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Civil-Military Coordination Considerations for SWIM Deployment

- Interoperability -

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Abstract

This document responds to the interoperability part of an outstanding task on System Wide Information Management (SWIM) Deployment, which was placed upon EUROCONTROL Agency at the 22nd meeting of the Military ATM Board (MAB) on 18th April 2018.

The purpose is to provide guidance and a structured list of recommendations to military organisations to ensure the minimum level of the interoperability for the deployment of System Wide Information Management.

It covers SWIM middleware but not the interoperability aspects related with the underlying IP communications infrastructure which are under development in a separated workstream.

A consolidated list of Recommendations for Military Organisations to ensure SWIM Interoperability is included in Annex C.

The document was submitted to the Military ATM Board (MAB) on 09 October 2019.

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EXECUTIVE SUMMARY

The MAB has repeatedly expressed interest in identifying the impacts of SWIM (System Wide Information Management) on the military systems and the subsequent necessary SWIM developments to be conducted to ensure the adequate integration of military systems in the deployment of SWIM.

The 22nd meeting of the Military ATM Board (MAB) on 18th April 2018 concluded that there was a need to define and consolidate the military requirements related to SWIM deployment**.** In order to facilitate the military engagement in SWIM, it has been proposed to identify and organise in a structured way a number of requirements and recommendations related to data exchange, interoperability and security in the context of SWIM. These could constitute a baseline for further discussions and to facilitate national military decisions and activities related to the deployment of SWIM. Therefore, the MAB asked the EUROCONTROL Agency to elaborate and develop three documents focusing on:

- data sharing,
- interoperability,
- security.

This document focuses on the interoperability element and explain the three main interoperability aspects of SWIM that are addressed for its military implications: service description, information definition and SWIM technical infrastructure (SWIM-TI). Some relevant information and considerations concerning SWIM governance, Standardisation and Regulation are also provided in the document.

It covers SWIM middleware but not the interoperability aspects related with the underlying IP communications infrastructure which are under development in a separated workstream.

This document therefore considers the deployment of initial SWIM, which is described in the Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 (Pilot Common Project) as the ATM Functionality #5.

A consolidated list of Recommendations for Military Organisations to ensure SWIM Interoperability is included in Annex C.

1. Introduction

1.1 About this Document

A task on System Wide Information Management (SWIM) Deployment was given to the EUROCONTROL Agency at the 22nd meeting of the Military ATM Board (MAB) on 18th April 2018. That task asked for the identification of Military requirements and recommendations related to SWIM deployment considering data sharing, interoperability and security.

MAB/22 requested EUROCONTROL to initiate this work on the basis of already available information that could better support the SWIM deployment, i.e. the initial military requirements elaborated in the framework of centralised services, and still valid today [RD 1], the EUROCONTROL SWIM specifications for information, service and technical infrastructure, the applicable outputs from SESAR 2020 (notably work on the definition of a SWIM-TI Green Profile and an Information Exchange Gateway – IEG), the ATM security policy and its implementation guidelines, etc. The Agency was asked to review and to list all necessary requirements and recommendations and submit them to the MAB for consideration and consolidation.

The outcome of the task is presented in three documents (data sharing including the data sets, interoperability and security), to be endorsed by the MAB and to be updated when required. The document related to data sharing requirements will identify the various data to be exchanged over SWIM in the different ATM domains (ASM, ATC, etc.). The document related to security will describe a civil-military ATM security implementation.

This document relates to interoperability and describes the elements that military organisations have to consider in order to ensure a sufficient level of interoperability for the three main SWIM components (Services, Information, Technical Infrastructure).

1.2 Purpose

The purpose of this document is to provide a structured list of recommendations to military organisations, including contextual information and guidance, to ensure the minimum level of interoperability for the deployment of System Wide Information Management based on agreed data sharing requirements between military and civil stakeholders. The mandated deployment of SWIM is covered in the Pilot Common Project (PCP) Regulation [RD 1] and further detailed in the associated SESAR Deployment Programme where it is described as “initial SWIM” (iSWIM).

1.3 Scope

According to the ICAO Manual on SWIM Concept [RD 2], SWIM is a collaborative, standardized, governed and managed way for information exchange in a networked environment and it is composed of four principal components:

- SWIM information;
- SWIM information services for each ATM information domain and for cross-domain purposes to perform the required information exchanges;

- SWIM technical infrastructure for the actual exchange of information. It provides the infrastructure services such as interface management, request-reply and publish-subscribe messaging, security services;
- and the supporting SWIM governance.

In addition to the three SWIM components and the SWIM governance aspects, this document will also address the Internet Protocol (IP) based network layer that is needed to support SWIM as depicted in figure 1.

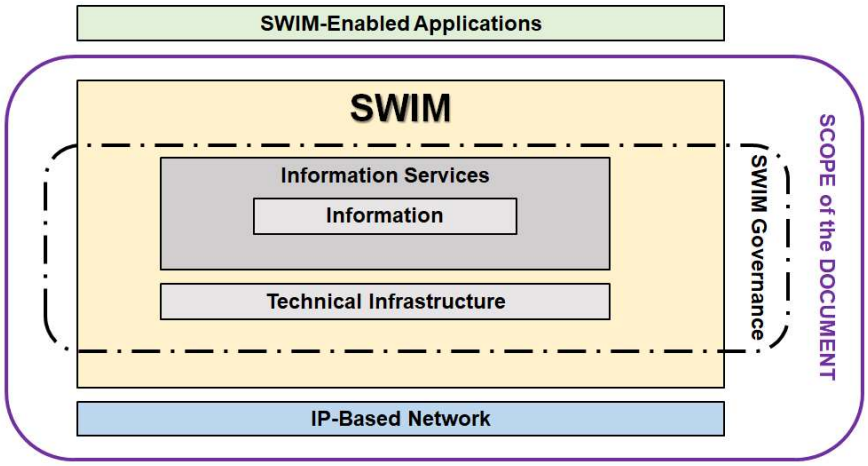

Figure 1: Scope of the Document

SWIM enabled applications (SEA) are specific to platforms implementing SWIM and are not directly considered in the current document. However some requirements described in the data sharing document may influence the design of SWIM enabled applications.

The scope of this document is in line with the SESAR deployment programme for ATM Functionality 5 “Initial System Wide Information Management”, which includes the implementation of SWIM components themselves (information, service, technical infrastructure), the governance aspects as well as the deployment of the Internet Protocol (IP) based networks.

This document focuses on SWIM Technical Infrastructure yellow profile as it is the only SWIM profile specification available for deployment. The SWIM blue profile is still under work with SESAR 2020 to reach a sufficient level of maturity for a future deployment. The SWIM green profile, which may support the SWIM exchanges between civil and military systems that need specific and potential higher levels of quality of services, performance and security, is currently under research and development in the framework of PJ17-03 SESAR 2020. The green profile shall be seen as an extension of the yellow profile to satisfy particular military requirements.

This document contains guidance that can be used by military organisations when implementing SWIM services. Annex C provides the list of SWIM Interoperability recommendations applicable to the military organisations that intend to deploy SWIM. The rationale for each interoperability recommendation is provided along with this document.

1.4 Abbreviations and Definitions

1.4.1 Abbreviations

Abbreviation	Description
AIRM	ATM Information Reference Model
AIXM	Aeronautical Information Exchange Model
AMQP	Advanced Message Queuing Protocol
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
B2B	Business to Business
CoI	Community of Interest
CR	Change Request
EASCG	European ATM Standards Coordination Group
EC	European Community
ERAF	EUROCONTROL Regulatory and Advisory Framework
FIXM	Flight Information Exchange Model
HTTP	Hypertext Transfer Protocol
ICAO	International Civil Aviation Organization, a UN specialized agency
IEC	International Electrotechnical Commission
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Standardization Organization
ISRM	Information Service Reference Model
IT	Information Technology
MEP	Message Exchange Pattern
NM	Network Manager

D-NOTAM	Digital Notice to Airmen
OASIS	Organization for the Advancement of Structured Information Standards
PCP	Pilot Common Project
PENS	Pan-European Network Service
P/S	Publish / Subscribe
QoS	Quality of Service
RPC	Remote procedure call
R/R	Request / Reply
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
SWIM	System Wide Information Management
TI	Technical Infrastructure
UML	Unified Modelling Language
XML	Extensible Markup Language
XSD	XML Schema Definition
W3C	World Wide Web Consortium
WSDL	Web Service Description Language
WXXM/IWXXM	Weather Information Exchange Model / ICAO Meteorological Information Exchange Model
YP	Yellow Profile

1.4.2 Definitions

Term	Definition	Source
Interface	named set of operations that characterize the behaviour of an entity	ISO 19119:2005, 4.2
Interface Binding	A specification of the protocols and data format to be used in transmitting messages defined by the associated interface.	Web Services Description Requirements, W3C https://www.w3.org/TR/ws-desc-reqs/

Interoperability	The ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge.	
IT Infrastructure	The collection of software and hardware used in an organization that enables the provision of information services. Note: It is synonym of Technical Infrastructure.	
Message Exchange Pattern	A Message Exchange Pattern (MEP) is a template, devoid of application semantics, that describes a generic pattern for the exchange of messages between agents. It describes relationships (e.g., temporal, causal, sequential, etc.) of multiple messages exchanged in conformance with the pattern, as well as the normal and abnormal termination of any message exchange conforming to the pattern.	W3C
Messaging	Messaging is the exchange of data between distributed systems via messages.	
Protocol	A set of semantic and syntactic rules for exchanging information.	ISO/IEC 14519:2001
Quality of Service	The degree or level of confidence that the performance of a service meets the requirements of the user.	
Semantic interoperability	Ability of computer systems to exchange data with unambiguous, shared meaning.	
Service	A mechanism to enable access to one or more capabilities, where the access is provided using a prescribed interface and is exercised consistent with constraints and policies as specified by the service description.	W3C
Service Description	The information needed in order to use, or consider using, a service.	
Service Interface	The means by which the underlying capabilities of a service are accessed. Note: the service interface is the means for interacting with a service.	OASIS
Technical Infrastructure	The collection of software and hardware used in an organization that enables the provision of information services. Note: It is synonym of IT Infrastructure.	

1.5 Reference Material

[RD 1] Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan

[RD 2] Manual on System Wide Information Management (SWIM) Concept – ICAO Doc 10039

[RD 3] EUROCONTROL Specification for SWIM Service Description Edition 1.0, dated 01/12/2017 - EUROCONTROL-SPEC-168

[RD 4] EUROCONTROL Specification for SWIM Information Definition Edition 1.0, dated 1/12/2017 - EUROCONTROL-SPEC-169

[RD 5] EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile Edition 1.0, dated 01/12/2017 - EUROCONTROL-SPEC-170

[RD 6] EUROCONTROL CMAC CNS Technical Leaflet #10 – SWIM Civil-Military Reflections, Edition 28 April 2017

[RD 7] Military ATM Board (MAB) consultation paper on Initial Military Information and Communications Interoperability Requirements for Centralised Services, dated 18 July 2014

[RD 8] HELIOS / Object Security Study on SWIM Civil-Military Interoperability - Detailed technical civil-military SWIM Interoperability Requirements, dated 11th June 2012

1.6 Document Structure

This document is organized as follows:

Chapter 1: Introduction, purpose and scope, terminology, reference materials

Chapter 2: General Scope for Initial SWIM

Chapter 3: General description of SOA principles and their application to SWIM

Chapter 4: SWIM Service

Chapter 5: SWIM Information

Chapter 6: SWIM Technical Infrastructure

Chapter 7: SWIM-TI IP Network

Chapter 8: Other aspects

Annex A: Civil Military Information Exchanges for Domains candidate for SWIM deployment

Annex B: Description of SWIM protocols for NM B2B

Annex C: List of SWIM Interoperability Recommendations for Military Organisations

2. Initial SWIM

The Pilot Common Project (PCP) Regulation [RD 1] introduced Initial SWIM requirements under the ATM Functionality #5. Recent deployment initiatives have revealed the willingness of several military organisations to actively carry out deployment projects to adhere to Initial SWIM requirements for the exchange of data.

Initial SWIM represents the first deployment supporting information exchanges, mandated by regulation, that are built on standards and delivered through an internet protocol (IP)-based network by SWIM-enabled systems. It consists of:

- Common infrastructure components:
  - SWIM Registry, which aims at improving the visibility and accessibility of ATM information and services available through SWIM. The Registry will enables service providers, consumers, and regulatory authorities to share a common view on SWIM.
  - SWIM Common Public Key Infrastructure (PKI), which shall be used for signing, emitting and maintaining certificates and revocation lists. The PKI ensures that information can be securely transferred.

- SWIM Technical Infrastructure (TI): Relying on standards and interoperable products and services, SWIM information exchange was planned to be structured around dedicated SWIM infrastructure profiles: Blue SWIM-TI Profile and Yellow SWIM-TI Profile. However in deployment this distinction is not that explicit anymore and in addition, the R&D on the blue SWIM-TI Profile is to-date not yet mature for standardisation. It is important to recognise that to comply with Initial SWIM requirements the infrastructure evolution will also have to address transition issues from legacy protocols to SWIM environment.

- Information Exchanges: The following information exchanges shall be supported by Initial SWIM:
  - Aeronautical Information such as airspace management information, D-NOTAM, airport data,
  - Meteorological Information,
  - Cooperative Network Information such as ATFCM[1] data, access to NOP[2], and other NM-related exchanges,
  - Flight Information: pre-tactical and tactical trajectory/flight information including flight planning.

The adoption of Pilot Common Project (PCP) Regulation [RD 1] triggered the elaboration of the SESAR Deployment Programme, which is the widely agreed implementation plan for Initial SWIM.

Recommendation [GEN01] Military organisations should develop and implement relevant required information exchanges in accordance with SESAR Deployment Programme in order to fulfil the PCP regulation for ATM Functionality #5 “initial SWIM”..

[1] Air Traffic Flow and Capacity Management

[2] Network Operations Plan

3. SWIM, a SOA based architecture

According to the Organization for the Advancement of Structured Information Standards (OASIS), a Service-Oriented Architecture (SOA) is a concept for “organizing and utilizing distributed capabilities that may be under the control of different owners”. SOA can be seen as an approach to integrate applications running on heterogeneous platforms using industry-wide acceptable standards. Each application may implement as one or more services where each information service provides a particular functionality. Information services (applications) communicate with each other in a coordinated sequence that is defined by a business process.

From a project management perspective, SOA is an architectural style based on components, mainly software items, which implement as much as possible industry standards and well-structured services. SOA practices are intended to create an agile, integrated Information Technology (IT) infrastructure that is scalable, reliable, and can rapidly respond to an organization’s changing needs by employing loosely coupled and dynamic services.

SWIM has been designed according to SOA architectural principles and should enable ATM organisations to benefit from them. ATM stakeholders can expect substantial reduction in costs and delivery schedules related to their SWIM development, implementation and operational use, particularly maintenance, whilst significantly enhancing the performance of their technical and operational processes.

One of the key benefits of SOA for SWIM is the promotion of “loose coupling”. Loose coupling means that a service provider has a reduced impact on the service consumer. Dependencies are minimized allowing components and services to operate with as little knowledge as possible of other components or services.

SWIM as a SOA based architecture will encourage ATM organizations to re-use processes and products that are technically enabled and integrated through the use of open technology standards. In addition, connectivity, data exchange and process integration efforts will be simplified, reducing costs related to the integration of hardware and software components during the SWIM development and to maintenance phases.

When military decide to participate as service consumer or provider, from a functional point of view, the military will be a normal SWIM participant. As a consequence, military users must respect the underlying SOA infrastructure and services and join on the basis of the defined standard interfaces in place.

Recommendation [GEN02] Military organisations should develop and implement SWIM with respect to SOA principles.

4. SWIM Service

4.1 SWIM Service Consumer or Service Provider

Military organisations have to carry out a detailed Operational Requirement Analysis from which they have to decide if their operational systems will be SWIM service consumers and/or SWIM service providers:

- As a SWIM service provider, a military organisation will publish the SWIM service description information in a SWIM registry enabling a service to be discoverable within the SWIM environment.

- As a SWIM service consumer, a military organisation can get access to the adequate SWIM service description in order to retrieve all the information about the SWIM services made available by the SWIM service providers.

SWIM is to be built on a standardised description of services providing a common baseline on discovering, understanding and implementing such services. SWIM standardised elements enable the so-called SWIM-Enabled Applications – the ATM applications that expose or consume services based on principles and requirements defined in SWIM specifications.

Recommendation [GEN03] Military organisations should carry out a detailed Operational Requirement Analysis from which they have to decide if their operational systems are SWIM service consumers and/or SWIM service providers.

4.2 SWIM Registry

As SWIM service provider or consumer, military organisations have to interact with the SWIM registry to efficiently conduct the deployment of SWIM..

The SWIM registry aims at improving the visibility and accessibility of ATM information and services available through SWIM. It enables SWIM service providers and SWIM consumers to share a common view on SWIM.

The SWIM registry provides consolidated information on services that have been implemented based on SWIM standards. It stores structured descriptions that facilitate the discovery and comparability of services.

The SWIM registry directly benefits to participating organisations by:

- Allowing SWIM service providers to increase visibility and adoption of their services. It will also support them in discovering and managing their dependencies with other services, standards and policies.
- Improving the efficiency of SWIM service consumers in identifying the most appropriated SWIM services and their providers.

As depicted above, the registry enables the “provider” to “publish” information related to its services so that the “consumer” is able to “discover” them and obtain what is required (e.g. interface information, access request procedure) to “use” those services. The “SWIM Governance” uses the registry to influence the implementation of services in SWIM with the publication of policies and standards.

The SWIM Registry deployed in a PCP context can be found here: eur-registry.swim.aero

Recommendation [GEN04] Military organisations should consider the SWIM registry as the primary means to discover service information in order to improve the visibility and accessibility to SWIM.

4.3 SWIM Service Description

4.3.1 Foreword

As soon as a military organisation has identified that a military system exchanges information over SWIM as a SWIM service provider, they have to describe the SWIM service in accordance with the methodology and requirements defined in EUROCONTROL Specification for SWIM service Description [RD 3]. The SWIM service description needs to be performed to achieve interoperability among ATM systems implementing SWIM and the military systems will have to adhere the SWIM service description requirements if they are SWIM service providers. A well-defined and standardised way of describing a SWIM service is necessary to improve efficiency and therefore interoperability when creating, exploring, comparing and using SWIM services.

The objective of paragraph 4.3 is to provide guidance to military organisations to understand the requirements applicable for SWIM service description, supporting the implementation of the requirements defined in [RD 2] for SWIM service providers.

4.3.2 Overall SWIM Service Requirements

The SWIM service description shall provide for a single SWIM service different types of information such as:

- the overall context,
- the operational needs fulfilled by the service,
- the associated information exchange requirements (IERs).
- the quality of service offered such as :
    - availability of the service,
    - response time of the service,
    - throughput of the service.

The SWIM service level QoS requirements may be complemented with other QoS requirements:

- at communication network level,
- at SWIM Technical Infrastructure level.

4.3.3 Service Breakdown structure

A SWIM service description describes an information service in an elaborated, well-structured and organized way according to the following service decomposition:

- Service Category:

  - The SWIM service Category represents the selected area for information exchanges such as aeronautical information, meteorological information, cooperative network information and flight information exchange.

- Service Identification, which is the name and the version of the service.
- Service Interfaces:
  - A SWIM service shall be decomposed into a list of service interfaces (provider side and consumer side interfaces), including for each interface:
    - the name, the purpose, a textual description, an indication that the interface is a provider side interface or a consumer side interface, the network address at which the interface can be accessed.
- Service Operations:
  - For each SWIM service interface, the underlying service operations shall be described with:
    - the name, the intent and the results of the service operation,
    - the messages supporting the exchanged information including the input, output and error messages.

4.3.4 Formalism and Languages for an information service

If the service interface binding specifies machine-readable formats, a service description shall include or refer to a service interface definition in a machine-readable format using a standard service definition formalism/language.

As an example of machine readable descriptions, WSDL may be used for the service description (if a web service binding using SOAP is selected) as well as XSD and Schematron Rules for the message description.

4.3.5 SWIM Service Considerations for IERs

An analysis of the IERs and services, vis a vis military needs and SWIM, was made in previous SESAR Industrial Research studies identifying the characteristics of multiple military-SWIM IERs and services. The results are provided in the Study on SWIM Civil-Military Interoperability by Helios/Object/Security Profile [RD 2]. From this study three ATM domains can be considered as mature to deploy SWIM as the principle for information exchange: Aeronautical Information, Airspace Management and Flight Planning. Annex A provides the tables that summarise civil-military Information Exchange of ATM domains that are candidate for SWIM deployment.

4.3.6 SWIM Service Description Recommendations

Recommendation [PROV01]

If a military organisation is a SWIM service provider, the military organisation should ensure that they provide a service description in conformance with the requirements defined in the EUROCONTROL Specification for SWIM service description [RD 2].

- In particular, the military organisation should define for each service to be provided the information exchange requirements (IERs) as well as the quality of service offered (availability of the service, response time, throughput, etc.).
- The military organisation should be active members of the SWIM Community of Interest in order to take full benefits of guidance materials related to SWIM service description.
- The military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.

Recommendation [CONS01]

If a military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM Service requirements contained in the Functional and Interface Specifications and associated technical data package to be developed and maintained by the SWIM services Providers.

5. SWIM Information

5.1 Overall SWIM Information Requirements

5.1.1 Information definitions

To ensure semantic interoperability, military systems exchanging information over SWIM have to be developed in line with the requirements defined in EUROCONTROL Specification for SWIM Information Definition [RD 2].

ATM related information is exchanged using information services between service providers and service consumers. For semantic interoperability reasons, the information needs to be clearly and uniquely defined, well understood and its meaning preserved as it travels through the European ATM network.

An information service description shall describe the elements of the exchanged information including the name, the definition, the applicable constraints such as datatype, value ranges, special values, character set restrictions, the semantic correspondence of the element with the AIRM and the structure and relevant relationships between the elements. This is done using an “information definition”.

The information definition can be embedded into the service description or provided by reference to an AIRM conformant standardised information exchange model, such as:

- Aeronautical Information Exchange Model (AIXM),
- Flight Information Exchange Model (FIXM),
- Weather Information Exchange Model (WXXM) / ICAO Meteorological Information Exchange Model (IWXXM).

5.1.2 AIRM conformance statement

A service description shall include a statement indicating whether the information definition used by the service conforms to the semantics of the AIRM and the version of the AIRM to which it conforms. AIRM covers the ATM information and the necessary ATM-related information that is exchanged via interoperable SWIM information services. Alignment with AIRM will remove the risk of semantic misalignment, possible re-interpretations and drift of meaning between different information definitions.

5.1.3 Exchange formats

The definition of interoperable information presupposes that the military will want to include all information, or use all information available from civilian service providers. This would then require an update of existing exchange formats (e.g. AIXM) to accommodate features that are not currently included. Such updates need to occur when the information exchange format supports the current exchange with civil ATM.

Within ATM, the information required between the civil and military domains is in a large extent similar. Nevertheless some information are specific to military context. For example, the exchange of aeronautical information using AIXM may need to include military specific features attached to aerodrome facilities, such as the availability of arrestor cables not available at civil aerodromes or other differences.

5.2 SWIM Information Definition Recommendations

Following recommendations can be made to military organisations.

Recommendation [PROV02]

If a military organisation is a SWIM service provider, the military organisation should ensure that the information exchanged over SWIM is in conformance with the requirements defined in EUROCONTROL Specification for SWIM Information Definition [RD 2] in order to ensure the SWIM semantic interoperability.

- In particular, military systems implementing SWIM have to conform with AIRM.
- In particular, military organisations have to contribute to development and maintenance of AIRM to integrate any specific military requirements as required.

A military organisation should be active members of the SWIM Community of Interest in order to take full benefits of guidance materials related to SWIM Information Definition.

A military organisation should be an active member of the AIRM change control board. Currently this is fulfilled by having a EUROCONTROL CIV-MIL expert on the AIRM CCB.

A military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.

Recommendation [CONS02]

If a military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM Information Definition contained in the Functional and Interface Specifications and associated technical data package to be developed and maintained by the SWIM services Providers.

6. SWIM Technical Infrastructure

6.1 General

SWIM Technical Infrastructure is a key enabler to perform the technical interoperability and, as such, the military systems (intended to be used in the context of SWIM) have to be developed/configured/adapted in accordance with following SWIM requirements:

- The functional and non-functional SWIM technical infrastructure capabilities for exchanging information in SWIM, hereinafter referred to as SWIM Infrastructure Capabilities.

- The specification of SWIM technical infrastructure interfaces that enable the exchange of information based on standardised protocols. More specifically, it focuses on the interfaces of services that enable the exchange of information between ATM organisations, providing interconnectivity requirements, hereinafter referred to as SWIM Interface Binding Specifications. Bindings themselves are grouped in two categories:
  - Service Interface bindings that enable services to exchange data with consuming applications based on the capabilities of the SWIM Infrastructure.
  - Network Interface bindings that enable the SWIM-TI to exchange data with the communication network.

SWIM Infrastructure Capabilities as well as Service and Network Interface Binding requirements are defined in the EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile [RD 2].

The EUROCONTROL SWIM TI Yellow Profile Specification (TI Spec) is a standard that provides requirements for general purpose SWIM TI capabilities based on mainstream technologies. It addresses a wide spectrum of information exchange needs in all the various ATM information domains (i.e. Aeronautical, Meteorological, Flight and Flow).

It should be noted that the TI Spec is a general-purpose exchange specification and it is acknowledged[3] that more specialised use cases could be addressed in the future by further standardization activities (e.g. Blue TI profile, specifies TI requirements that are specific to the exchange of flight information between ATCs.)

The SWIM Community of Interest is currently developing EUROCONTROL SWIM Technical Infrastructure Foundation Material that will also help military organisations when considering the SWIM Technical Infrastructure (TI).

The objective of chapter 6 is to provide guidance to military organisations on the requirements applicable in terms of SWIM Technical Infrastructure to attain the required levels of civil-military SWIM interoperability. The SWIM Technical Infrastructure and related requirements are described in following sections:

- Paragraph 6.2 for the SWIM Infrastructure,
- Paragraph 6.3 for the SWIM Service Interface Bindings,
- Paragraph 6.4 for the SWIM Network Interface Bindings,

[3] As stated in the rolling development plan of the European ATM Standards Coordination Group, and the deployment program managed by the SESAR Deployment Manager.

- Paragraph 6.5 for the SWIM-TI civil-military considerations.

An example of elements supporting a SWIM technical architecture is provided in annex B.

The SESAR 2020 PJ17-03 research project, ending Q4 2019, is in the process of developing the so-called 'SWIM-TI green profile' to support civil-military information exchanges based on identified specific military SWIM TI needs. The outcome will consist of a set of supplementary military functional requirements. As soon as SESAR 2020 PJ17-03 is completed, additional work will need to be performed to reach sufficient maturity for deployment. In particular it is necessary to develop the specific civilian military technical requirements to be included in the EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile [RD 2]. Furthermore, the need to carry out an exercise to validate these SWIM civilian military requirements should be identified. When required, this validation exercise should be conducted. Deployment of civilian military technical particularities need completion of both tasks mentioned above.

6.2 SWIM Infrastructure

SWIM Infrastructure has to be developed in accordance with requirements related to:

- Message Based Routing,
- SWIM Services and Resources Monitoring,
- Enhanced Reliability methods,
- Security Mechanisms.

6.3 SWIM Service Interface Bindings

Interface requirements focus mainly on the protocols to be used in transmitting messages. The SWIM Technical Infrastructure Yellow Profile includes different interface binding specifications that require different technologies and capabilities providing different alternatives for implementers.

SWIM service interface bindings enable services to exchange data with consuming applications based on the capabilities of the SWIM Infrastructure. Important aspects of are:

- Message Exchange Patterns,
- Service Interface Protocols.

6.3.1 Message Exchange Patterns (MEP)

A Message Exchange Pattern is required to support information interactions among SWIM service providers and SWIM service consumers. A MEP is a template that describes a generic pattern for the exchange of messages between agents. It describes relationships (e.g., temporal, causal, sequential, etc.) of multiple messages exchanged in conformance with the pattern, as well as the normal and abnormal termination of any message exchange conforming to the pattern.

To better understand the message exchange patterns in a detailed manner and in a broader scope, military organisations should use the EUROCONTROL SWIM Technical Infrastructure Foundation Material as a guideline. The material is currently under development by the SWIM Community of Interest, in which military organisations should take part, and provides the objective and a detailed description of the common MEPs in the scope of the SWIM-TI:

- either as Primitive MEPs directly supported by the SWIM-TI protocols:
  - SWIM-TI Fire-and-Forget (or One Way),
  - SWIM-TI Synchronous Request/Reply,

- or compositions on top of these in the form of Application MEPs:
  - Fire-and-Forget (or One Way),
  - Synchronous Request/Reply,
  - Asynchronous Request/Reply,
  - Fan-Out,
  - Publish/Subscribe Push,
  - Publish/Subscribe Pull,
  - Brokered Publish/Subscribe Push.

The selection of the adequate MEPs depends on operational requirement analysis, which military organisations should conduct and which focuses on some particular key aspects:

- Cardinality: one-to-one, on-to-may, many-to-many systems exchanges,
- Decoupling:
  - In space: the systems involved in the exchanges do not need to know of the network address of the other systems.
  - In time: the systems involved in the exchanges do not need to be simultaneously active to proceed.
  - In process, for which the exchanges may be:
    - Synchronous: The processes of the systems participating in the exchange of messages stay blocked while the exchange occurs.
    - Asynchronous: The processes of the systems participating in the exchange of messages do not stay blocked while the exchange occurs.
- Symmetry, for which the exchanges may be:
  - Asymmetric: the roles of systems involved in the exchanges cannot be inter-exchanged as typically done for the Client-Server architectures.
  - Symmetric: the roles of systems involved in the exchanges are fundamentally not different as typically done for the peer-to-peer architectures.

If the military systems are SWIM service Providers, military organisations have to decide which of the different Application MEPs and the underlying primitive MEPs will have to be developed and implemented. The choice is motivated by operational requirements.

If the military systems are SWIM service Consumers, military organisations have to develop and to implement the adequate SWIM technical infrastructure that is compliant with the different Application MEPs and the underlying primitive MEPs implemented by the SWIM service Providers.

6.4 SWIM Network Interface Bindings

SWIM can use the following four different Network Interface Bindings:

- IPv4 Unicast,
- IPv4 Secure Unicast,
- IPv6 Unicast,

- IPv6 Secure Unicast.

6.5 SWIM-TI civil-military considerations

6.5.1 General

SWIM-TI can also be seen as a set of software components distributed over a network infrastructure (middleware) providing capabilities properly enabling collaboration among ATM systems. These capabilities are instantiated in a set of SWIM nodes (stakeholder end points) and common components (providing capabilities to all the distributed SWIM nodes).

The SWIM node concept represents a package of SWIM-TI capabilities, allowing a given system to use the SWIM-TI. Examples of common components are the registry, which is used to enable the sharing of information (metadata) about services, or the public key infrastructure (PKI), aimed at managing the trusted digital certificates.

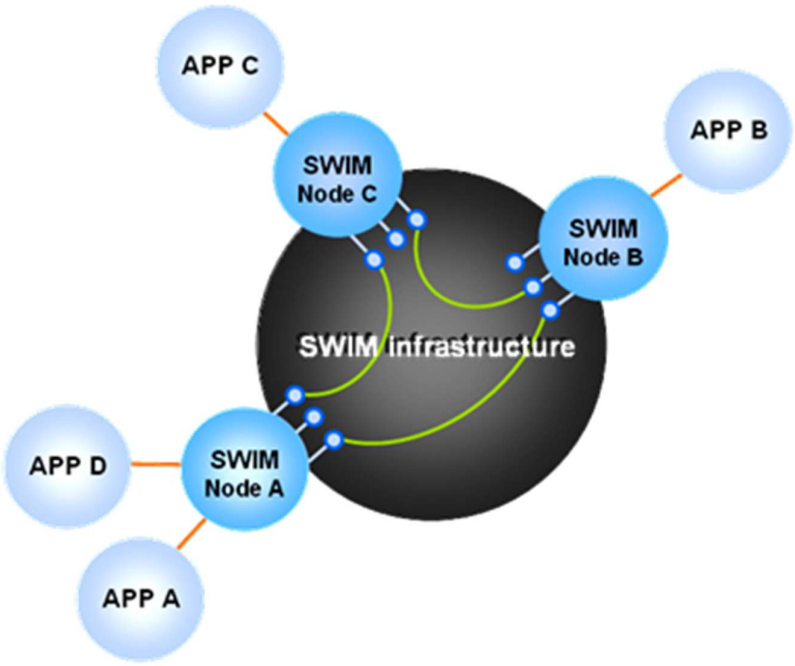

Figure 2: Notion of SWIM-TI Node

As stated before, a SWIM Profile is a particular set of middleware functions/services tailored at meeting specific functional and non-functional requirements expressed by in an Information service description.

The SWIM Profiles identified in SESAR R&D included: Yellow Profile (initially developed for all exchanges with less demanding QoS requirements), Blue Profile (exclusively developed for real time or near real time exchanges between ATC centre's Flight Data Processing Systems), Purple Profile for Air-Ground SWIM and the Green Profile for specific civil-military requirements

(if any). At the moment, only the Yellow Profile was further matured to support deployment with related standardisation work completed early 2018. The Purple, Blue and Green Profiles are still under research (SESAR 2020).

Under the SWIM-TI middleware layer, an IP network infrastructure needs to be available: IPv6 or IPv4 SWIM backbone, enabled by communication providers (e.g. PENS/NewPENS).

6.5.2 SWIM-TI impact on military users

Military users should connect to SWIM on the basis of the standardised interfaces (profiles) in place, which is today the yellow profile.

The Yellow Profile shall run over IPv4 or preferably over IPv6 and can be made sufficiently secure including the use of Virtual Private Network (VPN) tunnelling. Military have expressed particular military requirements that have been considered in the research work on Green Profile. The Green Profile is expected to result in due time in supplementary requirements to be added to the YP specification. If those requirements become consolidated/mature in time they must be consider for any military-SWIM implementation initiatives.

6.6 SWIM Technical Infrastructure Recommendations

Recommendation [PROV03]

If a military organisation is a SWIM service provider, the military organisation should ensure that they implement their SWIM Technical Infrastructure in conformance with the requirements defined in the EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile [RD 2].

In particular, the military organisation should ensure that their systems are developed/adapted/configured in accordance with the adequate features:

- Message Based Routing,
- SWIM Services and Resources Monitoring,
- Enhanced Reliability methods,
- Security Mechanisms,
- Message Exchange Patterns,
- Service Interface Protocols,
- Network Interface Bindings.

The military organisation should be an active member of the SWIM Community of Interest related to SWIM Technical Infrastructure in order to take full benefits of guidance materials under development, in particular the EUROCONTROL SWIM Technical Infrastructure Foundation Material.

The military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.

Recommendation [CONS03]

If the military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM Technical

Infrastructure (TI) Yellow Profile features contained in the Functional and Interface Specifications and associated technical data package to be developed and maintained by the SWIM services Providers.

7. SWIM-TI IP Network

As mentioned at paragraph 6.4 “SWIM Network Interface Bindings”, SWIM-TI assumes an IP Network as a base upon which SWIM Technical Infrastructure is deployed.

Military organisations have to perform studies to define the adequate target network architecture to support SWIM deployment. The target network architecture may include multiple network domains under the responsibility of multiple stakeholders. Therefore, an end-to-end architecture has to take into account the many ownership and/or security domains in effect and highlight the requirements and responsibilities allocated to stakeholders. Such domains can be identified as follow:

- Civilian Intra-Domain: applies to the network infrastructure within the ANSP’s Local Area Network (or Airspace User). This may also include firewalls and specific security requirements. The military systems may have to use this type of Intra-Domain to deploy SWIM.

- Military Intra-Domain: applies to the network infrastructure within the military Local Area Network (or Airspace User). This may also include firewalls and specific security requirements like adequate Information Exchange Gateway (IEG). The military systems may have to use this type of Intra-Domain to deploy SWIM

- Inter-Domain: refers to the interconnection network such as NewPENS. This is typically a Wide Area Network under the responsibility of one or more network providers. The military can opt-in for networking services from the service catalogue incl. security solutions.

In the studies to elaborate the adequate target network architecture, military organisations have to consider the Systems of Systems (SoS) nature of SWIM, which requires optimum usage of network resources by addressing some rules or methods such as:

- Limit bandwidth usage and adapt communication to available bandwidth.
- No IP fragmentation and adapt to path MTU when UDP/IP is used.
- Reuse network capabilities such as PIM-SM when multicast is requested for optimum use of the underlying network.
- Favour filtering at source level to avoid unnecessary usage of network resources.

The underlying IP network infrastructure required to support SWIM middleware connectivity is discussed in a separated document that is under preparation.

Recommendation [COM01]

Military organisations have to perform studies to define the adequate target network architecture to support SWIM deployment, including the involved Civilian Intra-Domains, Military Intra-Domains and Inter-Domains.

8. Other Aspects

8.1 SWIM Standardisation and Regulation

Three EUROCONTROL Specifications for SWIM [RD 3 to 5] were elaborated and released in Q1 2018.

Pilot Common Project Regulation (PCP) [RD 1] requires the use of the SWIM Yellow Profile for specifically identified information exchanges including those related to aeronautical information, meteorological information, cooperative network information and flight information.

European ATM Standards Coordination Group (EASCG) has ensured that the three EUROCONTROL Specifications for SWIM have been fully and formally coordinated among all the ATM stakeholders. The EASCG is a joint coordination and advisory group established to coordinate the ATM-related standardisation activities, essentially stemming from the European ATM Master Plan, in support of Single European Sky implementation. The main deliverable of the EASCG will be the European ATM Standardisation Rolling Development Plan

EUROCONTROL Regulatory and Advisory Framework (ERAF) has enabled the development and publication of the three EUROCONTROL Specifications for SWIM, as part of the regulatory functions of the Organisation under the EUROCONTROL Convention. The ERAF purpose is to facilitate the development and implementation of EUROCONTROL regulatory and advisory material which, with due regard to relevant ICAO provisions and European Community (EC) legislation, may be easily transposed into the legal order of the EUROCONTROL Member States and, where appropriate, of the European Community.

Satisfying the requirements of the three EUROCONTROL Specifications for SWIM shall be considered as means of compliance for the implementation of the iSWIM ATM functionality as defined by the PCP [RD 1].

8.2 SWIM Evolution

The three EUROCONTROL Specifications for SWIM [RD 3 to 5] and their subsequent evolutions will be maintained in the framework of the EUROCONTROL Specification Change Management process, which includes the EUROCONTROL Standards Update Process.

According to this process, Stakeholders may provide change proposals through one of the following channels:

- existing working arrangements (e.g. established working groups, CoI),
- by using the Change Request (CR) form (https://www.eurocontrol.int/eurocontrol-standards-change-request-form)
- by sending a formal Change Request to the generic email address: standardisation@eurocontrol.int

8.3 SWIM Governance

As soon as military organisations decide to use SWIM for identified information exchanges, it is important to consider active participation in SWIM governance. This comprises the bodies and processes that coordinate the operation of SWIM and its controlled evolution. SWIM governance is relevant for military organisations, both procurement agencies and armed forces, as it is one of the organisational structures to coordinate with the relevant stakeholders the evolution of SWIM in order to support civil-military data exchange interoperability.

Recommendation [GEN05]

> Military organisations should consider to participate in SWIM governance, ideally in a collaborative manner to ensure a harmonised approach through European Defence Agency as facilitator.

8.4 Benefits of Military Participation in SWIM

The benefits for military organisations and for EATMN as a whole, resulting from military adherence to SWIM, have been described in the EUROCONTROL CMAC CNS Technical Leaflet [RD 1]. The benefits derive from the ability to seamlessly exchange information between civil and military systems, enabling CDM and enhanced coordination as a whole and contribute directly to higher levels of ATM performance and efficiency.

In particular, the exchange of data between civil and military systems in a net centric context can enable trajectory concepts, use of advanced Flight data Processing System (FDPS) functionalities, enhanced airspace planning and management process, use of high quality static and dynamic ATM data, improved air picture for ATC and Air Defence purposes, lower coordination overhead, tracker and sensor rationalisation and response to security concerns.

The benefits offered by SWIM to the military can be summarised as follows:

- Seamless civil-military information exchange, Net centricity, CDM, improved Security,
- Trajectory Management and other SESAR concepts,
- Use of advanced FDPS,
- Enhanced ASM planning and management,
- Use of high-quality/harmonised ATM data.

ANNEX A: Civil Military Information Exchanges for Domains candidate for SWIM deployment

A.1 Information Exchange Table – Aeronautical Information

Information Element European AIS Database (EAD)	Content	Sending Operational Centre	Receiving Operational Centre
EAD SDO - Static Data Operations – data providers	Input and validation of : - ECAC full static data - Worldwide minimum static data	Civ mil AIS Office, ANSP	EAD SDO
EAD SDO - Static Data Operations –data users	- Download of static data in AIXM format - Query the SDO database - Graphical report	EAD SDO	Military ANSP, Airspace user
EAD INO - International NOTAM Operations – data providers	Worldwide creation of NOTAM, SNOWTAM and ASHTAM	Civ mil, AIS Office, ANSP, ARO	EAD INO
EAD INO - International NOTAM Operations –data users	Worldwide retrieval of : - NOTAM, SNOWTAM and ASHTAM, - pre-flight information bulletin	EAD INO	Military ANSP and Airspace user
EAD INO BF - Briefing Facility **-** data providers	Worldwide creation of flight plans	Civ mil, AIS Office, ANSP, ARO	EAD INO
EAD INO BF - Briefing Facility **-** data users	Retrieval of flight plans	EAD INO	Military ANSP and Airspace user
EAD PAMS - Published AIP Management System	For ECAC Area, creation and upload of : - text format AIPs, - AIP Amendments (AMDT), - AIP Supplements (SUP) - Aeronautical Information Circulars (AIC)	Civ mil, AIS Office, ATC, ARO	EAD PAMS
EAD PAMS - Published AIP Management System	For ECAC Area, consultation of : - text format AIPs, - electronic AIPs, - AIP Amendments (AMDT), - AIP Supplements (SUP), - Aeronautical Information Circulars (AIC), - AIP Charts	EAD PAMS	Military ANSP and Airspace user

A.2 Information Exchange Table – Airspace Management

Information Element	Content	Sending Operational Centre	Receiving Operational Centre
Airspace Structure data	Common Airspace data reference	- National AIS - NM ENV	All users of ASM
Long Term planning/ Event data	De-confliction major events and large scale exercises	- National high-level policy body - National authorized entities	- NM - FAB partners
AUP/UUP data	Consolidated National civil/military plan	AMC	- NM - FAB partners
ARES data	Continuous updated planning info	CIV and MIL Airspace Users	- AMC - FMP - FAB partners
Pretactical CDM data	Continuous opportunity to negotiate	- ACC/FMP - AMC - MIL Approved Agency	FAB partners
Airspace Status data	Common situational awareness	MIL SUP/AA	FAB partners
Tactical CDM data	Continuous opportunity to negotiate	- ACC/SUP - FMP - MIL Approved Agency - MIL SUP	- ACC/SUP - FMP - MIL Approved Agency - MIL SUP
Import ATFCM demand data	Expressing the Civil requirements	FMP	Local ASM managers

A.3 Information Exchange Table – Flight Planning

Information Element	Content	Sending Operational Centre	Receiving Operational Centre
Initial GAT Flight Plan FPL, CHG (Change), DLA (Delay), CNL (Cancel)	Submission of GAT Flight Plans and associated messages	Civil or Military ANSP	NMOC
Initial GAT Flight Plan FPL, CHG (Change) DLA (Delay) CNL (Cancel)	Dissemination of GAT Flight Plans and associated messages	NMOC	Civil or Military ANSP / Command and Control (C2)
Initial OAT Flight Plan FPL, CHG (Change), DLA (Delay), CNL (Cancel)	Submission of OAT Flight Plans and associated messages	WOC	NMOC
Initial OAT Flight Plan FPL, CHG (Change), DLA (Delay), CNL (Cancel)	Dissemination of OAT Flight Plans and associated messages	NMOC	Civil or Military ANSP / Command and Control (C2) / WOC
Extended GAT FPL EFPL (Flight Plan) ECHG (Change) EDLA (Delay) ECNL (Cancel)	Submission of extended GAT Flight Plans and associated messages “Extended” implies future provision of additional 4D data	Civil or Military ANSP	NMOC
Extended GAT FPL EFPL (Flight Plan) ECHG (Change) EDLA (Delay) ECNL (Cancel)	Dissemination of extended GAT Flight Plans and associated messages	NMOC	Civil or Military ANSP / Command and Control (C2)

ANNEX B: NM B2B, an example of SOAP R/R over HTTP and AMQP 1.0

1. Foreword

The information presented in this annex is a short extract of the technical data package for NM 22.0.0 NOP/B2B Reference Manuals, which was released in April 2018. Any additional information required on NM 22.0.0 can be asked to EUROCONTROL / Network Manager.

2. High Level Overview

NM 22.0.0 implements the Publish /Subscribe MEP to allow a client to subscribe to a topic and receive asynchronous messages published on that topic.

The Publish /Subscribe MEP is based on two distinct mechanisms:

- A Subscription Management via SOAP Request / Reply over HTTP;
- The Message Consumption itself via a Message Broker (aka B2B Broker) over AMQP 1.0 as a recommended protocol. SOAP may be used as a temporary developmental solution.

When a new subscription is requested on a subscription topic by a client, a corresponding queue is allocated on the B2B Broker that will collect messages related to the selected subscription topic. This is shown in the following picture:

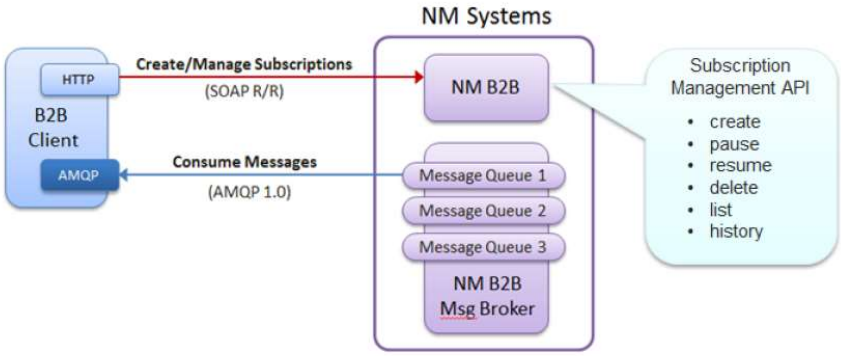

Figure 3: NM Publish/Subscribe Overview

3. Subscription Management

A subscription is always associated to exactly one queue. On the other hand, a queue can be associated to more than one subscription. When requesting a new subscription, it is the client's choice to indicate whether an existing queue should be reused or a new queue should be allocated. When the client requests to reuse an existing queue NM will check that all subscriptions previously associated to the same queue belong to the same NM release and are related to the same NM subscription topic. It is not possible to combine subscriptions on different topics into the same queue.

NM B2B offers different subscription topics and NM's policy on subscription topics and messages is that each subscription topic has a one-to-one correspondence to a message type.

NM B2B Subscription topics and associated message types available today are:

1. AIXM_DATASETS: Notification about the publication of new AIXM datasets (NM airspace data) with AIXMDatasetMessage.

2. ATM_INFORMATION: Notification about newly published AIMs (ATM Information Messages) with AIMMessage.
3. EAUP: Notification about the publication of EAUPs and EUUPs with EAUPMessage.
4. FLIGHT_DATA: Notification about flight progress with FlightDataMessage
5. FLIGHT_PLANS: Notification about new flight plans and changes to existing flight plans with FlightPlanMessage.
6. REGULATIONS: Notification about new ATFCM regulations and changes to existing regulations with RegulationMessage.

4. Message Consumption: Technical Messages or Business Messages

When a NM B2B client subscribes to a given subscription topic the client will receive Business messages that are pertinent with the subscribed topic. Business Messages are sub-classed into more specific types to match the subscription topics, so that a 1-to-1 correspondence exists between a message type and the subscription topic, which can be related to AIXM datasets, ATM Information, European AUP, Flight Data, Flight Plan, ATFCM Regulations.

In addition to those messages, NM B2B may also publish on the same queue the Technical Messages, which are not related to the subscription topic but are of technical nature. Examples of technical messages may be to notify about a degradation of the service or the suspension of a subscription.

A P/S client must be capable of dealing with both types of messages.

The recommended way to consume a P/S Message is to connect directly to the client queue on the B2B Broker. The wire protocol chosen by NM for the consumption of P/S Messages from the B2B Broker is AMQP version 1.0. AMQP is an ISO and IEC standard since May 2014.

Apart from accessing the queues via AMQP 1.0, NM also offers the possibility to consume the P/S Messages via web services R/R, therefore without connecting directly to the B2B Broker. However this is not the recommended way, which is provided to assist the development in an early phase.

The following picture illustrates three possible ways to consume the P/S Messages.

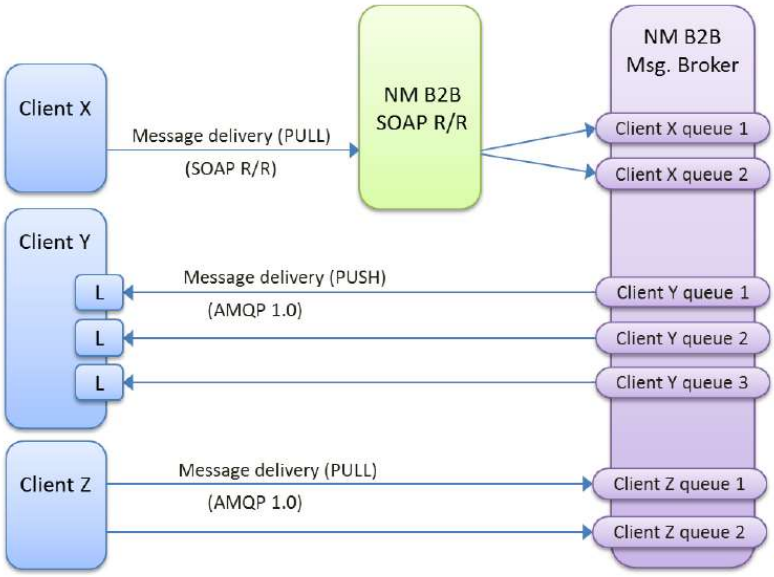

Figure 4: NM P/S Message Consumption Overview

The picture shows the following:

- Client X uses regular SOAP R/R to query and retrieve its messages (PULL fashion). The NM B2B node will effectively pull the messages off the client queues on the B2B Broker on behalf of the client. This may be sometimes useful during the development phase but it is not recommended in a production environment.
- Client Y connects directly to the B2B Broker via AMQP 1.0 and consumes the messages in a PUSH fashion. To do this, it creates a connection to the queue, initiates a session and creates a listener (indicated with L in the picture). By leaving the session open, messages will be continuously pushed by the NM B2B Broker (and handled by the listener) as soon as they land in the queue. This is the recommended way of consuming messages.
- Client Z also connects directly to the B2B Broker via AMQP 1.0 but chooses to PULL the messages at its own pace. To do this it creates a connection, initiates a session, browses the queue and if messages are present, pulls the messages one by one.

ANNEX C: Recommendations for Military Organisations to ensure SWIM Interoperability

LIST OF RECOMMENDATIONS	
GENERAL	
[GEN01]	Military organisations should develop and implement relevant required information exchanges in accordance with SESAR Deployment Programme in order to fulfil the PCP regulation for ATM Functionality #5 “initial SWIM”.
[GEN02]	Military organisations should develop and implement SWIM with respect to SOA principles.
[GEN03]	Military organisations should carry out a detailed Operational Requirement Analysis from which they have to decide if their operational systems are SWIM service consumers and/or SWIM service providers.
[GEN04]	Military organisations should consider the SWIM registry as the means to improve the visibility and accessibility on SWIM.
[GEN05]	Military organisations should consider to participate in SWIM governance, ideally in a collaborative manner to ensure a harmonised approach through European Defence Agency as facilitator.
MILITARY SYSTEMS as SWIM SERVICE PROVIDERS	
[PROV01]	If a military organisation is a SWIM service provider, the military organisation should ensure that they provide a service description in conformance with the requirements defined in the EUROCONTROL Specification for SWIM Service Description [RD 2]. In particular, the military organisation should define for each service to be provided the information exchange requirements (IERs) as well as the quality of service offered (availability of the service, response time, throughput, etc.). The military organisation should be active members of the SWIM Community of Interest in order to take full benefits of guidance materials related to SWIM service description. The military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.
[PROV02]	If a military organisation is a SWIM service provider, the military organisation should ensure that the information exchanged over SWIM is in conformance with the requirements defined in EUROCONTROL Specification for SWIM Information Definition [RD

	2] in order to ensure the SWIM semantic interoperability. In particular, military systems implementing SWIM have to conform with AIRM (ATM Information Reference Model). In particular, military organisations should contribute to development and maintenance of AIRM to integrate any specific military requirements as required. A military organisation should be active members of the SWIM Community of Interest in order to take full benefits of guidance materials related to SWIM Information Definition. A military organisation should be an active member of the AIRM change control board. A military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.
[PROV03]	If a military organisation is a SWIM service provider, the military organisation should ensure that they implement their SWIM Technical Infrastructure in conformance with the requirements defined in the EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile [RD 2]. In particular, the military organisation should ensure that their systems are developed/adapted/configured in accordance with the adequate features: - Message Based Routing, - SWIM Services and Resources Monitoring, - Enhanced Reliability methods, - Security Mechanisms, - Message Exchange Patterns, - Service Interface Protocols, - Network Interface Bindings. The military organisation should be an active member of the SWIM Community of Interest related to SWIM Technical Infrastructure in order to take full benefits of guidance materials under development, in particular the EUROCONTROL SWIM Technical Infrastructure Foundation Material. The military organisation should develop and maintain the Functional and Interface Specifications and associated technical data package accordingly.
MILITARY SYSTEMS as SWIM SERVICE CONSUMERS	
[CONS01]	If a military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM service requirements contained in the Functional and Interface Specifications and associated technical data package to be developed and

	maintained by the SWIM services Providers.
[CONS02]	If a military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM Information Definition contained in the Functional and Interface Specifications and associated technical data package to be developed and maintained by the SWIM services Providers.
[CONS03]	If the military organisation is a SWIM service consumer, the military organisation should ensure that they satisfy the SWIM Technical Infrastructure (TI) Yellow Profile features contained in the Functional and Interface Specifications and associated technical data package to be developed and maintained by the SWIM services Providers.
IP-Network for SWIM	
[COM01]	Military organisations should perform studies to define the adequate target network architecture to support SWIM deployment, including the involved Civilian Intra-Domains, Military Intra-Domains and Inter-Domains.

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