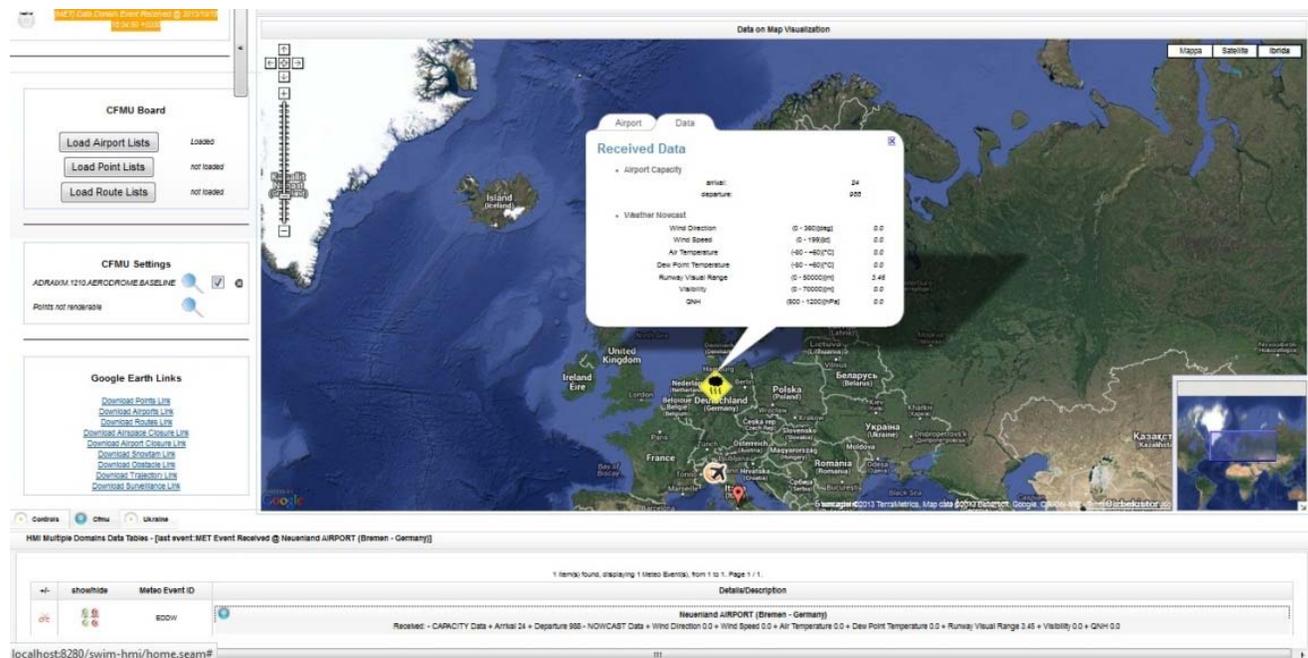
- ADR data (Aeronautical Data Repository) are the Aeronautical Information like Routes, Airports, Points provided by Eurocontrol through its NMVP Portal (also known as CFMU B2B NOP) formatted following AIXM 5.1 specification.



## ■ Meteo Information (consumer)

- Weather Information like Nowcast and Airport Capacity encoded according to SESAR WP8 SDM (Service Data Model).
- The Selex ES SWIM-Viewer consumes Weather Information through the *Airport MET Induced Capacity Reduction Service* and the *Airport MET Nowcast Service*.

© Copyright Selex ES S.p.A 2013. All rights reserved



**Received Data**

- Airport Capacity
 

arrival	24
departure	900
- Weather Nowcast
 

Wind Direction	(0 - 360)deg	0.0
Wind Speed	(0 - 180)kt	0.0
Air Temperature	(-60 - +60)°C	0.0
Dew Point Temperature	(-60 - +60)°C	0.0
Runway Visual Range	(0 - 5000)m	3.45
Visibility	(0 - 7000)m	0.0
QNH	(800 - 1200)hPa	0.0

Neuenland AIRPORT (Bremen - Germany)  
 Received - CAPACITY Data + Arrival 24 + Departure 900 - NOWCAST Data + Wind Direction 0.0 + Air Temperature 0.0 + Dew Point Temperature 0.0 + Runway Visual Range 3.45 + Visibility 0.0 + QNH 0.0

## Transformation of data in KML format

- Ability to transform Airspace Data Repository information in KML format (also possible for other AIXM info).



---

**SELEX-ES S.p.A.**

Via Tiburtina Km 12.400  
00131 Rome, Italy  
+39 06 41501 – [info@selex-es.com](mailto:info@selex-es.com)

---

**Thank you for the attention!**