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DDS Interoperability in SWIM

OMG Real Time and Embedded Workshop

Paris - April 17th, 2012

Outline

- SWIM – a key enabler of future ATM
- SWIM thread within SESAR
- SWIM FO/IOP Profile Interaction Patterns
- SWIM FO/IOP Profile General Context
- DDS Interoperability Issues
- Conclusion

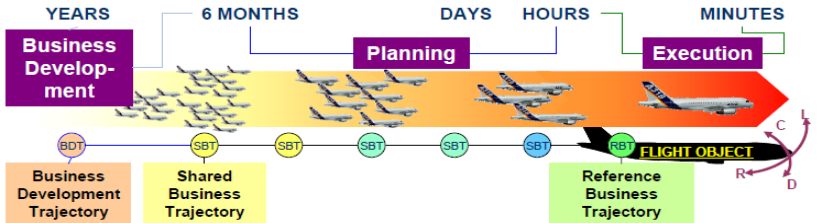
DISCLAIMER

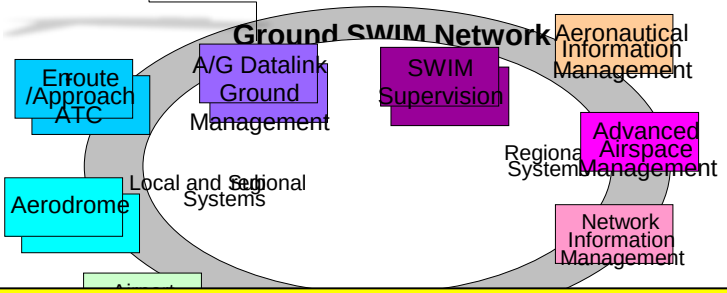
This presentation intentionally only focus on encountered DDSI issues. SWIM tests involving DDS interoperability were all OK ☺.

SWIM within the European ATM Target Concept

Four drivers for change (*)

- Business trajectory
- Network Management
- Airborne Separation Assistance
- System Wide Information Management (SWIM)





(*) Source: SESAR D3 “The ATM target Concept”, DLM-0612-001-02-00

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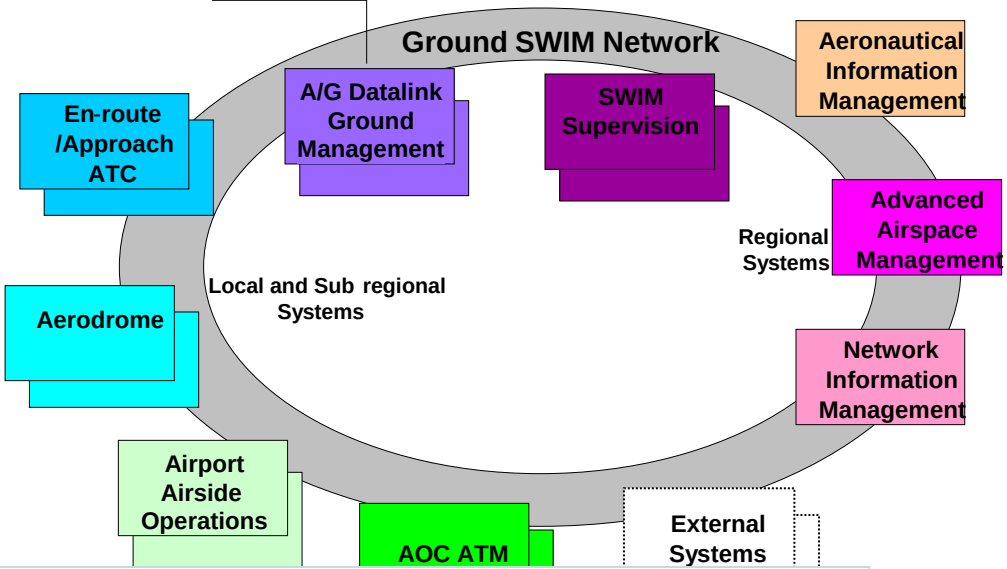
SWIM – a key enabler of future ATM

- SWIM addresses both G/G and A/G
- Integrates the aircraft
- Regional systems
- Sub-regional/local systems
- Safety requirements
- Information security



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

Source: SESAR 08.01.01 A01 "SWIM Concept of Operations", Ed 00.01.02

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SWIM thread within SESAR

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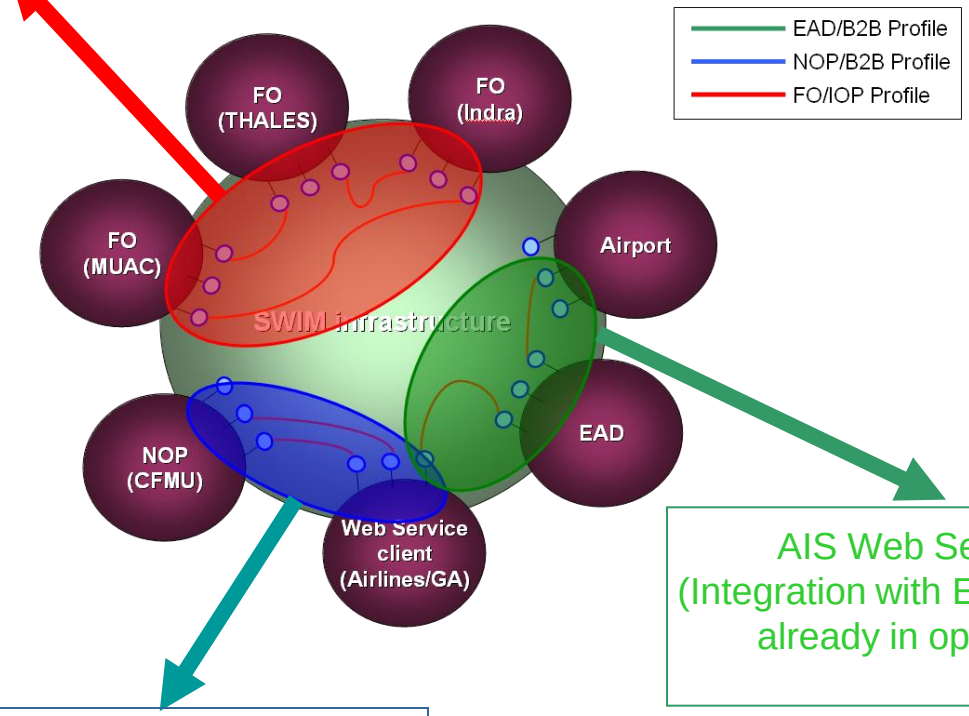
WP14 Step 1 Results

1st Prototypes Demonstrated at Eurocontrol Bretigny site In November 2011 !

Flight Object
Web services & Data distribution
(Follow-up of Flight Object studies)



AIS Web Services
(Integration with EAD services already in operation)

ATFM Web Services
(Integration with CFMU NOP Portal already in operation)

SWIM Infrastructure start being integrated with System projects prototypes

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SWIM FO/IOP Profile Interaction Patterns

Two main interoperable interaction patterns:

- Request/Reply
  - Web Service / WS-I
- Publish/Subscribe
  - OMG DDS Interoperability Wire Protocol

SWIM FO/IOP Profile General Context

- System of Systems
  - Many stakeholders
  - Different ownership domains
- Over a WAN
  - Very limited bandwidth
  - Various sizes for Protocol Data Unit (PDU)
  - No trivial support for multicast
- Multiple DDS vendors
  - Standard wire protocols for interoperability

Tests involving DDS performed in a LAN, 4 partners

- Two DDS products from major DDS vendors, DDSI v2.1

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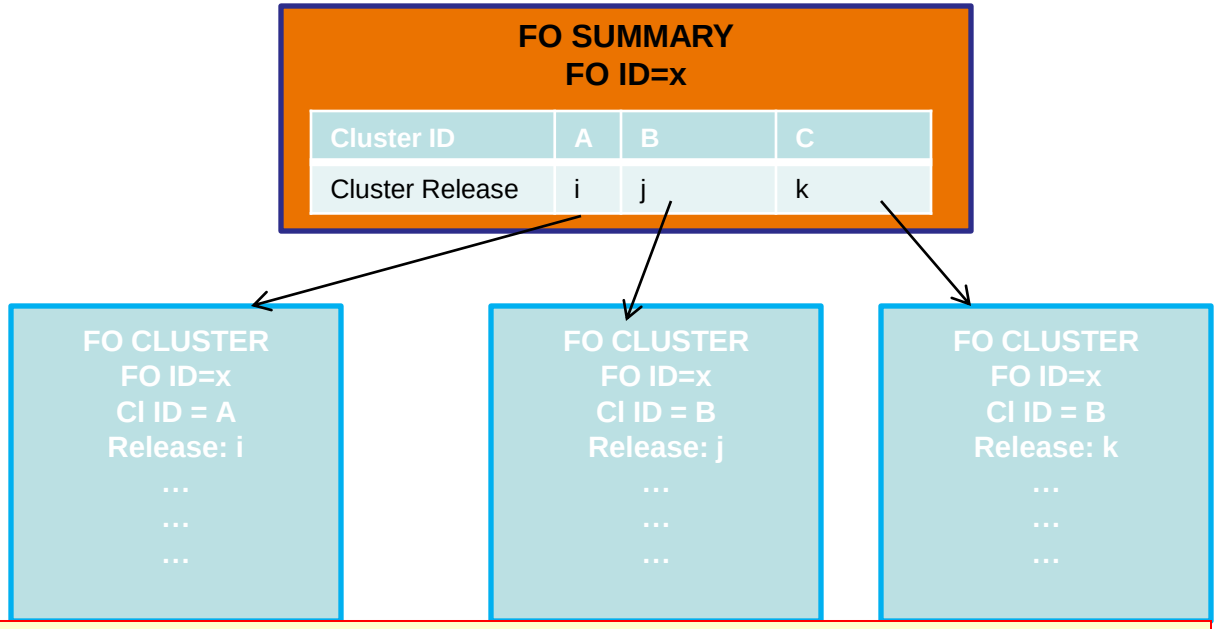
SWIM FO/IOP Profile : ED-133(*) Patterns

*A Flight Object (FO) is decomposed into multiple **Clusters** (13 in ICOG)*
Clusters can be sent in any order,
Only updated clusters are sent.
*For coherency/consistency management, a **Summary** Topic containing Cluster releases is used.*
A Summary sample is sent whenever one or more Clusters are sent.
Periodic publication of all summaries by the publisher.



SWIM (middleware) implements a protocol on top of OMG DDS.
Support for retries,
Detection of all FO releases
Only coherent clusters are delivered to application.

Strict QoS requirements

- *RELIABILITY*
- *DURABILITY*
- *PRESENTATION (coherent access)*
- *DEADLINE*

(*) Eurocae WG59, ED-133 Flight Object Interoperability Specification, June 2009

DDS Interoperability Issues

- Interoperability achieved in ‘lax’ mode, i.e. not strictly compliant to the standard
  - Interoperability with ‘strict’ mode uses high CPU and network load (Heartbeats and AckNacks)
- Dynamic change of QoS (Partition)
  - May disconnect and reconnect DataWriters of the Publisher
  - Potential disposal of all currently registered instances of the DataWriters of the Publisher
- ParameterID (PID) in the discovery data
  - Only values different from the specified defaults are required to be published explicitly.
  - What if default values change in future version of the spec?

DDS Interoperability Issues

- DURABILITY QoS
  - DDSI only deals with volatile and transient-local data
  - Behavior for transient and persistent data undefined.
- PRESENTATION QoS
  - GROUP *access_scope* is needed for using coherent access across multiple DataWriters (in the same Publisher); but not addressed by DDSI (§8.7.5)
  - Undefined behavior when end of coherent set is missing
    - Contradicts with fault containment and fault isolation requirements for SWIM Nodes.
- OWNERSHIP QoS
  - Use of EXCLUSIVE ownership requires defining OWNERSHIP_STRENGTH QoS for all the stakeholders!

DDS Interoperability Issues

- DESTINATION_ORDER QoS
  - By source timestamp destination order may require clock synchronization
- WRITER_DATA_LIFECYCLE QoS
  - *autodispose_unregistered_instances* defaults to ***'true'***. Failure/Stopping of a SWIM node result in disposal of registered data instances!

DDS Interoperability Issues

- No requirement for verification of topic consistency
  - No detection of Inconsistencies between vendors
- No support for true unicast-only mode
  - When network does not support multicast
- DDS Interoperability demonstrations do not use ‘large payloads’
  - DDS Fragmentation did not work out-of-the-box
- Matching of individual DataWriters with individual DataReaders do not scale

DDS Interoperability Issues

- No support for compression
  - Limited bandwidth in a WAN
- No support for security
  - A must have …
- No support for versioning
  - Extensible topics?

Conclusion

- SWIM tests involving DDS interoperability were all successful.

- Nevertheless, many issues with DDSI V2.1 specification need to be addressed by future releases of the standard to comply with the high levels of availability, continuity, and integrity that are required by SWIM.

Questions?

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