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| AbstractThis document describes the SWIM Foundation, its surrounding landscape and further relates it to SWIM evolution management. It does so by defining the SWIM Foundation components, i.e. the SWIM Controlled Vocabulary and the SWIM Essential Requirements and by introducing the standardisation context for SWIM. |

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Table of Contents

[Executive summary 8](#_Toc451876549)

[1 Introduction 9](#_Toc451876550)

[1.1 Purpose of the document 9](#_Toc451876551)

[1.2 Intended readership 9](#_Toc451876552)

[1.3 Acronyms and Terminology 9](#_Toc451876553)

[2 SWIM Foundation 12](#_Toc451876554)

[2.1 Definition 12](#_Toc451876555)

[2.2 Introduction to the SWIM Foundation 13](#_Toc451876556)

[2.3 SWIM Controlled Vocabulary 13](#_Toc451876557)

[2.4 SWIM Essential Requirements 13](#_Toc451876558)

[2.5 SWIM Foundation “landscape” 13](#_Toc451876559)

[3 Standards 16](#_Toc451876560)

[3.1 Using standards 16](#_Toc451876561)

[3.1.1 Examples 17](#_Toc451876562)

[3.2 Publishing and managing standards 18](#_Toc451876563)

[4 Guidance 19](#_Toc451876564)

[4.1 Examples 19](#_Toc451876565)

[5 SWIM Foundation ownership and use 20](#_Toc451876566)

[5.1 SWIM Authority view 20](#_Toc451876567)

[5.2 SWIM Implementer view 20](#_Toc451876568)

[5.3 SWIM Evolution 20](#_Toc451876569)

[6 References 22](#_Toc451876570)

[Appendix A Appendix A 23](#_Toc451876571)

[A.1 Classification of SWIM elements 23](#_Toc451876572)

[A.1.1 SWIM Governing Standards: 23](#_Toc451876573)

[A.1.2 Classification of SWIM Standards and Guidance: 23](#_Toc451876574)

[A.2 SWIM Foundation 25](#_Toc451876575)

[Appendix B SWIM Controlled Vocabulary 26](#_Toc451876576)

[B.1 Introduction 26](#_Toc451876577)

[Appendix C SWIM Essential Requirements 32](#_Toc451876578)

[C.1 Introduction 32](#_Toc451876579)

[C.2 Essential Requirements for SWIM Governance 34](#_Toc451876580)

[C.2.1 SWIM Authority: 34](#_Toc451876581)

[C.2.2 SWIM policies: 34](#_Toc451876582)

[C.2.3 SWIM design-time registry: 34](#_Toc451876583)

[C.2.4 SWIM Controlled Vocabulary: 34](#_Toc451876584)

[C.2.5 SWIM Foundation principles: 34](#_Toc451876585)

[C.2.6 SWIM governing standards: 35](#_Toc451876586)

[C.2.7 Compliance frameworks: 35](#_Toc451876587)

[C.3 Essential Requirements for SWIM Information Services 36](#_Toc451876588)

[C.3.1 Organisational interoperability: 36](#_Toc451876589)

[C.3.2 Platform Neutral Service Design (logical service): 36](#_Toc451876590)

[C.3.3 Platform Specific Service Design: 37](#_Toc451876591)

[C.3.4 Service Implementation: 37](#_Toc451876592)

[C.4 Essential Requirements for SWIM Information 38](#_Toc451876593)

[C.4.1 Semantic interoperability: 38](#_Toc451876594)

[C.4.2 Scope of the AIRM: 38](#_Toc451876595)

[C.4.3 Content of the AIRM: 38](#_Toc451876596)

[C.4.4 Information on definitions in the AIRM: 38](#_Toc451876597)

[C.4.5 AIRM Foundation material: 38](#_Toc451876598)

[C.4.6 Reuse of international standards in AIRM: 38](#_Toc451876599)

[C.4.7 Technology agnostic AIRM: 38](#_Toc451876600)

[C.4.8 Essential characteristics of the AIRM: 39](#_Toc451876601)

[C.4.9 Notation used for the AIRM: 39](#_Toc451876602)

[C.4.10 AIRM Compliance Framework: 39](#_Toc451876603)

[C.4.11 Governance of the AIRM: 39](#_Toc451876604)

[C.4.12 AIRM as an open, free standard: 39](#_Toc451876605)

[C.4.13 Standardised information exchange model alignment: 40](#_Toc451876606)

[C.4.14 Service implementation compliance: 40](#_Toc451876607)

[C.4.15 Technical interoperability within a community of interest: 40](#_Toc451876608)

[C.4.16 Information consistency: 40](#_Toc451876609)

[C.4.17 Metadata: 40](#_Toc451876610)

[C.5 Essential Requirements for SWIM Technical Infrastructure 41](#_Toc451876611)

[C.5.1 Technical interoperability: 41](#_Toc451876612)

[C.5.2 Technical infrastructure: 41](#_Toc451876613)

[C.5.3 IP connectivity: 41](#_Toc451876614)

[C.5.4 Machine-to-machine data exchange 41](#_Toc451876615)

[C.5.5 Open standards: 41](#_Toc451876616)

[C.5.6 Mainstream IT technologies: 41](#_Toc451876617)

[C.5.7 Off-the-shelf (OTS) products: 41](#_Toc451876618)

[C.5.8 Limited number of SWIM TI profiles: 41](#_Toc451876619)

[C.5.9 SWIM TI profile description: 42](#_Toc451876620)

List of tables

**No table of figures entries found.**

List of figures

[Figure 1 – SWIM Foundation components 12](#_Toc455415121)

[Figure 2 – SWIM Foundation “landscape” 14](#_Toc455415122)

[Figure 3 – “Governance chain” 15](#_Toc455415123)

[Figure 4 – “Perspective of the service implementer (SESAR1)” 15](#_Toc455415124)

[Figure 5 – Collection of Standards and Standards 16](#_Toc455415125)

[Figure 6 – Example of potential standards 17](#_Toc455415126)

Executive summary

This document describes the SWIM Foundation, its surrounding landscape and further relates it to SWIM evolution management. It does so by defining the SWIM Foundation components, i.e. the SWIM Controlled Vocabulary and the SWIM Essential Requirements, and by introducing the standardisation context for SWIM.

The document provides some initial insight to the relations between the SWIM Foundation and the SWIM standards and guidance. This will facilitate the necessary interoperability agreements. Furthermore, this will ensure the appropriate handover of the SESAR SWIM related outputs into the deployment context.

# Introduction

## Purpose of the document

This document describes and defines the SWIM Foundation and sets its components into a consistent context. Additionally, it outlines the SWIM Foundation surrounding landscape and further relates it to SWIM evolution management.

## Intended readership

The target audience for the document are:

* SJU;
* Stakeholders within the SWIM community;
* Members of the SEMG;
* SESAR Deployment Programme;
* EC/EASA;
* ANSPs.

## Acronyms and Terminology

| Term | Definition |
| --- | --- |
| AIRM | ATM Information Reference Model |
| AIXM | Aeronautical Information Exchange Model |
| COI | Community of Interest |
| CONOPS | Concept of operations |
| EATMN | European ATM Network |
| EC  | European Commission |
| FIXM | Flight Information Exchange Model |
| ICAO | International Civil Aviation Organization |
| ICAO GANP | ICAO Global Air Navigation Plan |
| IDL | Interface Definition Language |
| IM | Information Management |
| ISO | International Standards Organization |
| ISRM | Information Services Reference Model |
| PCP | Pilot Common Projects |
| SDD | Service Description Document |
| SEG | SWIM Expert Group |
| SEMG | SWIM Evolution Management Group[[1]](#footnote-1) |
| SESAR | Single European Sky Air Traffic Management Research |
| SJU | SESAR Joint Undertaking |
| SPA | SWIM Profile Assertion |
| SPD | SWIM Profile Descriptor |
| SSG | SWIM Steering Group |
| STDD | Service Technical Design Description |
| SWIM TI | SWIM Technical Infrastructure |
| WFS | Web Feature Service |
| WXXM | Weather Information Exchange Model |
| XSD | XML Schema Definition |
| WSDL | Web Services Description Language |

To foster interoperability within the future European ATM Network (EATMN) as envisaged by SWIM, the SESAR programme developed a series of documents covering aspects such as concepts, service descriptions, templates, governance and a series of technical resources such as models.

A few examples of these technical resources are:

* ATM Information Reference Model (note: provided as a Sparx EA file);
* Information Services Reference Model (note: provided as a Sparx EA file).

A few examples of these documents are:

* The SWIM CONOPS;
* The SWIM IM Functions;
* The SWIM Compliance Framework Criteria;
* The AIRM Foundation Rulebook;
* The ISRM Foundation Rulebook;
* The Service Description Documents;
* The SWIM TI Profiles.

SWIM Information Services play a prominent role in agreeing and achieving interoperability. Services are being collected and defined in a common portfolio, the Information Services Reference Model (ISRM). Using the ISRM, the ATM stakeholders can agree on and manage the lifecycle of each service, i.e. which services shall be developed, implemented, used and decommissioned.

A service is a self-contained unit that performs a specific task. The interface of a service defines how the service provider reacts to service requests. The contract of a service defines how the service provider and consumer interact. An important design principle for the implementation of services is “loose coupling”. This allows service implementations to be replaced independently since their interactions are decoupled from internal service execution aspects. This is the “open nature” of the service interfaces, which also promotes re-use.

SWIM Information Services enable interaction and collaboration in all phases of ATM operations, from flight planning to execution and follow up. Furthermore, they contribute to sharing operational situation awareness between the actors, thus enabling better decisions. They also will reduce system maintenance costs through their re-use. Finally they will increase competition through vendor independence.

Following the consensus building approach of the SESAR Programme, these documents and technical resources provide the necessary interoperability agreements as formally agreed upon by the SWIM community during the SESAR R&D. Therefore, these SESAR Programme outputs determine SWIM and its deployment by defining the acceptable interoperability solutions in the context of the European ATM Network modernisation.

Indeed, the SESAR Programme outputs referred to above are inputs to the deployment phase such as iSWIM PCP. Furthermore, within the context of SWIM deployment, interoperability can only be achieved, maintained and evolved by agreeing and managing SWIM in a collaborative way. This cannot be achieved in isolation and needs to take account the reality of standardisation.

In order to support the underlying agreement building process and to support SWIM implementation in the context of SWIM deployment, a classification which separates the standardisation concerns at hand is introduced by the SWIM Foundation. An essential aspect therein is the differentiation between essential requirements, standards and guidance as explained in the sections hereafter.

# SWIM Foundation

## Definition

The SWIM[[2]](#footnote-2) Controlled Vocabulary, Appendix B, defines the SWIM Foundation as *“a coherent set of principles, essential requirements and recommendations for establishing SWIM standards related to information, information service, technical infrastructure and governance.”*

The SWIM Foundation (Figure 1) is constituted of the SWIM Controlled Vocabulary and the SWIM Essential Requirements.



Figure 1 – SWIM Foundation components

In addition to providing the SWIM Controlled Vocabulary and the SWIM Essential Requirements, this document also provides the definition of the SWIM Foundation and an introduction to it.

The anticipated prime applicability is in the context of PCP iSWIM deployment, but this does not prevent the use of the SWIM Foundation in other SWIM deployment contexts.

The European Commission’s Implementing Rule on the establishment of the (EU/EC’s) Pilot Common Project [IR 716-2014] states: “*Service implementations shall be compliant with the applicable version of ATM Information Reference Model (AIRM), the AIRM Foundation Material and the Information Service Reference Model (ISRM) Foundation Material*”. The SWIM Foundation is aligned with the Pilot Common Project IR 716-2014 in support of PCP iSWIM deployment.

Each component of the SWIM Foundation is described hereafter.

## Introduction to the SWIM Foundation

The introduction to the SWIM Foundation sets its components into context. It also outlines the SWIM Foundation surrounding landscape and further relates it to SWIM evolution management, also indicating some usage aspects.

## SWIM Controlled Vocabulary

The SWIM Controlled Vocabulary defines the key terms used in the context of the SWIM Foundation and the essential requirements included therein. Furthermore the purpose of the SWIM Controlled Vocabulary is to provide the SWIM community with a common base for understanding of the most important SWIM terms employed in the European ATM Network (EATMN).

The SWIM Controlled Vocabulary is provided in Appendix B of this document.

## SWIM Essential Requirements

The term “essential requirement” is used in European law. In the context of this document it means the minimum set of requirements which are necessary for defining SWIM. More specifically the context in which the “essential requirements” apply is assumed to be PCP iSWIM. However, this does not prevent the use of the SWIM Foundation in other deployment contexts. The essential requirements are applicable to the standards used in the context of SWIM deployment. This allows, for example:

1. Governing standards to be established and declared as applicable (e.g. ISRM Foundation Rulebook, AIRM) which are specific to SWIM and define SWIM-enabled systems;
2. Existing standards to be selected (e.g. AIXM, FIXM, iWXXM) as “means of compliance” in alignment with the governing standards and in support of SWIM implementations within a community of interest.

The SWIM Essential Requirements cover the following matters:

* SWIM Governance;
* SWIM Information Services;
* SWIM Information;
* SWIM Technical Infrastructure.

The actual content of the SWIM Essential Requirements is provided in Appendix C.

## SWIM Foundation “landscape”

Through the SWIM Essential Requirements, the SWIM Foundation has the purpose to steer the standardisation of SWIM within a deployment context. As already alluded to, the SWIM Foundation sits within a wider landscape including standards and guidance (Figure 2):



Figure 2 – SWIM Foundation “landscape”

SWIM consists of standards that are expected to meet the requirements put forward by the SWIM users. These standards also capture the interoperability agreements made within the SWIM community. However, standards also come with supporting material qualified as guidance. Therefore, it appears that the governance and management of SWIM is performed through agreed content for each of the areas of interest at hand: the SWIM Foundation, the Standards and the Guidance. SWIM Standards and Guidance are further discussed with examples in chapters 4 and 5 of this document.

This current version of the SWIM Foundation does not further explore governance matters, yet to understand the nature of the SWIM Foundation some essential concepts in relation to standardisation are shortly explained.

Basically two approaches are distinguished:

* Performance-based approach;
* Prescriptive approach (sometimes referred to as design-based).

When performance-based, an essential requirement incorporates its goal into the language of the essential requirement, specifying the desired level of performance and allowing the implementers to decide how to achieve the objectives stated. Therefore the performance goals are defined in the essential requirement rather than specifying behaviour. In contrast, a prescriptive requirement uses or references design standards or technology-based standards that specify exactly how to implement. An easy way to think of the difference is to think of the performance-based approach as to specifying “what” is required whereas the prescriptive approach includes “how” elements, thus rather being part of the solution space. Yet in reality, a combination of prescriptive and performance based approaches may play and vary over time depending on the need triggered by the actual interoperability levels reached.

The previous section discussed the SWIM Foundation. From a governance point of view this means that the SWIM Foundation is “performance based”, meaning that it defines the “what” of interoperability and avoids the “how”. This facilitates the further agreement building required to deploy SWIM.

Figure 3 hereafter illustrates and summarizes the “governance chain”:



Figure 3 – “Governance chain”

Taking for instance, the perspective of the service implementer, the above generic picture is instantiated within SESAR1 R&D as shown in the

Figure 4 below:



Figure 4 – “Perspective of the service implementer (SESAR1)”

**Note**: The SEMG (SWIM Evolution Management Group) in Figure 4 above was the actual SESAR1 SWIM governance body fulfilling the “SWIM Authority” role.

The following chapters further describe the standards and guidance. Appendix A in this document provides the current classification of SWIM elements in terms of SWIM governing standards, SWIM standards and guidance.

# Standards

## Using standards

The SWIM CONOPS states that, amongst its other elements, SWIM consists of standards. In the context of SWIM, standards are understood in the broad sense as any specification, adopted by a recognised standardisation body or community of interest for repeated or continuous application.

One of the main principles of SWIM is “openness”. This can be applied to standards. Therefore it is desirable that the standards used within SWIM qualify as “open standards” (see Appendix B for the definition).

Furthermore, standards can be categorised according to the role they play within SWIM. Some standards can be seen as governing standards in that they enable the SWIM Authority to steer SWIM and its evolution.

In addition, a community of interest will typically agree on the particular standards to be used by its stakeholders. For example, the aeronautical information domain may decide to use AIXM 5.1 to share information. A community of interest standard is expected to be compliant with the governing standards in order to promote interoperability.

Governing and community of interest standards are often based on public standards such as those published by ISO and IEEE and other standardisation bodies which are not specific to ATM.

SWIM requires defined processes and criteria for adopting a standard. Although the further elaboration of this aspect is outside the scope of this document, it can be accepted that it is the role of the SWIM Authority to publish, where required, the collection of standards for use within SWIM.

A collection of standards is a group of consistent standards guiding and constraining an implementation of SWIM. In addition to standards, a collection of standards may also contain standard profiles which are based on standards and “candidate standards” where it is deemed appropriate.



Figure 5 – Collection of Standards and Standards

Examples of collections of standards are:

* The SWIM governing standards (See Appendix A);
* The SWIM TI Profiles;
* The Service Technical Design Description.

In order to compile the governing collection of standards, the SWIM Authority should be informed about relevant standardisation activities. It should know the status of a standard, whether it is a draft, an adopted or a deprecated standard. For example, deprecated standards have to be removed from the standards (e.g. if deprecated by ISO).

### Examples

The following examples are provided in order to better illustrate the standards:

* **Governing standards**: These include for example, the AIRM, the ISRM Foundation Rulebook, and the Yellow and Blue SWIM Technical Infrastructure Profiles. These have been adopted by the SESAR SWIM users and are seen as the key elements in steering SWIM;
* **Community of interest standards**: These include for example, the Aeronautical Information Exchange Model (AIXM) used within the aeronautical information domain, the ICAO Weather Information Exchange Model (iWXXM) used with the ATM meteorological domain and the Flight Information Exchange Model (FIXM) used within the flight domain;
* **Public standards**: These include for example, the ISO 19100 series of standards used to define geospatial and temporal aspects of information;
* **Standard profile**: These include for example, the Geography Markup Language (GML) profile for aviation based on ISO 19136 (this is the ISO standards on Geography Markup Language (GML)).
* **Open standards**: openness is an additional characteristic of standards (see Appendix B – SWIM Controlled Vocabulary). For example the AIRM, the AIXM, ISO1936, TCP/IP, are open standards.

The following figure provides further example standards as provided (as examples) by the ICAO Manual on SWIM Concept:



Figure 6 – Example of potential standards

## Publishing and managing standards

Several SESAR deliverables are candidates for further standardisation in the context of PCP iSWIM deployment or even at the ICAO level. These include the AIRM and the ISRM which have been recognised in the ICAO GANP. These SESAR deliverables have been adopted by the SESAR SWIM users but consideration should be given to hand-over further standardisation work to another body.

# Guidance

SWIM guidance material is typically developed to accompany the SWIM Foundation and standards in order to provide additional explanation to assist their use and to help illustrate the meaning of technical specifications and requirements. Guidance material is used to support the realisation of SWIM. Typically guidance material includes guidance documents, technical manuals (e.g. for tools), handbooks & tools.

## Examples

The following examples are provided in order to better illustrate guidance:

* AIRM Governance Handbook;
* ISRM Modelling Guideline;
* Service Description Document Template;
* Service Technical Design Description Template.

The guidance material is owned by a community of interest or a standardisation organisation.

The Appendix A in this document provides the current classification of SWIM elements in terms of SWIM governing standards, SWIM standards and guidance.

# SWIM Foundation ownership and use

## SWIM Authority view

The SWIM Foundation is owned by the SWIM Authority. It is used by the SWIM Authority to steer the evolution of SWIM.

For what concerns the SWIM Foundation aspect, the SWIM Authority role is assured by:

* the SWIM Evolution Management Group (SEMG) in the context of SESAR R&D;
* the SWIM Expert Group following the agreements on the SWIM Governance structure [5] in the PCP iSWIM context.

It is assumed that the SWIM Expert Group (SEG) will be setup and mandated to make technical proposals and recommendations on SWIM matters and will decide upon change requests to the SWIM Foundation and the governing collection of standards.

The SWIM Foundation is used by the SWIM community to build or select community of interest standards whose use, and if necessary enforcement, provides the expected levels of interoperability between the implementations of SWIM providers and consumers.

The anticipated SWIM governance structure in the context of iSWIM PCP is provided by the SWIM Governance Structure document [5].

## SWIM Implementer view

Whereas the SWIM Foundation and the SWIM governing standards are steering specifications it is obvious that the actual technical interoperability can be achieved in different ways depending on the implementation context.

The purpose of a collection of standards is to declare, if needed, a consistent grouping of standards for implementers. The SWIM Technical Infrastructure Profiles (Yellow/Blue/Purple) are examples of standards at the level of the SWIM Technical Infrastructure. Each Service Technical Design Description (STDD) is positioned to be used by implementers to build interoperable system components. As such the role of a STDD is to be an implementation specification that resolves the interoperability question which a developer/implementer has.

The translation from the governing standard such as the ISRM with associated Service Description Documents as guidance, into a corresponding STDD for a community of interest represents the translation from the interoperable solution agnostic information service specification into a technology specific solution space.

***Note****: A collection of standards, in general, needs to take into account possible references to standards within each standard referenced. This should not lead to conflicting declarations (e.g. WFS2.0 points at HTTP 1.1) unless covered by backward compatibility. It is recommended to ensure this consistency.*

## SWIM Evolution

The SWIM Foundation is used to steer the standardisation of SWIM within a deployment context. This is done by agreeing on the essential requirements and a collection of governing standards. The standardisation approach is performance driven as explained in Section 2.5 above.

SWIM participants handshake on interoperability aspects using agreed standards that comply with the governing standards and consequently also the related essential requirements of the SWIM Foundation.

The contents in each of the three standardisation areas (SWIM Foundation, Standards, Guidance), while expected to be relatively stable, are subject to evolution.

Changes of one element in one of these three high level areas may require changes in other elements of the same or different area in order to ensure overall consistency.

Some of the governing standards (e.g. AIRM) or community of interest standards (e.g. AIXM, FIXM, iWXXM) have already well defined change control mechanisms in place.

The introduction of the SWIM Foundation will not replace these mechanisms, but new mechanisms and processes may have to be provided. In this case the processes may be under the responsibility of the SWIM Authority.

Further evolution management related discussions are deemed beyond the scope of this current version of the SWIM Foundation.

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12. ISO 19136
13. Appendix A
	1. Classification of SWIM elements
		1. SWIM Governing Standards:

According to the SWIM Controlled Vocabulary, a governing standard is: *A standard which has been selected by the SWIM Authority in alignment with the SWIM foundation to steer SWIM and its evolution. The list of governing standards as agreed by the SEMG* (SESAR1 SWIM Evolution Management Group) is provided hereafter:

|  |  |
| --- | --- |
| **Area** | **Standard** |
| Governance | SWIM Foundation |
| Governance | SWIM Compliance Framework Principles |
| Governance | SWIM Compliance Framework Criteria1 |
| Information | AIRM Foundation Rulebook |
| Information | AIRM |
| Information Services | ISRM Foundation Rulebook |
| SWIM Technical Infrastructure | SWIM Profile Descriptor |
| SWIM Technical Infrastructure | SWIM TI-Yellow Profile |
| SWIM Technical Infrastructure | SWIM TI-Blue Profile |

Note 1: It should be noted that the SWIM Compliance Framework Criteria includes the necessary STDD material.

* + 1. Classification of SWIM Standards and Guidance:

The SWIM elements (standards and guidance) classification below is agreed by the SEMG (SESAR1 SWIM Evolution Management Group). Some of the listed SWIM elements are SESAR SWIM deliverables. In addition, some additional existing standards are provided on an informative basis but not in an exhaustive way. The list is indicative and does not provide version information. Furthermore it does not further detail the SWIM Technical Infrastructure Standards (e.g. from IETF and W3C such as SOAP, TSL, HTTP) which are covered through the SWIM Technical Infrastructure profiles.

|  |  |  |
| --- | --- | --- |
| **Area** | **Standards / Guidance** | **Maintained by** |
| Governance | SWIM CONOPS | SWIM Authority |
| Governance | SWIM IM Functions | SWIM Authority |
| Governance | SWIM Registry Service | SWIM Authority |
| Governance | SWIM Registry Functional Specification | SWIM Authority |
| Governance | SWIM Compliance Framework Criteria | SWIM Authority |
| Governance | SWIM Compliance Framework Principles | SWIM Authority |
| Governance | SWIM Compliance Template | SWIM Authority |
| Information | AIRM Foundation Rulebook | CoI |
| Information | AIRM | CoI |
| Information | AIRM Governance Handbook | CoI |
| Information | AIXM | CoI |
| Information | FIXM | CoI |
| Information | iWXXM | CoI |
| Information | WXXM | CoI |
| Information | AMXM | CoI |
| Information | ADEXP | CoI |
| Information | ARINC 424 | CoI |
| Information | ARINC 816 | CoI |
| Information | AIDX | CoI |
| Information | METCE | CoI |
| Information | ISO19115 | ISO |
| Information | ISO19107 | ISO |
| Information | ISO19136 | ISO |
| Information Services | ISRM | SWIM Authority |
| Information Services | ISRM Modelling Guideline | SWIM Authority |
| Information Services | SDD Template | SWIM Authority |
| Information Services | STDD | SWIM Authority |
| Information Services | STDD Template | SWIM Authority |
| Information Services | ISO19142 | ISO |
| Information Services | ISO19143 | ISO |
| Information Services | ISO19128 | ISO |
| SWIM Technical Infrastructure | Web Service Notifications | OASIS |

The list above mentions Community of Interest (CoI) standards which may be considered within a particular SWIM context. For example the ICAO Manual on SWIM Concept identifies the international standards AIXM, iWXXM & FIXM as Information Exchange Models for respectively aeronautical, weather and flight information. Examples at the European level are EUROCAE and Network Manager communities for whom the requirements of the governing standards should be applicable as defined by the SWIM governance authority.

* 1. SWIM Foundation

The SWIM Foundation provided here has been agreed by the SEMG during SESAR1.

**SWIM Foundation:**

|  |
| --- |
| **SWIM Foundation** |
| SWIM Controlled Vocabulary |
| SWIM Essential Requirements |

1. SWIM Controlled Vocabulary
	1. Introduction

The SWIM Controlled Vocabulary is a governing standard which is integral part of the SWIM Foundation.

**SWIM Controlled Vocabulary:**

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Candidate Standard | A draft specification which has been proposed for adoption as a standard by a recognised standardisation body or community of interest.[Source: SESAR] |
| Community of Interest | A gathering of stakeholders assembled around a topic of common interest who share information about the topic for the purpose of common understanding. Typically a community of interest will agree on the use of particular standards. ***Note***: Within ATM an example of a community of interest is a recognised ATM domain (such as the aeronautical information domain, weather information domain or flight information domain).[Source: SESAR]  |
| Community of Interest Standard | A standard specific to a community of interest.[Source: SESAR] |
| Compliance | The demonstration that specified requirements relating to a product, process, system, person, or body are fulfilled.[Source: SESAR] |
| Data Format | A structure of data elements, records and files arranged to meet standards, specifications or data quality requirements.[Source: SESAR] |
| Deprecated Standard | A standard which is deprecated by the standardisation body or community of interest.[Source: SESAR] |
| Draft Standard | A standard which is in preparation by a standardisation body or community of interest.[Source: SESAR] |
| Entity | A definition (type) of an item of interest.[Source: SESAR] |
| Essential Requirement | The set of requirements which are necessary for defining SWIM.[Source: SESAR] |
| Governing Standard | A standard which has been selected by the SWIM Authority in alignment with the SWIM foundation to steer SWIM and its evolution.[Source: SESAR] |
| Information Exchange Model | A model which defines the syntax of the information to be exchanged between operational stakeholders within a community of interest. ***Note***: Typically, an Information Exchange Model is designed to enable the management and distribution of information (e.g. through aeronautical information services).[Source: SESAR]  |
| Information Model | A model of the information about the concepts in the universe of discourse, relevant to the architecture effort.[Source: SESAR] |
| 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.[Source: SESAR] |
| Logical Data Model | A specification of business/operational information requirements as a formal data structure, where relationships and entities are used to specify the logic which underpins the information.[Source: SESAR] |
| Open Standard | A standard which meets the following requirements:* The standard is adopted and will be maintained by a recognised standardisation organisation, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties (consensus or majority decision etc.).
* The standard has been published and the standard specification document is available either freely or at a nominal charge. It must be permissible to all to copy, distribute and use it for no fee or at a nominal fee.
* The intellectual property - i.e. patents possibly present - of (parts of) the standard is made irrevocably available on a royalty-free basis.There are no constraints on the re-use of the standard.

[Source: SESAR] |
| Organisational Interoperability | An aspect of interoperability concerned with how organisations, such as public administrations in different States, cooperate to achieve their mutually agreed goals. ***Note***: In practice, organisational interoperability implies integrating business processes and related data exchange. Organisational interoperability also aims to meet the requirements of the user community by making services available, easily identifiable, accessible and user-focused.[Source: SESAR]  |
| Physical Data Model | A model which specifies how the logical data model will be instantiated in a particular product or service. It takes into account implementation restrictions and performance issues whilst still enforcing the constraints, relationships and typing of the logical model.[Source: SESAR] |
| Public Standard | As standard that is published by a recognised standardisation body and that is available for the public. (such as an ISO or IEEE standard)[Source: SESAR] |
| Reference Model | A reference model is an abstract framework for understanding significant relationships among the entities of some environment. It enables the development of specific reference or concrete architectures using consistent standards or specifications supporting that environment. A reference model consists of a minimal set of unifying concepts, axioms and relationships within a particular problem domain, and is independent of specific standards, technologies, implementations, or other concrete details.[Source: SESAR] |
| Semantic Interoperability | An aspect of interoperability which ensures that the precise meaning of exchanged information is preserved and understood by all parties.[Source: SESAR] |
| Service | The contractual provision of something (a non-physical object), by one, for the use of one or more others. Services involve interactions between providers and consumers, which may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures.[Source: SESAR] |
| Stakeholder | A person, group or organization that has a professional interest or concern in SWIM deployment.[Source: SESAR] |
| Standard | A specification, endorsed by a recognised standardisation body or community of interest for repeated or continuous application.[Source: SESAR] |
| Standard Profile  | A set of one or more base standards or subsets of base standards, and, where applicable, the identification of chosen clauses, classes, options and parameters of those base standards, that are necessary for accomplishing a particular function. ***Note***: A profile is derived from base standards so that by definition, conformance to a profile is conformance to the base standards from which it is derived. ***Note***: This term is not to be confused with a SWIM Technical Infrastructure Profile.[Source: SESAR] |
| Standardisation Body | An organization whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing standards that are intended to address the needs of some relatively wide base of affected adopters.[Source: SESAR] |
| SWIM Authority | The governance structure [5] that steers the evolution of SWIM.***Note***: The SWIM Authority role is performed by the SEMG in the context of SESAR R&D. In the context of SWIM deployment it is expected that a governance structure [5] will be setup consisting of the SWIM Steering Group, the SWIM Expert Group and the SWIM Management Unit.[Source: SESAR] |
| SWIM Element | A placeholder term used to refer, in a generic way, to their SWIM related documents, standards, technical means, etc…[Source: SESAR] |
| SWIM Foundation | The SWIM Foundation provides a coherent set of principles, essential requirements and recommendations for establishing SWIM standards related to information, information service, technical infrastructure and governance.[Source: SESAR]  |
| SWIM Governance | SWIM Governance is about establishing policies and continuous monitoring their proper implementation to ensure a stable operation and controlled evolution of SWIM. SWIM Governance means all the processes that coordinate and control all resources and actions of a pan-European SWIM implementation. It is established to align the SWIM strategy with the ATM strategy and implementing good ways to measure its performance. It makes sure that all stakeholders’ interests are taken into account and that processes provide measurable results.[Source: SESAR] |
| SWIM Infrastructure | The sum of all the SWIM Infrastructure elements which are needed to support SWIM Services. [Source: SESAR] |
| SWIM Profile Assertion  | Declaration of the existence of a SWIM Profile combined with precisions on scope and motivation and with design considerations.[Source: SESAR] |
| SWIM Profile Descriptor | The instrument that provides the guidance for defining the set of specifications that form a SWIM Profile.The SPD is a mandatory template to use for any effective composition of specifications related to any SWIM Profile Assertion.The SPD identifies and structures all the areas of specifications that have to be taken in consideration and, where applicable and possible, details each of these areas down to the level of provision of templates for atomic specification.The SPD defines how the set of specifications that form a SWIM Profile must be structured and documented.The use of the SPD creates value for distinct stakeholders.For the creator of the SWIM Profile, the use of a mandatory template promotes both the exhaustiveness of the definition of a SWIM Profile as well as quality of the specifications.For the governing bodies, the SPD provides a means for verification of the exhaustiveness and quality of the specifications in a SWIM Profile.For the user of a SWIM Profile (a Communication Infrastructure provider, a SWIM-TI solution builder as well as a service binding to a SWIM-TI solution), the SPD provides standardisation, stability, consistency and transparency across SWIM Profiles.[Source: SESAR] |
| SWIM Registry | A static registry or directory containing entries with the information necessary to discover and access services. The Registry utilizes a formal registration process to store, catalogue and manage metadata relevant to the services, thereby enabling the search, identification and understanding of resources. ***Note***: This covers only the design-time part of the registry.[Source: ICAO Doc 10039] |
| SWIM Technical Infrastructure Profile | A coherent, appropriately-sized grouping of middleware functions/services for a given set of technical constraints/requirements that permits a set of stakeholders to realize Information sharing. It also defines the mandated standards and technologies required to realize this coherent grouping of middleware functions/services.[Source: SESAR] |
| SWIM Technical Services | A service provided by the SWIM Technical Infrastructure.Note: The SWIM CONOPS defines an “enabling service” as a synonym of a SWIM Technical Service.[Source: SESAR] |
| SWM Controlled Vocabulary | The terms and definitions of the SWIM Foundation primer and the SWIM Essential Requirements. [Source: SESAR] |
| Syntactic Interoperability | An aspect of interoperability which describes the exact format of the information to be exchanged in terms of grammar, format and schemas. [Source: SESAR] |
| System Wide Information Management | SWIM consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.[Source: ICAO Doc 10039] |
| Technical Interoperability | An aspect of interoperability which covers the technical aspects of linking information systems. It includes topics such as interface specifications, interconnection services, data integration services, and data presentation and exchange.[Source: SESAR] |

1. SWIM Essential Requirements
	1. Introduction

The European Commission’s Implementing Rule on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan (IR 716-2014, see ref [6][6]) details the Initial System Wide Information Management (iSWIM) functionality.

iSWIM consists of:

1. Common infrastructure components;
2. SWIM Technical Infrastructure including the SWIM Profiles;
3. Aeronautical information exchange;
4. Meteorological information exchange;
5. Cooperative network information exchange;
6. Flight information exchange.

Common infrastructure components are:

1. The registry, which shall be used for publication and discovery of information regarding service consumers and providers,
2. 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

With regards to the information exchanges, the Implementing Rule states:

1. Service implementations shall be compliant with the applicable version of ATM Information Reference Model (AIRM), the AIRM Foundation Material and the Information Service Reference Model (ISRM) Foundation Material[[3]](#footnote-3).
2. Information services shall be implemented on one of the following profiles:
	1. Blue SWIM TI Profile, which shall be used for exchanging flight information between ATC centres and between ATC and Network Manager
	2. Yellow SWIM TI Profile, which shall be used for any other ATM data (aeronautical, meteorological, airport, etc.)

The Implementing Rule states that iSWIM functionality shall be deployed in the European ATM Network (EATMN).

In order to support iSWIM, this document details the essential requirements for:

1. SWIM Governance
2. SWIM Information Services
3. SWIM Information
4. SWIM Technical Infrastructure

These essential requirements will promote interoperability within the European ATM network.

The term “essential requirement” is a term used in European law. In the context of this document it means the minimum set of requirements which are absolutely necessary for defining SWIM. They are the requirements that a SWIM element must demonstrate (e.g. through technical documentation) conformance to in order to qualify as “SWIM”. This allows, for example:

1. New standards to be developed (e.g. ISRM Foundation Rulebook, AIRM);
2. SWIM-enabled applications to be developed; and
3. Existing standards to be selected (e.g. WFS - Web Feature Service) as a “means of compliance” in accordance with the essential requirements.
	1. Essential Requirements for SWIM Governance
		1. SWIM Authority:

**Requirement GOV-01**

The operation and evolution of SWIM shall be governed by a SWIM Authority consisting of the necessary bodies that represent the SWIM stakeholders’ interests.

* + 1. SWIM policies:

**Requirement GOV-02**

Policies should be defined under the responsibility of the SWIM Authority on the following subjects:

1. Service Management
2. Compliance Assessments
3. Information Security
4. Financial Management (not foreseen for iSWIM)
5. Supervision (not foreseen for iSWIM)
6. Legal Aspects (not foreseen for iSWIM)

**Note: Information security includes aspects such as user identity, authentication, encryption and authorisation.**

**Note: Service management includes aspects such as service design, implementation and deployment, service operation and notification, discovery and registration. It is related to the management of the SWIM Information Services as well as to the management of the SWIM Common Infrastructure Services (currently also referred to as SWIM-TI shareable functions). For more information on SWIM Policies refer to SWIM Governance [5] and IM Functions document [6].**

* + 1. SWIM design-time registry:

**Requirement GOV-03**

A design-time SWIM registry shall be created under the responsibility of the SWIM Authority in order to enable the discoverability of, access to, and support of the management of SWIM information services.

**Requirement GOV-04**

The design-time SWIM Registry shall contain information necessary to discover and access services.

* + 1. SWIM Controlled Vocabulary:

**Requirement GOV-05**

The SWIM Authority shall declare the applicable SWIM Controlled Vocabulary with the purpose of defining the common set of terms used by the SWIM community.

* + 1. SWIM Foundation principles:

**Requirement GOV-06**

The SWIM Authority shall take account of the following principles:

1. **Steering content**. The SWIM Foundation is constituted of a set of steering SWIM elements deemed to have a converging impact and used by the communities working on standardised SWIM solutions.
2. **Technology agnostic**. The SWIM Foundation should not include specific technical choices at the implementation level.
3. **Performance based approach**. The intent is to avoid being too prescriptive. In practice it may though be necessary that for some specific aspects some prescriptive technical specification may still be required to be included in the SWIM Foundation. However the intent is to minimize this.
4. **One SWIM Foundation**. The SWIM Foundation is a single item used in multiple contexts (e.g. the service developments, data standardisation within a community of interest specifying a data exchange model).
	* 1. SWIM governing standards:

**Requirement GOV-07**

The SWIM Authority shall establish the applicable list of standards and guidance to deploy SWIM.

* + 1. Compliance frameworks:

**Requirement GOV-08**

In the areas of Information, Information Service and Technical Infrastructure, normative compliance criteria shall ensure the ability to adhere to the governing standards. When a governing standard is accompanied by a normative compliance framework it shall ensure at a minimum the following aspects:

1. The ability for adherence to the governing standard;
2. The validity period of the compliance assessment result;
3. The renewal process; and
4. The resolution process for any issues identified during the compliance assessment.
	1. Essential Requirements for SWIM Information Services
		1. Organisational interoperability:

**Requirement SVC-01**

Information exchanges between European ATM Network partners shall be agreed upon through the definition of information services.

**Requirement SVC-02**

In order to ensure organisational interoperability within the European ATM Network and between the European ATM Network and its global partners:

* Information Services shall be identified and designed using the ISRM Foundation Rulebook;
* The ISRM Foundation Rulebook shall be accompanied by the necessary guidance material to ensure interoperability, and evolution in a consistent and appropriate manner.

**Requirement SVC-03**

The development and evolution of the logical service models and the ISRM Foundation Material shall be governed by the SWIM Authority according to agreed processes and documentation. This includes agreed mechanisms for change, release and version control.

**Requirement SVC-04**

In order to ensure an architectural approach within the European ATM Network, information services should be linked to Information Exchange Requirements (IER) as needed by the collaborative business processes.

**Requirement SVC-05**

In order to promote global interoperability services shall be defined in a way that allows their interpretation outside the European ATM Network context.

* + 1. Platform Neutral Service Design (logical service):

**Requirement SVC-06**

Logical service models shall be represented using a formal standardised notation. The notation used shall be declared.

**Note:** An example of such a notation is the Unified Modelling Language (UML).

**Requirement SVC-07**

Each logical service shall be independent of specific technologies, implementations, or other concrete details.

**Requirement SVC-08**

Each logical service shall be compliant with the applicable version of the AIRM, the AIRM Foundation Material and the ISRM Foundation Rulebook.

**Requirement SVC-09**

Each logical service interface of the service shall be described with a name and available operations.

**Requirement SVC-10**

Each logical service interface shall have a reference to a standard Message Exchange Pattern.

**Requirement SVC-11**

All logical service messages (Information Exchanges) that can be passed as parameters to the operations shall be described. This includes a description of all information exchange model entities and the tracing to the AIRM.

* + 1. Platform Specific Service Design:

**Requirement SVC-12**

**A Service Technical Design Description shall to be provided which explains how to implement the physical service interfaces within software systems.**

**Requirement SVC-13**

For each physical service interface, there shall be a description in the Service Technical Design Description of what protocols are used in order to enable interoperability between the service provider and service consumer. This shall be achieved by selecting a binding from the SWIM-TI Profile.

**Requirement SVC-14**

For each physical service interface, machine processable service descriptions (e.g. WSDL/XSD, IDL etc...) shall be provided to enable provider and consumer software components to be created.

**Requirement SVC-15**

The Service Technical Design Description shall contain a documented and human readable mapping between the elements of the platform specific design[[4]](#footnote-4)[1] (e.g. the physical messages and physical service operations) and the elements of the platform neutral service design (e.g. logical service interfaces, logical service operations and logical service messages).

**Requirement SVC-16**

The Service Technical Design Description shall be compliant to an existing Platform Neutral Service Design, the AIRM, and a SWIM-TI Profile binding as described in the SWIM Compliance Framework.

* + 1. Service Implementation:

**Requirement SVC-17**

A service implementation shall be compliant with an existing Platform Specific Service Design as specified by a Service Technical Design Description.

* 1. Essential Requirements for SWIM Information
		1. Semantic interoperability:

**Requirement INF-01**

In order to promote semantic interoperability within the European ATM Network and between the European ATM Network and its global partners, there shall be an ATM Information Reference Model (AIRM) which is commonly agreed between the SWIM stakeholders.

* + 1. Scope of the AIRM:

**Requirement INF-02**

The AIRM shall, at a minimum, cover the ATM information and the necessary ATM-related information that is exchanged via interoperable SWIM information services and systems.

* + 1. Content of the AIRM:

**Requirement INF-03**

The AIRM shall include:

1. The necessary and uniquely identified entities that are within its scope;
2. The properties of the entities;
3. The relationships between the entities; and
4. The definitions of the entities, properties and relationships defined to be within its scope.
	* 1. Information on definitions in the AIRM:

**Requirement INF-04**

The AIRM shall include, at a minimum, details on:

1. The source of the definitions;
2. The status of each definition; and
3. Any adaptations which have occurred to the definitions in order to make them suitable for inclusion in the AIRM.

**Note:** This information is necessary to ensure the transparency of definition sources which, in turn, establishes a known and managed state for the semantic content.

* + 1. AIRM Foundation material:

**Requirement INF-05**

The AIRM shall be accompanied by an AIRM Foundation to ensure that its content is understood, built and evolved in a consistent and appropriate manner to achieve its purpose.

**Note:** The AIRM Foundation contains for example an AIRM Rulebook and a meta-model.

* + 1. Reuse of international standards in AIRM:

**Requirement INF-06**

The AIRM content shall, as far as possible, reuse an agreed set of international standards for basic types, such as free-text types, spatial types and temporal types.

**Note:** An example set of international standards is the ISO 19100 series.

* + 1. Technology agnostic AIRM:

**Requirement INF-07**

The AIRM content shall be independent of specific technologies, implementations, or other concrete details.

**Note:** This does not prevent that the AIRM contains technical specifications where necessary to achieve interoperability.

* + 1. Essential characteristics of the AIRM:

**Requirement INF-08**

The essential characteristics of the ATM Information Reference Model are:

1. Be consistent with the ICAO terms and definitions as far as possible;
2. Ensure the separation of concerns in terms of semantic content whereby definitions, business rules are and remain well separated;
3. Be able to bridge over different communities of interest and support the creation of new ones;
4. Be able to support the transformation of current information provision to future SWIM based information sharing whereby SWIM stakeholders will evolve at different paces;
5. Be stable in the face of changing information exchange requirements;
6. Be flexible in the face of changing business practices;
7. Be an enabler for the architecture driven modernisation required to achieve SWIM;
8. Be reusable by others;
9. Meet the information exchange requirements of the SWIM stakeholders;
10. Be clear and unambiguous to all; and
11. Be able to reconcile conflicting information exchange models.
	* 1. Notation used for the AIRM:

**Requirement INF-09**

The AIRM shall be represented using a formal standardised notation. The notation used shall be declared.

**Note:** An example of such a notation is the Unified Modelling Language (UML).

* + 1. AIRM Compliance Framework:

**Requirement INF-10**

There shall be an AIRM Compliance Framework which defines the process and criteria whereby a model (for example, an information service implementation’s information exchange model) can be demonstrated to be compliant with the semantics of a given version of the AIRM.

**Note**: the AIRM Compliance Framework is managed and provided together with the AIRM in accordance with GOV-08. The SWIM Compliance Framework is based upon the AIRM Compliance Framework for what concerns the information aspect and is consistent therewith. Compliance requirements for what concerns services and technical infrastructure are embedded in the SWIM Compliance Framework.

* + 1. Governance of the AIRM:

**Requirement INF-11**

The development and evolution of the AIRM and the AIRM compliance framework shall be governed by a recognised body according to agreed processes and documentation. This includes agreed mechanisms for change, release and version control.

* + 1. AIRM as an open, free standard:

**Requirement INF-12**

**The AIRM shall be:**

1. An open standard published under an open license; and
2. Made available free of charge.

**Note:** An example of an open licence is the Berkeley Software Distribution (BSD) licence.

* + 1. Standardised information exchange model alignment:

**Requirement INF-13**

Each standardised information exchange model intended for use in the European ATM Network shall be aligned with the semantics of the AIRM by applying the AIRM compliance framework.

**Note**: Examples of standardised information exchange models are the Aeronautical Information Exchange Model (AIXM) and the ICAO Weather Information Exchange Model (iWXXM).

* + 1. Service implementation compliance:

**Requirement INF-14**

Each service implementation shall ensure that its information exchange model or format complies with the semantics of the AIRM by applying the AIRM compliance framework.

**Note**: A service implementation may reuse a standardised information exchange model (see INF-13).

* + 1. Technical interoperability within a community of interest:

**Requirement INF-15**

In order to ensure syntactic interoperability within a given community of interest, an information exchange model shall:

1. Be defined and agreed by the community of interest;
2. Reference the semantics contained within the AIRM to facilitate interoperability with other communities of interest;
3. Apply a commonly used data format;
4. Cover all the entities, properties, data types and relationships required by the community of interest; and
5. Be complemented by the necessary additional agreements applicable within the community of interest.

**Note**: Examples of commonly used data formats include Extensible Markup Language (XML), Geography Markup Language (GML), and JavaScript Object Notation (JSON).

* + 1. Information consistency:

**Requirement INF-16**

Where information is exchanged within the European ATM Network in multiple formats, processes which make use of the AIRM shall be implemented to facilitate interoperability and promote information consistency between formats.

* + 1. Metadata:

**Requirement INF-17**

The AIRM shall contain metadata reference entities in support of all the semantic interoperability concerns of SWIM (e.g. for data and registry).

* 1. Essential Requirements for SWIM Technical Infrastructure
		1. Technical interoperability:

**Requirement TI-01**

The SWIM Technical Infrastructure (SWIM TI) shall enable technical interoperability within the European ATM Network.

* + 1. Technical infrastructure:

**Requirement TI-02**

The SWIM TI shall enable Ground/Ground and Air/Ground information exchange.

* + 1. IP connectivity:

**Requirement TI-03**

The SWIM TI shall use IP connectivity.

**Note:** This does not necessarily imply a single IP network since it may occur that several IP networks together realize a connection. For example, the Flight Object Routers & Brokers may work over different IP networks.

* + 1. Machine-to-machine data exchange

**Requirement TI-04**

The SWIM TI shall be limited to system-to-system information exchange.

* + 1. Open standards:

**Requirement TI-05**

The SWIM TI specifications shall be based on open standards.

* + 1. Mainstream IT technologies:

**Requirement TI-06**

The SWIM Technical Infrastructure (SWIM TI) shall offer SWIM Technical Services based on standard technologies.

* + 1. Off-the-shelf (OTS) products:

**Requirement TI-07**

The SWIM Technical Infrastructure (SWIM TI) shall, where opportune, be based on off-the-shelf (OTS) products*.*

**Note:** This does not prevent that the development of specific software when this is required. Off-the-Shelf products may be commercial or not (free of charge, open source, etc.).

* + 1. Limited number of SWIM TI profiles:

**Requirement TI-08**

In order to maximize interoperability and to avoid proliferation of heterogeneous solutions the SWIM TI shall be specified using a limited number of SWIM TI profiles.

**Note: In the context of technical interoperability heterogeneous constraints and competitive requirements represent the main challenges. Each specific interoperability need usually offers multiple options to satisfy the need. Ideally an agreed minimal set of technologies provides the interoperability but they are not sufficient to reach this ideal world objective. Without some form of governance, considering the opportunity for differentiation, the risk for proliferation of point solutions, with very limited local interest for the directly involved Stakeholders only, is very high and leads to high fragmentation. Furthermore, proliferation of point solutions leads to exaggerated and unneeded cost and complexity. Finding an agreed minimal set of technologies to provide the required interoperability is considered not possible: this is mainly due to constraints (e.g. heterogeneous Stakeholders, business and systems) and competing requirements (e.g. Security versus performance, Reliability versus cost, Consistency versus Availability versus Partition Tolerance, etc.). In order to mitigate the risk of the proliferation of SWIM Profiles and heterogeneous solutions and at the same time to maximize interoperability, a governance process takes all technical interoperability needs of the System of Systems (SoS) into consideration and segments these needs into coherent and of the appropriate size groups for each of which a satisfactory uniform solution can be defined. The criteria used for the grouping are mainly drawn from identified sources of constraints (involved stakeholders, systems and business activities) and based on the analysis of any competitive requirements areas.**

* + 1. SWIM TI profile description:

**Requirement TI-09**

Each SWIM TI Profile design activity shall follow a well-defined methodology and principles.

**Note**: the current methodology and principles are described in SESAR 14.01.03-D36 deliverable.

-END OF DOCUMENT-

1. *In the context of SESAR R&D* [↑](#footnote-ref-1)
2. *SWIM consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services* [↑](#footnote-ref-2)
3. The Implementing Rule actually mentions an Aeronautical Information Reference Model. This has been corrected to ATM Information Reference Model in these requirements. [↑](#footnote-ref-3)
4. [1] Typically represented in the machine processable formats like WSDL/XSD, IDL [↑](#footnote-ref-4)